



Assessing Maternal Morbidity in India, Pakistan, Kenya and Malawi

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Dedication

To all healthcare providers who work in often difficult circumstances, in low resource settings across the world, to improve the quality of maternity care for women and their babies during and after pregnancy. I sincerely applaud your efforts and care that you give to women and their babies.

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Abbreviations

AKUADS	Aga Khan University Anxiety and Depression Scale
ASSIST	Alcohol, Smoking and Substance Involvement Screening Test
AUDIT	Alcohol Use Disorders Identification Test
CASP	Critical Analysis Skills Programme
CES-DR	Centre for Epidemiological Studies Depression scale
CI	Confidence interval
CIS-R	Clinical Interview Schedule-Revised
CMD	Common Mental Disorders
CMNH	Centre for Maternal and Newborn Health
DEL	Delivery
DHQ	District Headquarter Hospital
DHS	Demographic Health Survey
ENAP	Every Newborn Action Plan
EPDS	Edinburgh Postnatal Depression Score
EPMM	End Preventable Maternal Mortality
EPN	Early Postnatal
GRADE	Grading of Recommendations, Assessment Development and Evaluation
HCF	Healthcare facility
HCP	Healthcare provider
HITS	Hurt, Insulted, Threatened, Screamed questionnaire
HIV	Human Immunodeficiency Virus
HTQ	Harvard Trauma Questionnaire
ICD-10	International Classification of Disease version 10
ICT	Islamabad Capital Territory
IQR	Interquartile range
IPV	Intimate partner violence
ISA	Index of Spousal Abuse
K-10	Kessler-10 item psychological distress scale K-10
LAN	Late Antenatal
LIC	Low Income Country
LLV-EPDS	Local Language Versions of the Edinburgh Postnatal Depression scales
LMIC	Low-or Middle-Income Countries
LPN	Late Postnatal
LSTM	Liverpool School of Tropical Medicine
LTE	List of Threatening Experiences questionnaire
MADRS	Montgomery–Åsberg Depression Rating scale

MDG	Millennium Development Goal
MESH	Medical Subjects Headings
MMR	Maternal Mortality Rate
MNM	Maternal Near Miss
MSSI	Maternity Social Support Index
NMR	Neonatal mortality rate
OR	Odds Ratio
PHQ-9	Patient Health Questionnaire
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QOL	Quality of Life
RCOG	Royal College of Obstetricians and Gynaecologists
RHC	Rural Health Centre
SAMM	Severe Acute Maternal Morbidity
SBA	Skilled Birth Attendance
SDG	Sustainable Development Goal
SES	Socioeconomic Status
SIRS	Systemic Inflammatory Response Syndrome
SRPB	Spirituality, Religiousness and Personal Beliefs
SRQ-20	Self-Reporting Questionnaire-(20 Items)
SPS	Social Provisions Scale
STAI	State-Trait Anxiety Inventory
STI	Sexually transmitted infection
STROBE	Strengthening the Reporting of Observational studies in Epidemiology
SVAWS	Severity of Violence against Women scale
THQ	Tehsil Headquarters
UK	United Kingdom
UN	United Nations
USA	United States of America
UTI	Urinary Tract Infection
WCC	White Cell Count
WHO	World Health Organization

Declaration

This thesis is the result of my work. The information contained in the thesis has not been presented nor it is currently being presented, either wholly or as part of any other degree or qualification.

Abstract

Title

Assessing Maternal Morbidity in India, Pakistan, Kenya and Malawi

Background

For every woman who dies during pregnancy and childbirth, many more suffer ill-health, the burden of which is highest in low- and middle-income countries. The PhD study sought to assess the extent and type of maternal morbidity in these settings.

Methods

A descriptive observational cross-sectional study was conducted to assess physical (infectious and medical/obstetric), psychological and social morbidity. Socio-demographic factors, education, socioeconomic status, reported symptoms, clinical examination and laboratory investigations, quality of life, and satisfaction with health were assessed. Relationships between morbidity and maternal characteristics were investigated using logistic regression analysis.

Findings

11454 women were assessed in India (2099), Malawi (2923), Kenya (3145), and Pakistan (3287). Almost 3 out of 4 women had ≥ 1 symptom (73.5%), abnormalities on clinical examination (71.3%) or laboratory investigation (73.5%). In total, 9.0% of women had an identified infectious disease (HIV, malaria, syphilis or chest infection) and 23.1% had signs of early sepsis with an identifiable source of infection in 43%. HIV positive status was highest in Malawi (14.5%) as was malaria (10.4%). Overall, 47.9% of women were anaemic, 11.5% had other medical or obstetric conditions, 25.1% psychological and 36.6% social morbidity. Infectious morbidity was highest in Malawi (40.5%) and Kenya (38.5%), psychological and social morbidity was highest in Pakistan (47.3%, 60.2%). Morbidity was not limited to a core at risk group; only 1.2% had a combination of all four morbidities.

Age, socioeconomic status, educational, previous pregnancies, and adverse maternal or neonatal outcomes were associated with different types of morbidity per country, but there was no consistent direction of strength of association. For each country, women with medical/obstetric morbidity was more likely to report psychological and infectious morbidity, apart from Malawi. Women with an infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity in Pakistan and Malawi. Women with psychological morbidity were more likely to report social morbidity in Pakistan and Kenya.

Conclusion

Despite women reporting that they have a good quality of life and are satisfied with their health, there is evidence of a significant burden of infectious, medical/obstetric, psychological, and social morbidity in women during and after pregnancy. At present available antenatal and postnatal care packages do not include comprehensive screening for all forms of ill-health.

This study demonstrates that women have health needs, beyond simply the physical aspects of health and includes psychological and social well-being. To ensure all women have the right to the highest attainable standard of health and well-being, current antenatal and postnatal care packages need to be adapted and improved to provide comprehensive, holistic care in a way that meets a woman's health needs.

CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter introduces concepts necessary to understand the background to this research project. This chapter gives an overview of the current priorities in global maternal health. The history of the international maternal health agenda from the year 2000, and the Millennium Development Goals (MDGs) are presented. Progress of interventions to address the MDG 5a are described and the Sustainable Development Goal (SDG) 3 is considered. The change in international priorities from woman “surviving to thriving” pregnancy is highlighted. The internationally agreed definitions and criteria for measurement of maternal death and Severe Acute Maternal Morbidity (SAMM) are reviewed. The continuum of maternal health, the concept of maternal morbidity, previous descriptions of maternal morbidity and the need for a standardised methodology and identification criteria to measure maternal morbidity in a comprehensive approach is considered. The overall aim, objectives and key research questions are summarised at the end of this chapter. The chapter ends with a summary.

1.2 Background

Worldwide, it was estimated that 303,000 women died due to pregnancy-related complications in 2015, equating to an estimated 830 women dying every day (WHO 2015b). An estimated 99% of these deaths occur in low- and middle-income countries (LMIC) (WHO 2015b). In addition, almost 2.6 million stillbirths and an estimated 2.7 million neonatal deaths occurred annually in 2015 (WHO 2015ba). Many of these maternal and perinatal deaths can be prevented or avoided through actions that are proven to be effective and affordable (WHO 2015b).

Over the past decade, the international community have been working to support evidence-based strategies to prevent maternal and newborn mortality, especially in LMIC where the burden is highest (WHO 2015b). In addition to preventing mortality,

there is a current renewed focus on improving quality of care and decreasing the numbers of women who suffer ill-health (maternal morbidity), and experience short- or long-term disabilities and complications that have a negative impact on the woman, related to their pregnancy (Zafar 2015, Chou 2016).

Millennium Development Goals

In 2000, world leaders at the United Nations (UN) constructed eight development goals and targets in critical areas of health and socioeconomic development to improve the lives of women, men and children to be attained by 2015, the MDG (UN 2000). Reducing pregnancy related mortality was MDG 5a, adopted by the international community (UN 2000). Under MDG 5a, countries committed to reducing maternal mortality by 75% between 1990 and 2015 (UN 2000).

Maternal death and maternal mortality rates

The WHO application of International Classification of Disease version 10 (ICD-10) to deaths during pregnancy, childbirth and the puerperium, defines maternal death as the “death of a woman while pregnant or within 42 days of the end of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes” (WHO 2012a). The Maternal Mortality Ratio (MMR) (per 100,000 live births) represents the risk associated with each pregnancy, or “the obstetric risk” (WHO 2017b). Worldwide, maternal deaths have commonly been considered indicators of maternal health. Specifically, MMR has been the main maternal health indicator to monitor progression of the MDG 5a (UN 2000).

MDG 5a was an important catalyst for the reductions in MMR that have been achieved in many settings (WHO 2015a). Over the past decade, much progress has been recorded, with a significant reduction (43%) in the estimated number of maternal deaths worldwide since 1990 (WHO 2015a). In some countries, annual declines in maternal mortality between 2000 and 2010 were above 5.5%, the rate needed to achieve MDG 5A (WHO 2015a). Globally, the total number of maternal

deaths decreased from an estimated 523,000 in 1990 to 289,000 in 2015 (WHO 2015a). The estimated global MMR declined from 400 to 216 deaths per 100,000 live births in 1990 and 2015 respectively, representing an average annual decline of 2.3% (WHO 2015a). However, despite good progress in some settings, many low-income countries (LICs), particularly in Sub-Saharan Africa and post conflict settings, did not make sufficient progress to meet MDG 5a (WHO 2015a). Currently the MMR are highest in sub-Saharan African countries such as Sierra Leone, Chad, Central African Republic, Sudan, Democratic Republic of the Congo and Nigeria. The current global MMR is approximately 216 maternal deaths per 100,000 live births, and this estimated MMR has declined by an average of 3.0% per year between 2000 and 2015, more than doubling the estimated average annual decline of 1.2% between 1990 and 2000 (WHO 2015a, WHO 2017c). Furthermore, the estimated MMR in LMIC is 239 per 100 000 live births which is an estimated 20 times higher than that of the MMR in high income countries (WHO 2015a). The difference between MMR can reflect inequality in the access to and quality of emergency and routine care for women during and after pregnancy between different countries. **Table 1.1** displays examples of MMR for different regions and countries that are included in this research project.

Table 1.1: Maternal mortality ratios for different regions and countries (WHO 2015a)

Type of income country (World Bank 2017)		MMR per 100,000 live births
Global		216
High income countries combined		12
Low- and middle-income countries combined		239
Study countries included in research project	Type of country	MMR per 100,000 live births
India	Lower middle income	174
Pakistan	Lower middle income	178
Kenya	Low income	510
Malawi	Low income	634

Key global interventions to decrease maternal and neonatal mortality

The proportion of births attended by skilled healthcare provider is a useful healthcare indicator and is a measure of the ability of health system to provide adequate care during birth (WHO 2016c). Globally, coverage of skilled birth attendance (SBA) has increased from 61% in 2000 to 78% in 2016 (WHO 2017d). However, despite steady improvement, both globally and across various countries, millions of births are not assisted by a skilled birth attendant. In Sub-Saharan Africa, approximately only half of all live births were delivered with the assistance of a skilled birth attendant in 2016 (WHO 2017d).

Efforts to reduce adverse outcomes for pregnant women and newborn babies have largely been directed at interventions that need to be in place around the time of birth, including the availability of emergency care. These interventions have been highlighted in two international documents published by the WHO: Strategies Toward Ending Preventable Maternal Mortality (EPMM) (WHO 2015b) and the Every Newborn Action Plan (ENAP) (WHO 2015c). These strategic documents aim to catalyse global action to eliminate the wide disparities in the risk of death and end preventable maternal and newborn mortality and stillbirths within a generation (WHO 2015b, WHO 2015c).

The effective implementation of evidence-based interventions during the time of childbirth and immediately after birth are particularly critical to continue to reduce maternal deaths, stillbirths and early neonatal deaths - the “triple return” (WHO 2015a). A total of 50 essential interventions for reproductive, maternal, newborn and child health, for which there is evidence of effectiveness, have been described and are being further evaluated in different settings in LMIC, with the aim to demonstrate significant and sustainable impacts on maternal, newborn and child survival (WHO 2015a, Lassi 2015).

Although the focus on the time around birth is crucial to save lives, until recently, less emphasis has been placed on ensuring availability and quality of other aspects of the “continuum of care” including measures to ensure well-being and to improve routine and general health for women during and after pregnancy (UN 2015b). This imbalance has been highlighted in the latest global initiatives, in which the scope of global maternal health goals has been expanded moving from a focus on preventing death to formulating targets and emphasizing the importance of health and well-being (UN 2015b).

Sustainable Development Goals

Although MDG 5a was not universally achieved by 2015, the new Sustainable Development Goals (SDG) have been agreed internationally with new global strategies and accompanying targets (UN 2015b). The post-2015 agenda of the SDG is broader than the previous MDG agenda, with a greater number of non-health goals and a strong focus on inequity reduction (UN 2015b).

The SDGs consist of 17 goals aimed to stimulate action in areas of critical importance for humanity and the planet from 2015-2030 (UN 2015b). The goals are categorized into five areas (5 P’s): people, planet, prosperity, peace and partnership (UN 2015b). Of the 17 SDGs, eight goals are indirectly related to maternal and newborn health, while one goal (SDG 3) explicitly deals with health (UN 2015b) (**Table 1.2**).

Table 1.2: Sustainable Development Goals related to health

Sustainable Development Goals		Related to health
1.	End poverty in all its forms everywhere	Yes - indirectly
2.	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Yes - indirectly
3.	Ensure healthy lives and promote well-being for all at all ages	Yes - directly
4.	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Yes - indirectly
5.	Achieve gender equality and empower all women and girls	Yes - indirectly
6.	Ensure availability and sustainable management of water and sanitation for all	Yes - indirectly
7.	Ensure access to affordable, reliable, sustainable and modern energy for all	No
8.	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Yes - indirectly
9.	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	No
10.	Reduce inequality within and among countries	Yes - indirectly
11.	Make cities and human settlements inclusive, safe, resilient and sustainable	Yes - indirectly
12.	Ensure sustainable consumption and production patterns	No
13.	Take urgent action to combat climate change and its impacts	Yes - indirectly
14.	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	No
15.	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	No
16.	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Yes, indirectly
17.	Strengthen the means of implementation and revitalize the global partnership for sustainable development	No

SDG 3 is to ensure healthy lives and promote well-being for all at all ages (UN 2015b). A sub-target of SDG 3 concerning health care for women, is SDG 3.1, a reduction in the global MMR to less than 70 per 100,000 live births by 2030 (UN 2015b). Many countries have united behind the new SDG 3.1 target but continued and sustained global efforts to develop innovative strategies to achieve this ambitious target are required (WHO 2015a).

The Global Strategy for Women's, Children's and Adolescents Health complements the SDG 3 to ensure healthy lives and promote well-being (UN 2015a). This strategy emphasises that all women have the right to the highest attainable standard of health and well-being including physical, mental and social aspects (UN 2015b). The current international aim is to ensure that every woman in every setting has an equal chance to "survive and thrive" during and after pregnancy (UN 2015a). The updated global strategy strives for a world in which every mother can enjoy a wanted and healthy pregnancy and childbirth and realise their full potential, resulting in enormous social, demographic and economic benefits (UN 2015a). Moving from the MDGs to the SDGs, the scope of global maternal health targets have been expanded from a focus on preventing death to an emphasis on the importance of health and well-being (UN 2015b).

Maternal mortality accounts for a small fraction of the overall burden of poor maternal health (Chou 2016). By concentrating only on why women are dying, many LMIC, may overlook other major complications and conditions that women suffer during and after pregnancy (Chou 2016).

Historically, maternal mortality and morbidity have been studied in isolation from one another (Geller 2006). However, to achieve further global reductions in MMR and to improve maternal health, there is a need to broaden focus to the entire spectrum of maternal morbidity, beyond maternal mortality (Vandenkruik 2013). Extending the attention of research and preventative efforts to include maternal morbidity, will strengthen the global understanding of the continuum of maternal health and ill-health (Vandenkruik 2013).

1.3 Expanding understanding of maternal health

In the following sections of this chapter, the definitions of maternal death and severe acute maternal morbidity, and the criteria used to measure these outcomes are described. The continuum of maternal health is explained and the concept of maternal morbidity is introduced, along with a current definition. Previous descriptions of maternal morbidity are discussed, and the need for a standardised methodology and data collection tool to measure maternal morbidity is highlighted.

Maternal health indicators and definitions

To monitor global progress in reducing maternal mortality and improving maternal health, several definitions and identification criteria have been developed.

Maternal death

Maternal death is defined as “the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes” (WHO 2012a). Complications during pregnancy and childbirth are a leading cause of death among women of reproductive age (WHO 2015b). The major complications that directly account for nearly 75% of all worldwide maternal deaths are:

- Haemorrhage
- Hypertensive disorders of pregnancy
- Infection
- Obstructed labour
- Complications of early pregnancy (WHO 2015b)

The remainder, known as indirect deaths, are associated with pre-existing medical disorders such as heart disease, diabetes; or are associated with infections such as HIV, tuberculosis or malaria during pregnancy (WHO 2012a). The WHO has published criteria, detailing how to categorise maternal deaths (direct or indirect) and these criteria has been used internationally, in maternal death surveillance and in-depth reviews (WHO 2012a) (**Table 1.3**).

Table 1.3. Groups of underlying causes of death during pregnancy, childbirth and the puerperium in mutually exclusive, totally inclusive groups (WHO 2012a).

Type of maternal death	Categorization	Examples of potential causes of maternal death
Maternal death: direct	1. Pregnancies with abortive outcome	Abortion, miscarriage, ectopic pregnancy and other conditions leading to maternal death and a pregnancy with abortive outcome.
Maternal death: direct	2. Hypertensive disorders during and after pregnancy	Hypertensive disorders in pregnancy, childbirth, and the puerperium. Oedema, proteinuria and hypertensive disorders in pregnancy, childbirth and the puerperium.
Maternal death: direct	3. Obstetric haemorrhage	Obstetric diseases or conditions directly associated with haemorrhage.
Maternal death: direct	4. Pregnancy-related infection	Pregnancy-related, infection-based diseases or conditions.
Maternal death: direct	5. Other obstetric complications	All other direct obstetric conditions not included in groups to 1–4.
Maternal death: direct	6. Unanticipated complications of management	Unanticipated complications of management. Severe adverse effects and other unanticipated complications of medical and surgical care during pregnancy, childbirth or the puerperium.
Maternal death: indirect	7. Non-obstetric complications	Non-obstetric conditions Cardiac disease (including pre-existing hypertension) Endocrine conditions. Gastrointestinal tract conditions Central nervous system conditions Respiratory conditions Genitourinary conditions Autoimmune disorders Skeletal diseases Psychiatric disorders Neoplasms Infections that are not a direct result of pregnancy
Maternal death: indirect	8. Unknown/undetermined	Maternal death during pregnancy, childbirth and the puerperium where the underlying cause is unknown or was not determined.
Death during pregnancy, childbirth and the puerperium	9. Coincidental causes	Death during pregnancy, childbirth and the puerperium due to external causes.

Severe acute maternal morbidity

The WHO has defined SAMM as “a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy” (Say 2009). This concept is also known as “maternal near miss” (MNM) and refers to a life-threatening disorder that can result in a near miss with or without enduring morbidity or mortality (Say 2009). Furthermore, the WHO has defined potentially life-threatening condition or morbidity as a “clinical conditions or diseases that can threaten a woman’s life during pregnancy and labour and after termination of pregnancy” (WHO 2011a). This is also known as “severe maternal complications” (WHO 2011a).

Different methods and identified criteria have been developed to identify SAMM cases. These approaches include disease specific, interventions, organ dysfunction and the WHO criteria, each with its own advantages and disadvantages (Mantel 1998, Waterstone 2001, Say 2009). As an example, **Table 1.4** displays the WHO criteria to measure SAMM (WHO 2011a).

Table 1.4: The WHO SAMM criteria (WHO 2011a)

Organ system dysfunction	Clinical criteria	Laboratory criteria	Management based proxies
Cardiovascular dysfunction	Shock Cardiac arrest (absence of pulse/ heart beat and loss of consciousness)	Severe acidosis (pH<7.1) Severe hypo- perfusion (lactate>5 mmol/l or >45 mg/dl)	Use of continuous vasoactive drugs Cardiopulmonary resuscitation
Respiratory dysfunction	Acute cyanosis Gaspings Respiratory rate>40 or <6 bpm	Severe hypoxemia Oxygen saturation <90% for ≥60 minutes or PAO ₂ /F _i O ₂ <200 mmHg	Intubation and ventilation not related to anaesthesia
Renal dysfunction	Oliguria non- responsive to fluids or diuretics	Severe acute azotemia Creatinine ≥300 μmol/l or 3.5 mg/dl	Dialysis for acute renal failure
Coagulation/ haematological dysfunction	Failure to form clots	Acute severe thrombocytopenia (<50,000 platelets/ml)	Massive transfusion of blood or red cells (≥5 units)
Hepatic dysfunction	Jaundice in the presence of pre- eclampsia	Severe acute hyperbilirubinemia Bilirubin>100 μmol/l or >6.0 mg/dl	
Neurological dysfunction	Any loss of consciousness lasting>12h Coma (including metabolic coma) Stroke Uncontrollable fit/status epilepticus Total paralysis		
Uterine dysfunction			Uterine haemorrhage or infection leading to hysterectomy

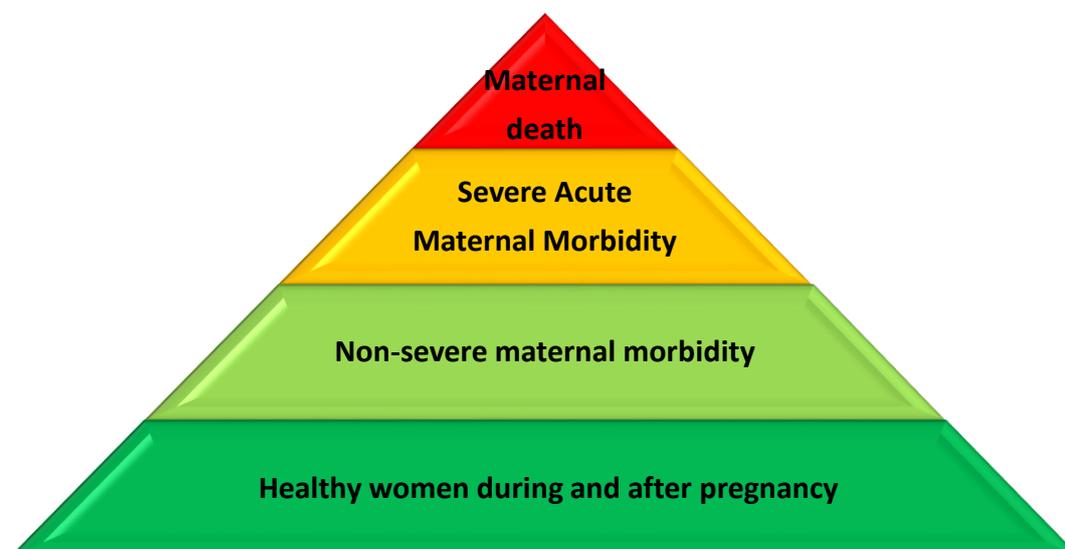
The SAMM concept can be used as a tool to measure and monitor the quality of maternity care and the WHO currently recommends the use of MNM indicators to assess the quality of maternity care (WHO 2011a). Characterising SAMM is valuable for monitoring the quality of health facility care and for assessing the incidence of potentially life-threatening complications (Tunçalp 2012). In addition, cases of SAMM are an appropriate comparison group for maternal deaths and can be used to identify quality of care issues related to preventability (Adler 2012, Filippi 2009). The different forms of criterion available allows for routine measurement and monitoring of SAMM across different settings in many LMIC (Tunçalp 2012, van den Akker 2013). It has been suggested that SAMM can be used as a better healthcare indicator than maternal mortality alone for monitoring and evaluating maternal health programs in many LMIC (Say 2004, Kaye 2011, Tunçalp 2012).

Much of the recent research on maternal morbidity has focused mainly on SAMM, which is generally assessed at secondary or tertiary healthcare levels using internationally accepted criteria to investigate deficiencies in maternal care as a complementary measure into the investigations of the causes of maternal deaths and to assess the quality of care given (Tunçalp 2013, van den Akker 2011). There is, however a gap in current knowledge regarding how non-severe or non-acute maternal morbidity is understood and assessed in a standardised and comparable way across LMIC.

Continuum of maternal health

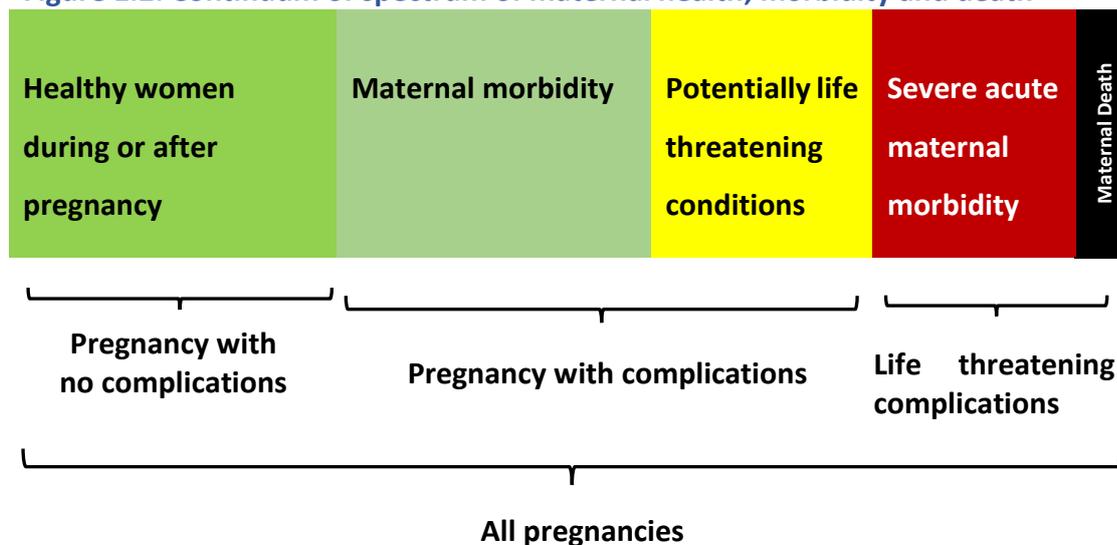
Maternal mortality has been described as the “the tip of the iceberg” with a burden of poorly documented and misunderstood maternal ill-health or morbidity as the “base of the iceberg” (Liskin 1992, Fortney 1997).

Figure 1.1: Hypothetical “iceberg” demonstrating continuum from maternal health to maternal death (adapted by the lead researcher from Liskin 1992).



Maternal morbidity can represent a critical stage in the connection between a healthy maternal population and maternal death (**Figure 1.1** and **Figure 1.2**). While some women with ill-health or morbidity will recover with or without treatment, others will not (Chou 2016). Understanding the scope of maternal morbidity coupled with early recognition and appropriate management is an important step in improving maternal health and potentially averting preventable maternal deaths (Tunçalp 2013). This approach to maternal health recognises that death is the last stop on a continuum of adverse pregnancy events, if maternal morbidity is not recognised, detected and managed appropriately. It is thought that efforts to prevent the progression of the severity of morbid conditions will prevent more severe complications and maternal death (Geller 2002). The continuum of maternal health can be sub-divided into clinical and epidemiologic ranges that permit an analysis of factors, including preventability factors that may differentiate deaths, severe acute, potentially life threatening and non-severe morbidities (Geller 2004). However, determining clear thresholds for a normal pregnancy and locating intermediate points between severe, potentially life threatening and non-severe morbidity is difficult (Geller 2006).

Figure 1.2: Continuum of spectrum of maternal health, morbidity and death



Whilst the causes of maternal mortality and morbidity may not be simply connected, it is recognised that many women suffer both short- and long-term consequences of pregnancy and childbirth; the major burden of which is highest in women living in LMIC (Zafar 2015). It is well recognised that behind every maternal death, there are potential preventable preceding events which may have contributed (Tunçalp 2013). It is thought that recognising and addressing maternal morbidities before they become severe and potentially life-threatening, will improve the survival of mothers and their babies and will improve their overall health and well-being during and after pregnancy (Zafar 2015, Say 2016). To date, recent research on factors contributing to maternal morbidity have focused mainly on the severe acute type of maternal morbidity (Say 2009, Ferdous 2012, van den Akker 2013).

1.4 Maternal morbidity

There is a current gap in the knowledge of the understanding, extent and measurement of non-severe maternal morbidity as a component of the continuum of maternal health. Maternal morbidity has been described as a broad and complex concept that affects women, their children, families, communities and societies (Filippi 2016). The following sections describe current definitions of health, ill-health and maternal morbidity.

Definitions of health and ill-health

The WHO definition of health is “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO 1948). Within this framework, reproductive health addresses the reproductive processes, functions and system at all stages of life (WHO 2016b). The WHO definition of reproductive health emphasises that people “can have a responsible, satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so” (WHO 2016b). Alternatively, reproductive morbidity has previously been defined as “any morbidity or dysfunction of the reproductive tract, or any morbidity which is a consequence of reproductive behaviour including pregnancy, abortion, childbirth, or sexual behaviour and may include those of a psychological nature” (WHO 2005a).

Definition of maternal morbidity

There have been several descriptions and definitions of non-severe and non-acute maternal morbidity. For example, Bacak et al defined maternal morbidity as “a group of physical or physiologic conditions, resulting from or aggravated by pregnancy that adversely affects a woman’s health” (Bacak 2005). On the other hand, Danel et al referred to maternal morbidity as “a condition that adversely affects a woman’s physical health during childbirth beyond what would be expected in normal delivery” (Danel 2003). Maternal or obstetric morbidity has also previously been defined as “morbidity in a woman who has been pregnant (regardless of the site or duration of the pregnancy) from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes”, and is a subset of reproductive morbidity (National Research Council 2000). Researchers have previously emphasised that maternal morbidity can be physical or psychological and can result from direct or indirect causes (Hardee 2011). The WHO have recently defined maternal morbidity as “any health condition that is attributed to or aggravated by pregnancy and childbirth which has a negative impact on the woman’s wellbeing” (Firoz 2013). This definition is imprecise at present, without a time limit,

does not clarify between different types of morbidity and does not lend itself to objective operational study without clearer refinement.

Components of maternal morbidity

With the proposed WHO definition of maternal morbidity, different types of conditions (including physical, psychological, and social) can potentially have a negative impact on a woman's wellbeing during and after pregnancy, and the specific extent and burden of which may vary from woman to woman (Zafar 2015). Each type of morbidity could have an impact on a woman of varying severity.

For example, the current definition of maternal morbidity can include conditions referred to as "common discomforts of pregnancy", symptoms that are often associated with the "normal" physiological changes in the maternal condition by being pregnancy (for example, nausea and vomiting, heartburn, constipation, breast tenderness, backache). These "normal" physiological changes due to pregnancy may have a negative effect on the women's well-being and functioning and can, therefore, represent maternal morbidity. Other components of health included in the definition of maternal morbidity may be of various severity and could include conditions similar to the causes of SAMM and/or maternal mortality listed previously in **Table 1.3** and **Table 1.4**.

A WHO maternal morbidity working group have explored and summarised what conditions may contribute to maternal morbidity, and have proposed identification criteria to measure this (Say 2016, Chou 2016). The summary of possible conditions emphasises the wide range of indirect conditions of morbidity that women may experience during and after pregnancy and childbirth, listing more than 180 diagnoses and dividing them into 14 organ dysfunction categories, ranging from obstetric to cardiorespiratory and rheumatology conditions (Chou 2016). To date, no study has used this data collection tool to measure maternal morbidity in LMIC and therefore the true extent of maternal morbidity is not known.

It has been estimated that for every woman who dies related to pregnancy, 20 or 30 more suffer maternal morbidity (Dakka 1980, Ashford 2002). Based on the mathematical modelling of available data, estimates suggest that of the 136 million women who give birth each year, an estimated 1.4 million women experience SAMM, 9.5 million experience other types of complications and 20 million suffer from long-term disabilities (WHO 2015c). Other research based upon primary data suggests that the magnitude of maternal morbidity could be much larger (Zafar 2015).

Community-based studies conducted in various countries report that women suffer significant morbidity both during and after pregnancy with up to 41% of women experiencing some form of morbidity, many of which were preventable (Bhatia 1996). There has been much research and systematic reviews focussed on the prevalence and impact of individual diseases, highlighting that women are suffering many treatable complications during and after pregnancy in LMIC e.g. sepsis, anaemia, hypertension, diabetes, haemorrhage (van den Broek 2003, Calvert 2012, Calvert 2013). Furthermore, it is well recognised that maternal health is linked to newborn babies' health and maternal morbidity can be associated with poor fetal and newborn health outcomes (Garcia-Moreno 2005, Satyanarayana 2011). However, to date, no study has measured the prevalence of maternal morbidity as a comprehensive and holistic measurement in different LMIC.

Rationale for this study

As part of the need to develop innovative strategies, as well as effective, evidence-based and low-cost methods to improve and monitor maternal health, there is now a focus on maternal morbidity in terms of definition, measurement, and interventions (Zafar 2015, Say 2016, Chou 2016). There are internationally accepted definitions and identification criteria in place for SAMM and maternal death (WHO 2009, 2012a). In contrast, criteria to identify non-severe maternal morbidity has not been internationally agreed and the true extent of maternal morbidity is currently largely unknown (Chou 2016). Furthermore, the influence of various aspects of health

(physical, psychological and social) and their impact on women and/or health outcomes are currently not well documented (Zafar 2015). Currently, when considering the current definition of maternal morbidity, there is a lack of understanding regarding what women themselves consider ill-health and their experiences (subjective measures) compared to the clinical findings (objective measures) assessed, documented and defined as morbidity by a healthcare provider (Zafar 2015).

Maternal morbidity is a complex and broad concept and its presentation and severity are suspected to be along a spectrum or continuum linked to potentially life-threatening conditions, SAMM and/or maternal death (Geller 2006). For a more accurate estimation of the global burden of maternal morbidity, clarity is needed on a measurement tool, assessments need to be conducted at the population level and self-reported morbidity may need to be “validated” (Zafar 2015). Agreed international identification criteria for maternal morbidity during and after pregnancy is crucial to provide accurate prevalence of the burden of maternal morbidity across settings where the need is greatest.

1.5 Aim

The aim of the research project is to assess maternal morbidity using a new assessment tool to obtain estimates of maternal morbidity during and after pregnancy in India, Pakistan, Kenya and Malawi.

Objectives

1. To field test a new data collection tool to comprehensively measure maternal morbidity.
2. To apply this new data collection tool to women during and after pregnancy in healthcare facilities, in different settings in four LMIC.
3. To determine the prevalence and types of maternal morbidity in each setting.
4. To determine the prevalence of maternal morbidity at five assessment stages during and after pregnancy.
5. To assess what factors are associated with maternal morbidity in women during and after pregnancy.
6. To assess whether there is an association between the different types of morbidity.

Research questions

In this research study, there are four research questions.

Table 1.5: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

1.6 Chapter summary

This chapter has set the scene for the proposed research project and has given an overview of the current priorities in global maternal health. Progress of interventions to address the MDG 5a have been described and the SDG 3 has been considered. The definitions and criteria for measurement of maternal death and SAMM have been highlighted. The continuum of maternal health, the concept of maternal morbidity, previous descriptions of maternal morbidity and the need for a standardised methodology to measure maternal morbidity has been described. The overall aim, objectives and key research questions have been summarised.

Summary box

- Maternal morbidity is a broad concept that encompasses a comprehensive approach to maternal health and can include physical, psychological and social aspects.
- Currently, there are no national figures for the number of women who report different types of ill-health due to pregnancy across different countries and settings.
- A challenge in the understanding of maternal morbidity has been the lack of clear, consistent and transparent methodology.
- The measurement of maternal morbidity has the potential to be an important indicator of women's health and could help inform policy and program decisions and resource allocations to improve maternal health.
- Better information on women's well-being and morbidity during and after pregnancy will help plan targeted, effective antenatal and postnatal care and education, ensuring that all women not only survive, but also thrive during and after pregnancy.

1.7 Overview of thesis

This thesis is structured by chapters as follows:

Chapter 1: Introduction

This chapter has just been described in detail and has introduced the concept of maternal morbidity and has described the overall aim, objectives and key research questions of this research project.

Chapter 2: Literature review

The following chapter describes studies that have assessed maternal morbidity previously, and presents a systematic review of studies that have measured the prevalence of and/or associations between two of more different types of maternal morbidity in LMIC.

Chapter 3: Methodology

This chapter describes the positionality of the research project, lead researcher contribution, study design, study settings, study population and sampling. How the sample size is determined and the data collection tool and the process of piloting is described. This chapter describes the process of data collection, processing, cleaning, coding and analysis. This chapter concludes with how the quality of the data was assured and ethical considerations are described and addressed.

Chapter 4, 5, 6 and 7: Results

These chapters present the main results of the research study, structured in sequence to address each key research question. For the purposes of this thesis, results for the study settings are presented per country in the following sequence: India, Pakistan, Kenya and Malawi. Where appropriate, results are presented as a combined study population.

- Chapter 4, the first results chapter, presents the burden of maternal morbidity per country and as a combined study population.
- Chapter 5, the second results chapter, presents the prevalence of maternal morbidity per assessment stage of pregnancy per country and as a combined study population.
- Chapter 6, the third results chapter, presents the factors associated with maternal morbidity per country.
- Chapter 7, the fourth results chapter, presents the associations between different types of maternal morbidity per country.

Results are presented in a narrative text accompanied by tables and figures. Where supplementary information is necessary, this is presented in the appendices. At the end of each results chapter, the main findings are summarised and compared to published literature. Further positioning of the findings from all the results chapters are further compared to available literature in the main discussion chapter of this thesis in more detail.

Chapter 8: Discussion and recommendations

In this chapter, the results of the study are discussed. This chapter begins with an overview of the principal findings and each key objective and accompanying research question is considered and interpreted. This chapters considers the strengths and weaknesses of the study, generalisability of the results and relation of the results to other studies. This chapter also discusses the meaning of the study, implications for clinical practice and implications for research. Recommendations are given and key future research priorities are suggested.

Chapter 9: Conclusion

In this chapter, a clear and concise conclusion to the research study is given.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The systematic review in this chapter was conducted to explore available evidence on the prevalence of maternal morbidity and/or associations between different types of maternal morbidity in low- and middle-income countries. In addition, approaches to the measurement of maternal morbidity used in LMIC were reviewed. This chapter gives a background to the conceptualisation of ill-health and maternal morbidity and how it is described for the purposes of this systematic review. The methods section of this chapter describes how the systematic review was conducted. A description of included studies with related quality assessment is then presented. In the results section, the main findings from the included studies are presented using a narrative synthesis, alongside diagrams and summary tables. The discussion explains what the results mean; major findings are highlighted; strengths and limitations of the review are discussed; and explanation is provided on key similarities and differences with other studies before conclusions are drawn. The chapter ends with a summary.

2.2 Background

In the introduction chapter, it was highlighted that one of the key goals of the global strategic plan is to ensure all women have the highest attainable standard of health and well-being (UN 2015a). WHO has defined health as “a state of complete (physical, mental and social) well-being and not merely the absence of disease or infirmity” (WHO 1948). There is a current debate that this definition is out-dated and needs to be re-formulated to consider health in a context of functionality, capacity, adaptability and the ability to perform activities of daily living despite having a disease or disability (Huber 2011). However, to date there is no alternative internationally recognised and agreed definition of health. There have been various proposals to develop the definition of health using the concept of “health, as the ability to adapt and to self-manage” with a continued emphasis on the importance of the three domains of health: physical, mental, and social (Huber 2011).

Regarding maternal morbidity, in 2013, the WHO defined maternal morbidity as: “Any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman’s wellbeing” (Firoz 2013). This definition can therefore in principle, include physical, mental (or psychological) and/or social conditions that are attributed to and/or aggravated by pregnancy.

Definitions

Maternal morbidity: “Any health condition attributed to and/or aggravated by pregnancy and childbirth that has a negative impact on the woman’s wellbeing” (Firoz 2013).

Health: “complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (WHO 1948).

There have been many systematic reviews to assess the prevalence of **single** physical, or mental (psychological), or social diseases or conditions that negatively impact a women’s health and wellbeing during and after pregnancy. To date, to the best of the lead researcher’s knowledge, no systematic review has described the prevalence of, and/or associations between **two or more** different types of maternal morbidity that have a negative impact on women during and/or after pregnancy.

Therefore, for the purposes of this systematic review, the concept of maternal morbidity is classified as **two of more** of the following components or categories of health:

1. Physical
2. Mental (or psychological)
3. Social

Concepts

For the purposes of this systematic review of literature, for example, the different types or categories of maternal morbidity could include the following diseases or conditions (although these are not definitive).

1. **Physical morbidity:** (a) infectious or (b) medical/obstetric.

a) Infectious morbidity: HIV, malaria, syphilis, sepsis and other general infections.

b) Medical/obstetric morbidity: anaemia, hypertensive disorders of pregnancy, haemorrhage and other common medical or obstetric conditions.

2. **Psychological morbidity:** common mental disorders: depression, puerperal psychosis, anxiety, stress and/or thoughts of self-harm.

3. **Social morbidity:** domestic violence, substance use and lack of social support.

Objective

The objective is to systematically review the literature to assess studies that have measured the prevalence of and/or associations between at least two types of maternal morbidity, in women in LMIC, and to review the types of data collection tools that were used.

Research questions

The main research questions for this systematic review are:

1. What studies have been conducted in LMIC that have measured two or more components of ill-health (maternal morbidity) in women during and/or after pregnancy?
2. What data collection tools have been used to assess different types of maternal morbidities (physical, psychological, social) described in these studies?
3. What is the prevalence of the different types of maternal morbidities (physical, psychological, social) described in these studies?
4. Are there associations between the different types of maternal morbidities (physical, psychological, social) described in these studies, and if so what are the reported associations?

2.3 Methodology

Databases used

Four electronic databases were searched using the same search terms. The databases were selected based on their relevance to the topic and the wide geographic reach.

1. Medline
2. CINAHL plus
3. Global Health
4. Web of Science

Search strategy

A search strategy was designed to include terms and key words relevant to the review objectives. The term “maternal morbidity” and associated keywords, were used as main search terms (**Table 2.1**). For each aspect of maternal morbidity (“physical”, “psychological”, and “social”) search terms and related keywords were selected based on the corresponding common causes of maternal mortality that could in principle be detected during routine maternity care during and/or after pregnancy. For example, common causes of physical maternal mortality would include “haemorrhage”, “hypertensive disorders of pregnancy”, and “sepsis”. Search terms and keywords for psychological morbidity included “common mental health disorders”. An example of maternal mortality due to psychological ill-health is suicide and therefore “suicidal ideation” and “thoughts of self-harm” were included as keywords. Examples of maternal mortality due to social circumstances includes “domestic violence”, and “overdose of substance use” (for example “illicit drugs”). Search terms and keywords for social morbidity therefore included “domestic violence”, “substance use” and other common social determinants of health. In addition to the common causes of types of maternal mortality that could in principle be detected during routine maternity care, well recognised indirect causes of maternal ill-health across LMIC were also included, such as “HIV”, “tuberculosis”, “malaria”, “syphilis” and “anaemia”.

An initial exploratory limited search using Web of Science was conducted using Booleans "AND/OR" to combine keywords and phrases related to this review. This preliminary search helped to identify relevant keywords contained in the title, abstract and subject descriptors of papers (**Table 2.1**). Terms identified in the first stage and the synonyms used in the respective databases were used in a further extensive search of the four databases using the Medical Subjects Headings (MeSH) approach.

Search terms

Table 2.1: MeSH terms and keywords used

Topic	MeSH terms	Keywords
Maternal	Parturition OR Pregnanc* OR Prenatal care OR Postnatal care OR Obstetric labor complication*	Labor OR Obstetric OR Puerperal OR Maternal OR Delivery OR Intrapartum OR Antenatal
Morbidity	Morbid* OR Pregnancy complications	Unwell OR Ill* OR Disorder* Disease*
Physical	Infection* OR Puerperal infection* OR Sepsis OR Systematic inflammatory response syndrome* OR HIV* OR Malaria OR tuberculosis OR syphilis OR Haemorrhage OR haemorrhage OR Postpartum haemorrhage OR urinary incontinence OR Anemia or anaemia OR Pre-eclampsia OR Hypertension OR Pregnancy induced hypertension	Medical OR Obstetric
Psychological	Mental health OR Depression OR Postpartum depression OR Self-mutilation OR Suicide OR Anxiety OR Psycho* OR Neurosis OR Mental disorder* OR Stress disorder*	Suicidal ideation OR Self-harm
Social	Domestic violence OR Intimate partner violence OR Substance related disorders OR Alcohol* OR Tobacco use OR Smoking OR Street drugs OR Inhalant abuse OR Hypnotics and sedatives OR	Gender based violence OR Domestic abuse
Low resource setting	Developing countr* OR Low income countr* OR Middle income countr* OR Low resource setting* OR Global south	
Limitations	Human Female 2007-2017	

Reference lists and bibliographies of key topic articles were also searched and any additional papers necessary were obtained. A record of researched databases was performed using tracking sheets. The four databases were searched for all published studies, available in English, between 2007-2017, limited to human and female populations.

Inclusion and exclusion criteria

The inclusion criteria used in this systematic review are set out in **Table 2.2** and the exclusion criteria are set out in **Table 2.3**. The aim was to assess maternal morbidity, and therefore, the study population was limited to women during and after pregnancy. When deciding on the inclusion criteria for the timeframe over which to assess women, the definitions for maternal mortality and SAMM were reviewed. Each of these internationally recognised definitions (described in the introduction chapter) have a clear timeframe, that is “while pregnant or within 42 days of termination of pregnancy” (WHO 2009, WHO 2012). The current maternal morbidity definition is “open”, and therefore could in principle include diseases or conditions that affect women beyond the standard definition the postnatal stage. For the purposes of this systematic review, studies were included if they assessed women during pregnancy, childbirth or up to twelve weeks postnatal. The rationale for the twelve-week postnatal time-frame, as opposed to the standard six-week postnatal cut off time frame, was to capture maternal morbidities that may first develop or manifest beyond the first six weeks after childbirth, but that may still be due to the pregnancy and/or childbirth. The methodology was limited to cross-sectional surveys; cohort studies; observational, prospective studies; secondary data analysis; retrospective analysis, and case note reviews to enable the reporting of prevalence of and/or associations between maternal morbidities measured in these types of studies.

The sample size was limited to studies that assessed 500 or more women. This rationale was partly arbitrarily and to enable more accurate comparisons between any prevalence reported in the included studies and the findings of this proposed

study at each assessment stage. The sample size calculation for this study was a minimum of 576 women at each of the five assessment stages of pregnancy, with an overall total of 2880.

The outcome was limited to quantitative data on maternal morbidity of two or more types of physical, psychological and/or social morbidities, in keeping with the concepts of the WHO current definitions of health and maternal morbidity. Any study reporting on one type of maternal morbidity only and any study that examined trend, risk factors or associations only, were excluded.

In keeping with the continuum of maternal health described in the introduction chapter and **Figure 1.2**, any study that reported severe or potentially life-threatening complications of pregnancy, that would require emergency obstetric care, were excluded. For example, studies reporting on severe acute maternal morbidity or maternal near miss were excluded.

The review is limited to studies from LMIC as this is the primary interest of the lead researcher; the burden of maternal morbidity is expected to be highest in women living in LMIC or resource poor settings; and the burden and epidemiology of disease is likely to be different in LMIC compared to high-income countries or settings, especially regarding infectious disease, including HIV, tuberculosis and malaria.

Dates were limited for the past ten years (2007-2017), based on the concept of reviewing recent data. Due to lack of translation support and for convenience, the language was limited to English.

Table 2.2: Inclusion criteria for the systematic review

Methodology	Cross-sectional survey; cohort study; observational, prospective, retrospective analysis, secondary data analysis; case note review.
Study population	Women during pregnancy, childbirth or up to twelve weeks after the end of the pregnancy.
Sample size	≥500 women.
Outcome	Quantitative data on the prevalence of and/or associations between, maternal morbidity including two of more of the following morbidities: 1. Physical 2. Psychological 3. Social
Settings	Low- or middle-income countries.
Dates	2007-2017.
Language	English.

Table 2.3: Exclusion criteria for the systematic review

Methodology	Qualitative research, commentary or communication articles, systematic or narrative reviews, case series, case control studies.
Study population	Non-pregnant women or postpartum women more than twelve weeks after delivery of baby.
Sample size	Less than 500.
Outcome	Severe acute maternal morbidity or maternal near miss. Reported outcomes on one type of morbidity only. Reported maternal morbidity outcomes without providing primary data.
Settings	High income countries.
Dates	Before 2007.
Language	Non-English.

Hits from the database search

Table 2.4 displays the “hits” obtained from the four databases using the search terms and keywords, categorised into different possible combinations of types of maternal morbidity (“physical”, “psychological”, “social”), linked to the overall search resulting from the use of the term “maternal morbidity” and associated keywords. For the purposes of this review, physical maternal morbidity was initially separated into infectious and non-infectious search categories but then combined when linked using “AND/OR” to other types of possible morbidities. Across the four databases, when the overall search for “maternal morbidity” was linked using “AND/OR” to two or more types of morbidities, there were more hits in the following categories: physical and social (1325; 46.7% of total), physical and psychological (754; 26.5%) compared to psychological and social (494; 17.4%). When “maternal morbidity” search was linked to three types of morbidity (“physical”, “psychological”, “social”), there were 267 (9.4%) “hits” (**Table 2.4**).

Table 2.4: Database hits for search terms and keywords used in the systematic review

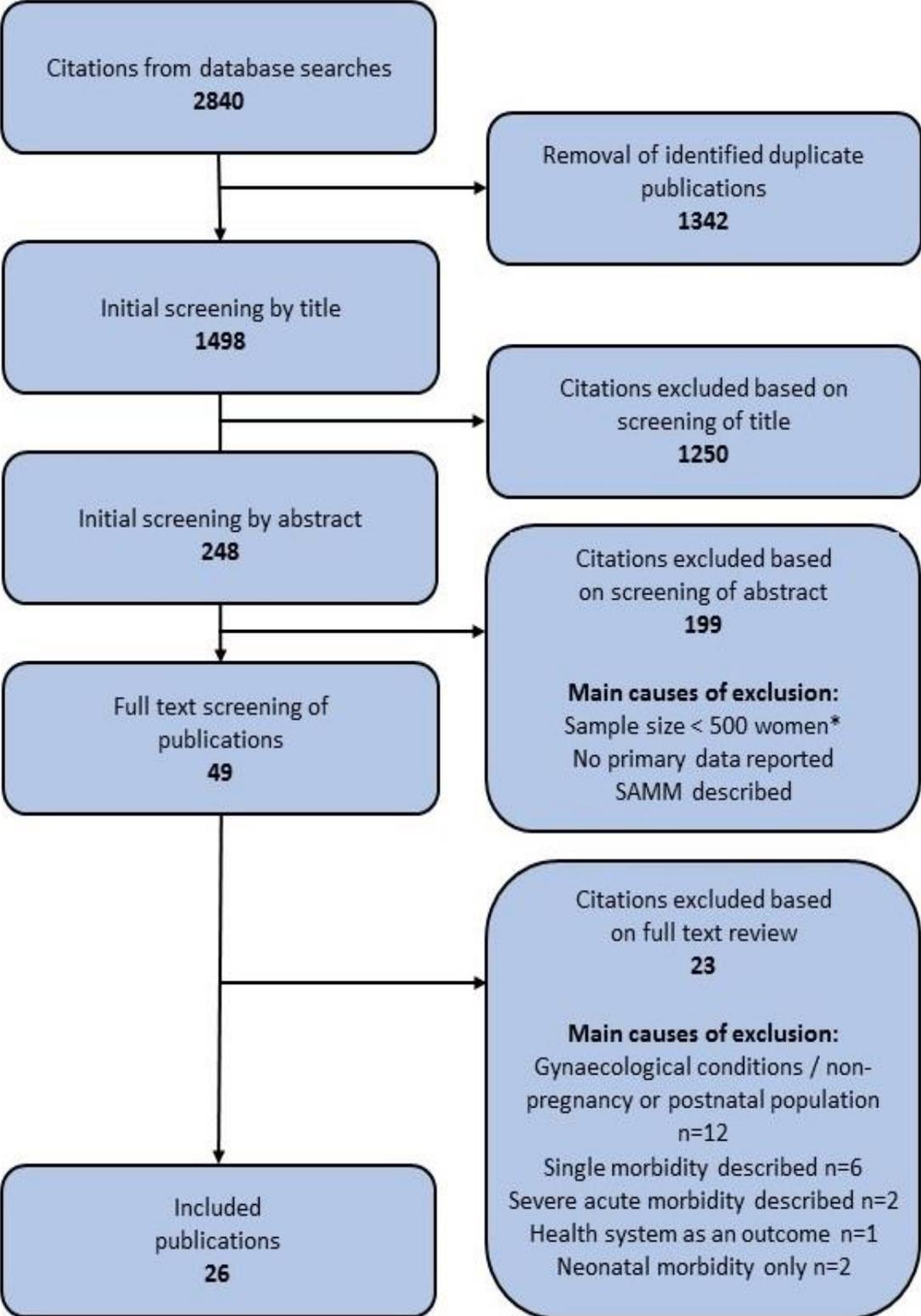
Medline, Global Health, CINAHL											Web of Science	Total	
Maternal morbidity		Physical - medical/obstetric		Physical - infectious		Psychological		Social	LMIC	Limits: English, female, 2007-2017			
Maternal morbidity	AND	Physical - medical/obstetric	OR	Physical - infectious	AND	Psychological			All	363	391	754	
Maternal morbidity	AND	Physical - medical/obstetric	OR	Physical - infectious			AND	Social	All	994	331	1325	
Maternal morbidity	AND				AND	Psychological	AND	Social	All	280	214	494	
Maternal morbidity	AND	Physical - medical/obstetric	OR	Physical - infectious	AND	Psychological	AND	Social	All	157	110	267	
Limits	Female, English language, 2007-2017												
Total										1794	1046	2840	

Data extraction

The search from four databases yielded 2840 potentially relevant publications (**Table 2.4**). Using the inclusion and exclusion criteria, the lead researcher screened all titles and abstracts. After screening titles and abstracts for relevance, 49 papers were retrieved for full text review (**Figure 2.1**). All included studies were summarised and outcomes of interest were extracted and used to populate pre-designed summary tables (**Summary Table 1 and 2**) (**Appendix 1 and 2**). For eight papers, a second opinion was obtained from the primary supervisor regarding whether to include or exclude the publications. Upon applying the inclusion criteria, the search was further narrowed to 26 studies that are reviewed in detail in this chapter. Other studies were excluded as they did not meet the inclusion criteria (**Figure 2.1**).

Study selection

Figure 2.1: PRISMA diagram for article selection process



*For reference, all studies with a sample size of less than 500 women are included in Appendix 5, Table A and Table B

Excluded studies

Twenty-three studies were excluded at full text stage. Most of these studies were excluded because they were conducted in a general female, non-pregnant population and assessed gynaecological outcomes only (n=12); the outcome was a single morbidity only (n=6); the outcome was neonatal morbidity only (n=2); the outcome was severe acute maternal morbidity (n=2); or the outcome was the effect on the health system only (n=1) (**Appendix 3**).

Included studies

By combining the search terms, 2840 studies were identified from the four databases and after screening for relevance, 49 were retrieved for full text review ([Figure 3](#)). Upon applying the eligibility criteria, the search was narrowed down to 26 studies which were included in the review.

Quality assessment

The quality of evidence for each study was assessed using the Grading of Recommendations, Assessment Development and Evaluation (GRADE) tool adapted from the Critical Analysis Skills Programme (CASP) tool (Grade Working Group 2004, Atkins 2004). This tool was used because of its objective approach to grade the quality of studies. Individual studies were assessed against a set of criteria and given a score. For the purposes of this review, there were eleven variables and the scoring system for each variable was: no=0; yes, to an extent=1; yes, fully= 2. This scoring system gave a maximum score of 22. If a study scored less than 10, it was considered low quality. If a study scored 10-17, it was considered medium quality. If a study scored 18-22, it was considered high quality. Identified bias throughout the studies was reviewed. The details of the scoring of the quality of each study are displayed in **Appendix 4**.

Ethical considerations

Each study was reviewed to ensure ethical approval had been granted by a research ethics committee and that this was documented in each paper. Ethical issues regarding risks (for example informed consent, confidentiality and safety of the women involved in the studies) were considered.

Data synthesis

A narrative synthesis approach was used to describe outcomes investigated in this review. The main outcomes extracted and summarised for this review include: the different types of maternal morbidity measured (physical, psychological, and/or social); the data collection tools used to measure maternal morbidity; the prevalence of the described maternal morbidities; and the reported associations (if any) between the types of maternal morbidity. Where a standardised data collection tool was used, this was described. The methodology and results of studies belonging to the same outcome category were compared for similarities and differences

2.4 Results

In this section of the chapter, the characteristics and outcomes for the included studies are described, accompanied by diagrams and summary tables. Initially, the data extracted from each study was in one large summary table. For ease of readability, the lead researcher has split the larger main summary table into two summary tables. **Summary Table 1 (Appendix 1)** provides a summary of included studies, study design, country, setting, study participants, objective, main conclusion of the study and the quality score of the study. **Summary Table 2 (Appendix 2)** provides a summary of the main findings from the included studies, specifically what types of morbidity were measured, how the data was collected, prevalence of morbidities described where provided and, reported associations between the types of maternal morbidity.

A total of 26 publications were included in the review. Two of the included studies were conducted by the same authors group (Faisal-Cury 2009, Faisal-Cury 2010; and Shamu 2014, Shamu 2016). In these publications, the same methodology was reported in two papers, but there was a different emphasis on the results and outcomes reported per publication. For the purposes of this review, the first publication is referenced in the methodology section. Both publications were included in the summary tables and the prevalence and/or associations for each publication are described in the results section. However, to avoid duplication, the total number of studies described in the methodology section was 24.

In the following results section, when relating the findings to any of the included studies, for ease of readability, categories with ten or less studies are referenced and alphabetical ordering is used.

Characteristics of studies included

Geographical spread

The 24 studies were from a total of 15 different countries, across five continents. Seven studies were conducted in low-income countries and eight studies were conducted in middle-income countries (five lower-middle and three upper-middle income countries). Of the included studies, one study was conducted in two countries: Malawi and Pakistan (Zafar 2015). Three studies were carried out in South Africa (Brittain 2017, Tsai 2016, Wong 2017); three in Bangladesh (Nasreen 2011, Natasha 2015, Surkan 2017); two in Ethiopia (Hanlon 2009, Wado 2014); Kenya (Chersich 2009, Ukachukwu 2009); Pakistan (Karmaliani 2009, Waqas 2015), and Tanzania (Isaksen 2015, Stöckl 2010). One study was conducted in each of the following countries: Brazil (Faisal-Cury 2009); Iran (Hassan 2014); India (Prost 2012); Malawi (Stewart 2014); Rwanda (Ntaganira 2008); Mexico (Romero-Gutiérrez 2011); Morocco (Assarag 2013), Timor-Leste (Rees 2016); and Zimbabwe (Shamu 2014). The geographical distribution of country in which the study was conducted is given in **Figure 2.2**. The number in the circles represents the number of studies in that country.

Figure 2.2: Geographical distribution of studies included in the systematic review



Study design

Sixteen studies used a cross sectional survey study design. Four studies were observation prospective cohort studies (Faisal-Cury 2009, Karmaliani 2009, Patra 2008, Wado 2014). Three studies were secondary data analysis of large population databases (Isaksen 2015, Surkan 2017, Tsai 2016). One study was a survey that extracted data from medical case notes retrospectively (Ukachukwu 2009).

Sample size

Nine studies had a sample size of 500-749 women, four studies had a sample size of ≥ 2500 women (Isaksen 2015, Prost 2008, Surkan 2017, Zafar 2015), six studies had a sample size of 1000-1499 women (Assarag 2013, Karmaliani 2009, Hassan 2014, Hanlon 2009, Stöckl 2010, Tsai 2016), three studies had a sample size of 1500-1999 (Romero-Gutiérrez 2011, Rees 2016, Ukachukwu 2009) and two studies had a sample size of 750-999 women (Faisal-Cury 2009, Shamu 2014) (**Table 2.5**).

Table 2.5: Number of studies in each category of sample size

Number of women	Number of studies in category
500–749	9
750–999	2
1000–1499	6
1500–1999	3
2000–2499	0
≥2500	4
Total number	24

Source of data and data collection method

A review of the included studies showed that most (20) studies used face-to-face interviews to collect primary data from women using questionnaires. One study extracted data from medical cases notes (Ukachukwu 2009) and three studies conducted secondary analysis on existing published databases and registers (Isaksen 2015, Surkan 2017, Tsai 2016). There was no mention of primary electronic data collection in any study.

Included studies that used secondary data analysis

In three studies, the data used to estimate levels and types of maternal morbidity were from databases of hospital admissions, discharges and birth registers (Isaksen 2015, Surkan 2017, Tsai 2016). Isaksen et al 2015 conducted secondary data analysis on data related to 34,090 births between 2000 and 2010, obtained from the medical birth registry at Kilimanjaro Christian Medical Centre in Moshi, Tanzania, to assess alcohol use in pregnant women and to describe associations between alcohol consumption and health-related maternal and fetal outcomes (Isaksen 2015). Surkan et al conducted secondary data analysis using population-based data from a community trial among 39,000 married women living in a rural area after childbirth, to assess the relation between women's reported morbidity symptoms from childbirth to three months postpartum, and subsequent depression symptoms assessed at six months postpartum (Surkan 2017). Tsai et al conducted secondary

data analysis of population based data collected as part of a longitudinal study during home visits of 1328 pregnant women in South Africa, to estimate the association between intimate domestic violence and depression in pregnant women (Tsai 2016). In all the cases of secondary data analysis, data was directly extracted and analysed from these databases using the authors own data collection tool, with little or no detail of the exact variables collected described, in the paper.

In one study, Ukachukwu et al collected data on sociodemographic, recorded antenatal care activities and maternal morbidities from case notes of all pregnancies and births over a two-year period in Kikuyu Hospital, Kenya. Data was directly extracted from the medical case notes of study participants with no mention nor description of any tool or form specifically designed for data extraction regarding maternal morbidities (Ukachukwu 2009).

Included studies that used primary data collection

Stages of pregnancy assessed

A total of 20 studies used a cross sectional study design to collect data from women during and/or after pregnancy. In 14 studies, data was collected using surveys from women during pregnancy. In 10 of these 14 studies, the gestation or time of pregnancy was not given by weeks or trimester. In two studies, women were assessed in the second trimester (Karmaliani 2009, Rees 2016) and in one study women were assessed in the third trimester (Nasreen 2011). In one study, women were either assessed in the second or third trimester (Faisal-Cury 2009). In six studies, data was collected using a cross sectional survey from women postnatally, after childbirth. Two studies assessed women within 12 weeks of childbirth (Assarag 2013, Prost 2012). In two studies, data collection was carried out at more than one assessment stage of pregnancy (Chersich 2009, Zafar 2015). 2 weeks), middle (12-24 weeks) and late (24-26 weeks) after childbirth (Chersich 2009). Zafar et al used a cross sectional survey to assess different women at three different assessment stages, both during (early and late antenatal) and after pregnancy (Zafar 2015). Prost et al assessed women

postnatally and asked women to recall complications experienced during pregnancy and at the time of childbirth (Prost 2012).

Site of data collection

In most studies (10), data collection took place during a visit to the outpatient clinic of a healthcare facility. In five studies, these healthcare facilities were tertiary/provincial hospitals (Chersich 2009, Hassan 2014, Natasha 2015, Romero-Gutiérrez 2011, Waqas 2015); in one this was a secondary level or district hospital (Stewart 2014) and in four studies, these were at primary healthcare facility level (Brittain 2017, Faisal-Cury 2009, Ntaganira 2008, Rees 2016, Shamu 2014). In nine studies, data collection took place in the community or home of women (Assarag 2013, Hanlon 2009, Karmaliani 2009, Tsai 2016, Stöckl 2010, Nasreen 2011, Prost 2012; Wado 2014, Zafar 2015). In two studies, data was collected at both the health facility and at the home of women.

Data collection

Most of the studies that collected primary data relied solely on women's self-reported symptoms. In four studies, clinical examination and/or laboratory tests were also carried out at the same time of face-to-face interview (Assarag 2013, Chersich 2009, Wado 2014, Zafar 2015).

Number of types of morbidity assessed

Ten studies assessed psychological and social ill-health (Faisal-Cury 2009, Faisal-Cury 2010, Karmaliani 2009, Nasreen 2011, Rees 2016, Shamu 2014, Shamu 2016, Stöckl 2010, Tsai 2016, Wong 2017). Five studies assessed physical and psychological ill-health (Assarag 2013, Natasha 2015, Surkan 2017, Ukachukwu 2009, Zafar 2015). One study assessed physical and social ill-health (Isaksen 2015). Seven studies assessed aspects of physical, psychological and social ill-health (Brittain 2017, Chersich 2009, Hanlon 2009, Prost 2012, Stewart 2014, Wado 2014, Waqas 2015).

Descriptions of maternal morbidity

In the following part of the results section of this chapter, the different types of data collection tools, measurements, prevalence of and associations between maternal morbidities reported in the included studies, are described.

For the purposes of the review, maternal morbidity included physical, psychological and social aspects of ill-health. In this results section, each type of maternal morbidity, the data collection tool used, and prevalence's reported in the included studies are described using narrative synthesis with accompanying summary tables. The associations between the different types of maternal morbidity are described separately at the end of the results section of this chapter.

Physical morbidity

Data collection tools

A total of 17 included studies described a form of physical morbidity. Different types of data collection tools were used, were not well reported and were mostly described as simply "questionnaires". Some questionnaires were described as semi-structured and other included open-ended questions. There was no single standardised validated questionnaire to measure physical morbidity across the different studies. A large variety of data items were collected across the included studies, including symptoms, clinical signs elicited during examination, results of investigations, and clinical diagnoses. Different studies reported different types of physical morbidity. In most studies, co-morbidities were listed with no reference to any classification system. It was not possible to present a summary table of data collection tools, as no study used a validated international classification or tool to assess physical morbidity.

Types and prevalence of physical morbidity reported

Of the 17 studies that reported physical morbidity, HIV status was considered the primary measure of physical morbidity in four of these studies (Ntaganir 2008, Shamu 2014, Shamu 2016, Wong 2017).

Assarag defined physical morbidity in 1523 women using self-reported symptoms and then aggregated the symptoms together into one category; and reported overall prevalence of physical morbidity as 44% of women with at least one self-reported physical complaint. In this study, 60% of women had a medical condition diagnosed by a healthcare provider (Assarag 2013). During a postpartum consultation, 8% of women self-reported complaints considered due to genital infections (mainly vaginal discharge) and 5% of women reported breast problems (Assarag 2013). Other gynaecological and obstetric problems (sexual problems, uterine prolapse, and infected episiotomy) were self-reported by 10% of women (Assarag 2013). Burning during urination and urinary leakage were self-reported in 2% and 1% of women respectively (Assarag 2013). When assessed objectively by a healthcare provider, 60% of women received a diagnosis of a complication, and of these women, 9% received more than one diagnosis (Assarag 2013). The most common medical diagnosis made by a healthcare provider was related to gynaecological problems (22%) (genital infection, uterine prolapse, cystocele, bad repair of an episiotomy), followed by laboratory-confirmed anaemia (19%) (Assarag 2013).

Chersich et al used their own structured questionnaire as a data collection tool for self-reported symptoms; conducted clinical examinations; collected blood, cervical swabs for laboratory investigations and offered the Papanicolaou (PAP) smear (Chersich 2009). Chersich et al reported physical morbidity and the prevalence as: 52% of women had anaemia; 31% had bacterial vaginosis; 25% had abnormal vaginal discharge; 17% had abdominal pain; 10% had dysuria; 7% had candida; 7% had trichomonas vaginalis; 6% had febrile symptoms; 5% had severe anaemia; 4% had nitrites in their urine; and 1% had incontinence (Chersich 2009).

Faisal-Cury et al used the term “obstetric complications” to describe physical morbidity and, in addition to face-to-face questionnaires with 831 women, collected information on the weight and gestational age at birth of the newborn baby from the hospital records of the newborn baby. Overall, 7.0% of women interviewed had a baby with low birth weight and 6.9% had a preterm birth (Faisal-Cury 2010).

Hassan et al used a variety of measures to assess physical morbidity in 1300 women, including adverse maternal outcomes such as: antenatal hospitalization (55.4%), vaginal bleeding during pregnancy (31.0%), preterm labour (30.3%); Caesarean section (24.4%), abortion (1.5%) and premature rupture of the membranes (0.1%) (Hassan 2014).

Hanlon et al also used a variety of measures to assess physical morbidity in 1065 pregnant women, and reported women with a past neonatal death (25.0%); ≥ 1 episode of fever in pregnancy (13.1%); ≥ 1 episode of malaria (15.9%); low birth weight (7.1%); past stillbirth (4.3%); and “poor/bad global health” (3.8%) (Hanlon 2009).

Natasha et al assessed physical morbidity in 748 women as gestational diabetes (51%), hypertension (13%); and a history of neonatal death (3.7%) (Natasha 2015). The prevalence of gestational diabetes in this study was very high as the main objectives of this survey was to compare the prevalence of depression during pregnancy in a pre-selected population, with or without gestational diabetes (Natasha 2015). This is a bias sample and not a true representative of gestational diabetes in a pregnant population in Bangladesh.

Prost et al reported that 46.3% of women recalled “problems” in the antepartum stage; at delivery (35.1%); in the postpartum stage (30.5%); and 1.7% of women delivered by Caesarean section (Prost 2012). “Problems” included any one of the following: “severe stomach pain; excessive vomiting; fever for more than 24 hours; excessive vaginal bleeding; jaundice; reduced/no fetal movement; self-reported symptoms of malaria; high fever in the three days before labour, foul smelling vaginal discharge; prolonged labour; fits or convulsions; retained placenta; tear around birth passage; umbilical cord around infant's neck; foul smelling discharge; leaking from vagina”. The possibility of list of “problems” were adapted slightly depending on the stage of pregnancy that the women was asked to base her recall of symptoms upon

(for example, no questions antenatal haemorrhage in the postnatal stage) (Prost 2012).

Romero-Gutiérrez et al reported “maternal and neonatal complications” as measures of physical morbidity. However, specific prevalence was not reported but associations between the “maternal and neonatal complications” and violence against women was reported in this study (Romero-Gutiérrez 2011). The associations are reported and commented upon at the end of this results section.

Stewart et al used the HIV status of women (10.8%) as a measure of physical morbidity in 583 women, and reported that 17.2% of women “had a child die” and 15.4% of women had “complications in previous pregnancy” (Stewart 2014).

Surkan et al conducted secondary data analysis of a database of 39,000 women and describe the types and prevalence of physical morbidity as gastroenteritis (22.1%); anaemia (18.7%); severe headache (14.2%); urinary tract infection (6.0%); pneumonia (4.9%); stress incontinence (3.2%); reproductive infection (2.5%); prolapse (2.2%); and continuous dripping of urine (0.33%) (Surkan 2017).

Ukachukwe et al conducted a retrospective case note review of 1716 women and described the types and prevalence of physical morbidity as genital tract trauma (90.6%), urinary tract infection (14.5%) and HIV positive status (3%) (Ukachukwe 2009).

Wado et al measured mid-upper arm circumference as a possible measurement of physical morbidity in 622 pregnant women. The mean birth weight of the newborn baby were also reported as an indirect measure of possible physical morbidity in the mother. In this study, 17.0% of women had a baby with a low birth weight and 68.1% of women had a mid-upper arm circumference less than 23cms, suggestive of maternal malnutrition (WHO 1995, Wado 2014)

Waqas et al measured the following as possible measures of physical morbidity in 500 women: previous Caesarean section (27.2%), previous abortion (22.0%), previous episiotomy (16.2%), and previous miscarriage (8.8%) (Waqas 2015).

Zafar et al used self-reported symptoms and signs elicited on clinical examination, bundled to reflect infectious and non-infectious physical morbidity in 3459 women across two countries (Malawi and Pakistan) (Zafar 2015).

Types and prevalence of physical non-infectious morbidity in 1732 women assessed in Malawi included: anaemia (39.5%); nausea and vomiting (19.1%); antepartum haemorrhage (3.1%); asthma (1.0%); pre-eclampsia (0.2%); and epilepsy (0.3%) (Zafar 2015). All women denied incontinence and 10% of women reported a previous pregnancy complication (Zafar 2015). Overall, in 1732 women assessed in Malawi, when symptoms and signs elicited on clinical examination were bundled, 28.8% of women had one non-infective morbidity, 1.2% had two non-infective morbidities; and 0.2% had three non-infective morbidities (Zafar 2015).

Types and prevalence of physical non-infectious morbidity in 1727 women assessed in Pakistan included: anaemia (35.3%); nausea and vomiting (18.8%); incontinence (4.7%); antepartum haemorrhage (4.1%); asthma (1.4%); pre-eclampsia (0.8%); epilepsy (0.8%); (Zafar 2015). Overall, in 1727 women assessed in Pakistan, when symptoms and signs elicited on clinical examination were bundled, 34.4% of women had one non-infective morbidity, 6.9% had two non-infective morbidities and 1.8% had three non-infective morbidities (1.8%) (Zafar 2015). Overall, 1 in 5 women in Pakistan reported a previous pregnancy complication (Zafar 2015).

Types and prevalence of physical infectious morbidity in 1732 women assessed in Malawi included: HIV positive status (16.0%); malaria (8.2%); possible sexually transmitted infection (7.5%); possible urinary tract infection (5.4%); fever (2.4%); and suspected TB (0.8%) (Zafar 2015). Overall, in 1732 women assessed in Malawi, when symptoms and signs elicited on clinical examination were bundled, 25.9% of women

had one infective morbidity, 5.4% had two infective morbidities and 1.3% had three infective morbidities (1.3%) (Zafar 2015).

Types and prevalence of physical infectious morbidity in 1727 women assessed in Pakistan included: possible STI (14.9%); suspected TB (10.0%); possible UTI (8.2%); HIV positive status (6.3%); fever (3.1%); malaria (2.7%); and hepatitis (1.6%) (Zafar 2015). Overall, in 1727 women assessed in Pakistan, when symptoms and signs elicited on clinical examination were bundled, 21.1% of women had one infective morbidity, 6.4% had two infective morbidities and 4.1% had three infective morbidities (Zafar 2015).

The authors of the Zafar et al study highlighted that as a combined study sample (Malawi and Pakistan), multiple morbidities were uncommon in women (<10%), (Zafar 2015).

Table 2.6 summarises the reported prevalence for each reported physical morbidity in the included studies. All studies reported more than one type of physical morbidity. The different types of physical morbidity are categorised as those relating to the (1) woman (2) fetus/neonate or (3) as “other” descriptions or measures. For ease of readability, the different conditions in each section are listed in alphabetical order.

Table 2.6: Summary table of prevalence of physical morbidity

Physical morbidity (as per authors description)		Reported prevalence (%)
Specific condition related to the women	Abdominal pain	17.0
	Abnormal vaginal discharge	25.0
	Abortion	1.0; 22.0
	Anaemia	18.7; 19.0; 35.3; 39.5; 52.0
	Antepartum haemorrhage	3.1; 4.1; 31.0
	Asthma	1.0; 1.4
	Bacterial vaginosis	31.0
	Breast problems	5.0
	Burning during urination	2.0
	Caesarean section	1.7; 24.4; 27.2
	Candida	7.0
	Continuous dripping of urine	0.33
	Dysuria	10.0
	Epilepsy	0.3; 0.8
	Episiotomy	16.2
	Febrile symptoms	6.0
	Fever	2.4; 3.1; 13.1
	Gastroenteritis	22.1
	Genital tract trauma	90.6
	Gestational diabetes	51.0*
	Hepatitis	1.6
	HIV positive	3.0; 6.3; 10.8; 16.0
	Hypertension	13.0
	Incontinence	0.0; 1.0; 4.7
	Malaria	2.7; 8.2; 15.9
	Mid; upper arm circumference <23cms (maternal malnutrition)	68.1
	Miscarriage	8.8
	Nausea and vomiting	18.8; 19.1
	Nitrites in urine	4.0
	Pneumonia	4.9
	“Poor/bad global health”	3.8
	Pre-eclampsia	0.2; 0.8
	Premature rupture of the membranes	0.1
Preterm labour	30.3	
Prolapse	2.2	
Reproductive infection	2.5	
Severe anaemia	5.0	
Severe headache	14.2	
Sexually transmitted infection	7.5; 14.9	
Stress incontinence	3.2	
Trichomonas vaginalis	7.0	

	Tuberculosis (suspected)	0.8; 10.0
	Urinary leakage	1.0
	Urinary tract infection	5.4; 6.0; 8.2 14.5
Specific condition related to the fetus/neonate	Neonatal death	3.7; 17.2; 25.0
	Low birth weight	7.0; 7.1; 17.0
	Preterm labour	30.3
	Preterm birth	6.9
	Stillbirth	4.3
“Other” descriptions/ measures of physical morbidity	Antenatal hospitalization	55.4
	At least one self-reported physical complaint	44.0
	Genital infections (vaginal discharge)	8.0
	Gynaecological problems (genital infection, uterine prolapse, cystocele, complications of episiotomy)	22.0
	Gynaecological and obstetric problems (sexual problems, uterine prolapse, and infected episiotomy)	10.0
	Infective morbidity - One condition	21.1; 25.9
	Infective morbidities - Two conditions	5.4; 6.4
	Infective morbidities - Three conditions	1.3; 4.1
	Medical condition diagnosed by a healthcare provider	60.0
	More than one medical condition diagnosed by a healthcare provider	9.0
	Multiple morbidities	<10.0
	Non-infective morbidity - one condition	28.8; 34.4
	Non-infective morbidities -two conditions	1.2; 6.9
	Non-infective morbidities -three conditions	0.2; 1.8
	Previous pregnancy complication	0.0; 15.4; 20.0
	“Problems” in the antepartum stage	46.3
	“Problems” at delivery	35.1
“Problems” in the postpartum stage	30.5	

*in pre-selected population of women with gestational diabetes.

Table 2.6 shows that there is a wide range of different types of physical morbidity assessed in the included studies, with wide ranges of prevalence for some conditions. Some descriptions of physical morbidity were described as aggregates or a

summative condition, for example, in one study gynaecological problems included “genital infection, uterine prolapse, cystocele, bad repair of an episiotomy”. Only one study used antenatal hospitalisation as a “proxy” for physical morbidity. The difference in the prevalence of physical morbidities may be due to different data collection tools; different population groups; and assessment at different stages of the pregnancy. These factors are explored in the discussion section of this chapter.

In this part of the results section so far, the types of physical morbidity and the prevalence of the types of physical morbidity described in the included studies have been reported.

In the following section of this results section, the data collection tools used, and prevalence of psychological maternal morbidities reported in the included studies are described. The associations between the different types of maternal morbidity are described separately at the end of the results section of this chapter.

Psychological morbidity

In total, 14 studies assessed psychological morbidity and depression was the most commonly assessed aspect of maternal mental health. Of these 14 studies, three assessed anxiety and depression (Karmalianai 2009, Nasreen 2011, Stewart 2014). One study assessed “distress” (Prost 2012), and one study assessed depression and psychological distress (Rees 2016).

Across the 14 studies that assessed psychological morbidity, twelve internationally recognised data collection tools were used either alone or in combination with other data collection tools. A table of the data collection tools used in the included studies, with an explanation of the purpose, the country of origin, the author and date of first publication of the data collection tool is displayed in **Table 2.7**. Many of the data collection tools used to assess psychological morbidity were originally developed in English and validated in high-income countries.

Two studies stated clearly that the authors used a locally adapted and validated version of the Edinburgh Postnatal Depression Score (EPDS) (Nasreen 2011, Tsai 2016). In other studies, there was little if any, information regarding the process of translation and back-translation of established data collection tools. The quality of the translation is therefore uncertain in studies, and this impacts the validity of the data collected in this way.

Table 2.7: Description of data collection tools used in included studies to assess psychological morbidity

No.	Data collection tool to assess psychological morbidity	International abbreviation	Details	Original country, author and date
1.	Aga Khan University Anxiety and Depression Scale	AKUADS	The Aga Khan University Anxiety and Depression Scale is an indigenous screening scale developed at the Aga Khan University, Karachi, Pakistan. AKUADS is in Urdu, a language which is widely understood and spoken in Pakistan and India. It has been developed from a list of complaints collected by a retrospective file review of symptoms mentioned in Urdu by patients of anxiety and depression coming to the Community Health Center (CHC) of AKU. It is a 25-item questionnaire which includes 12 psychiatric and 13 somatic symptoms. It is a differential scale which is rank ordered for severity and inquiries about the presence and severity of psychiatric and somatic symptoms of anxiety and depression over a period of last two weeks. It has been validated in a community setting in Pakistan (Ali 1988).	Pakistan, Ali 1988
2.	Clinical Interview Schedule-Revised	CIS-R	The Clinical Interview Schedule-Revised can be used to assess common mental disorders. In the CIS-R, 14 different symptom groups are enquired after in the previous month, focusing on symptoms experienced within the last week. The 14 symptoms enquired are: (1) somatic symptoms; (2) fatigue; (3) sleep problems; (4) irritability; (5) physical health worries; (6) depression; (7) depressive ideas; (8) worry; (9) anxiety; (10) phobias; (11) panic; (12) compulsive behaviours; (13) obsessive thoughts; (14) forgetfulness/concentration problems. Scores on each symptom group ranged from 0 to 4 (and 0 to 5 for depressive ideas), with higher scores indicating higher levels of symptomatology (Lewis 1992).	USA, Lewis 1992

3.	Edinburgh Postnatal Depression Scale	EPDS	The 10-question Edinburgh Postnatal Depression Scale is a valuable and efficient way of identifying patients at risk for perinatal depression. The EPDS is easy to administer and has proven to be an effective screening tool. Mothers who score above 13 are likely to be suffering from a depressive illness of varying severity. The EPDS score does not override clinical judgment. A careful clinical assessment should be carried out to confirm the diagnosis. The scale indicates how the mother has felt during the previous week. In doubtful cases, it may be useful to repeat the tool after two weeks. The scale will not detect mothers with anxiety neuroses, phobias or personality disorders (Cox 1987).	UK, Cox 1987
4.	Harvard Trauma Questionnaire	HTQ	The Harvard Trauma Questionnaire is a checklist that enquires about a variety of torture, and traumatic events, as well as the emotional symptoms considered to be uniquely associated with trauma, post-traumatic stress disorder (Mollica 1992).	USA, Mollica 1992
5.	Kessler-10 item psychological distress scale	K-10	This is a 10-item questionnaire intended to yield a global measure of distress based on questions about anxiety and depressive symptoms that a person has experienced in the most recent 4-week period (Kessler 2002).	USA, Kessler 2002
6.	List of Threatening Experiences questionnaire	LTE-Q	List of Threatening Experiences questionnaire includes a subset of 12 life event categories with considerable long-term contextual threat (Brugha 1985).	UK, Brugha 1985
7.	Montgomery-Åsberg Depression Rating scale	MADRA	The Montgomery-Åsberg Depression Rating Scale (MADRS) is a ten-item diagnostic questionnaire which psychiatrists use to measure the severity of depressive episodes in patients with mood disorders (Montgomery 1979).	UK, Montgomery 1979
8.	Patient Health Questionnaire	PHQ-9	The Patient Health Questionnaire (PHQ) has nine questions and is used to make criteria-based diagnoses of depressive and other mental disorders commonly encountered in primary care (Spitzer 1992).	USA, Spitzer 1992

9.	Self-Reporting Questionnaire-(20 Items)	SRQ-20	The Self-Reporting Questionnaire is a 20-item self-report screening tool developed by the World Health Organization specifically for the LMIC primary healthcare setting. It employs a yes/no answer format and is designed to detect non-specific psychological distress, including suicidal ideation (Beusenberg 1994).	WHO, Switzerland, Beusenberg 1994
10.	State-Trait Anxiety Inventory	STAI	The State Anxiety Scale evaluates the current state of anxiety, asking how respondents feel “right now,” using items that measure subjective feelings of apprehension, tension, nervousness, worry, and activation/arousal of the autonomic nervous system. The STAI has 40 items, 20 items allocated to each of the S-Anxiety and T-Anxiety subscales (Spielberger 1983).	USA, Spielberger 1983
11.	Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition	SCI- DSM IV	DSM-IV codes are the classification found in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision, also known as DSM-IV-TR, a manual published by the American Psychiatric Association that includes all currently recognized mental health disorders (American Psychiatric Association 1994).	USA, American Psychiatric Association 1994
12.	WHO version of the Centre for Epidemiological Studies Depression scale	CES-DR	The 20 items in CESDR scale measure symptoms of depression in nine different groups as defined by the American Psychiatric Association Diagnostic and Statistical Manual, fifth edition. It is a 20-item measure that asks caregivers to rate how often over the past week they experienced symptoms associated with depression, such as restless sleep, poor appetite, and feeling lonely (Radloff 1977).	USA, Radloff 1977

Prevalence of psychological morbidity

In the following results section, the data collection tools used and prevalence of psychological morbidity reported are described for each included study.

Assarag et al adapted questions from a WHO report in 2001. Questions used to identify psychological morbidity included screening for symptoms such as “feeling negative about yourself, crying easily, decreased interest or pleasure in daily activities” in the last two weeks that represented a change from normal (Assarag 2013). Assarag et al reported that 10% of women reported mental distress (anxiety, unexplained crying, nervousness) (Assarag 2013).

Brittain et al used the EPDS score to measure psychological morbidity and reported 19% of 623 HIV positive pregnancy women had a EPDS score ≥ 10 and 11% had a EDPS score ≥ 13 (Brittian 2017). Chersich et al used ICD-10 definitions for mild and major depression and reported 2% of 500 postnatal women had major depression (Chersich 2009). Faisal-Cury et al used the Clinical Interview Schedule-Revised version and reported a prevalence of common mental disorders as 20.2% in 831 pregnant women (Faisal-Cury 2009).

Karmaliani et al used the Aga Khan University Anxiety Depression Scale to assess psychological distress and reported that 18% of 1368 pregnant women had anxiety and/or depression (Karmaliani 2009). Hanlon et al used the Self-Reporting Questionnaire-20 Items (SRQ-20) to assess symptoms of antenatal common mental disorders and used the List of Threatening Experiences (LTE) questions to assess stressful life events during pregnancy for 1065 women (Hanlon 2009). Women were asked whether they were worried about the forthcoming delivery. High symptom levels (SRQ scores ≥ 6) were present in 128 women (12.0%), low symptoms (SRQ scores 1–5) were present in 634 women (59.5%) and no symptoms (SRQ = 0) in 303 (28.5%) of women (Hanlon 2009).

Nasreen et al used the EPDS to measure depression and reported a EPDS score ≥ 10 in 18% of 720 pregnant women (Nasreen 2011). The authors stated that the EPDS questionnaire had previously been validated for use in Bangladesh using the national language (Gausia 2007). In this study, Nasreen et al also used the State-Trait Anxiety Inventory (STAI) to assess general anxiety and reported anxiety in 29% of 720 pregnant women (Nasreen 2011). Natasha et al used the Montgomery-Åsberg Depression Rating Scale (MADRS) to assess depression and reported 18.3% of 748 pregnant women were depressed (Natasha 2015). Prost et al used Kessler-10 item scale to measure psychological distress and reported 11.5% of 5801 women had symptoms of distress (Kessler score >15).

Rees et al used a combination of three data collection tools: the EPDS, the Kessler-10 item scale and the Harvard Trauma Questionnaire to assess different types of psychological morbidity (Rees 2016). In 1672 women, 19.7% had a EPDS score ≥ 13 ; 6.3% had a Kessler (K10) score ≥ 30 ; 5.7% had post-traumatic stress disorder score ≥ 2 ; and overall, 24.1% had symptoms of any type of mental distress (Rees 2016).

Shamu et al assessed 842 women using the WHO version of the Center for Epidemiologic Studies Depression Scale (CES-D) and reported one in five postnatal women (21.4%) met the diagnostic criteria for postnatal depression symptomatology whilst 21.6% reported postpartum suicide thoughts and 4% reported suicide attempts (Shamu 2016).

Stewart et al measured psychological morbidity using validated local versions of the Self-Reporting Questionnaire (SRQ). In a sub-sample, Diagnostic Statistical Manual (DSM)-IV diagnoses of major and minor depressive disorders were made using the Structured Clinical Interview for DSM-IV. In this study, 10.7% of 538 pregnant women reported major depression and 10.4% reported minor depression (Stewart 2014).

Surkan et al conducted secondary data analysis on a database of 39,000 women to assess postpartum depressive symptoms based on questions about the women's experiences in the prior six months, at the time of data collection. The authors

created their own five-item scale based on items modified from the Patient Health Questionnaire (PHQ-9) and the CES-D (Surkan 2017). A standard suicidal ideation question was also added. Independent translation and back translation was used and the items were piloted in focus group discussions to ensure their adequate translation, cultural relevance, and understandability. The five-item scale included: feeling sad all the time; becoming more forgetful; crying all the time; having thoughts of hurting oneself; and not wanting to bathe or eat for several days (Surkan 2017). Using these questions, 13.5% of 39,000 women experienced high depressive symptoms (3–5 symptoms) (Surkan 2017).

Tsai et al used the Xhosa version of the EDPS to screen for depression in 1328 women and reported 39.5% of women screened positive for depression. It is not clear what the cut off score for depression was used in this study (Tsai 2016).

Ukachukwu et al used their own questionnaire to extract data from medical case notes and reported that psychological disorders constituted 5.3% of reported postpartum complications among 1716 women (Ukachukwu 2009).

Zafar et al used the EPDS questionnaire to assess depression (as a cut off score >9) and reported depression in 2.6% of women in Malawi and 26.9% of women in Pakistan (Zafar 2015).

Table 2.8 below displays the summary of reported prevalence of psychological morbidity in the included studies. Different types of psychological morbidity with varying severity were assessed in the included studies, with wide ranges of prevalence for some conditions. Different studies used various cut-off scores to indicate depression in the EPDS and to indicate distress in the Kessler scale. Some descriptions of psychological morbidity were described as aggregates or a summative condition, for example, terms such as “common mental disorders” and “symptoms of any mental distress” were used to report prevalence.

Table 2.8: Summary table of prevalence of psychological morbidity

Psychological morbidity (author description)		Reported prevalence (%)
Anxiety	Anxiety	29.0
Depression	“Depression”	13.5; 18.3; 21.4; 39.5
	EPDS score >9	2.6; 26.9
	EPDS score ≥10	18.0; 19.0
	EPDS score ≥13	11.0; 19.7
	Minor depression	10.4
	Major depression	2.0-10.7
Suicidal ideation	Postpartum suicide thoughts	21.6
	Attempted suicide	4.0
Distress	Distress (Kessler score >15)	11.5
	Distress (Kessler score >30)	6.3
	Post-traumatic stress disorder score ≥2	5.7
Stress	High symptom levels (SRQ scores ≥6)	12.0
	Low symptoms (SRQ scores 1–5)	59.5
	No symptoms (SRQ = 0)	28.5
More than one condition	Anxiety and/or depression	18.0
	Mental distress (anxiety, unexplained crying, nervousness)	10.0
	“Common mental disorders”	20.2
	Psychological disorders	5.3
	Symptoms of any type of mental distress	24.1

In this part of the results section so far, the data collection tools used, the types of psychological morbidity and the prevalence of the types of psychological morbidity described in the included studies have been reported. There is a wide range of symptoms and signs considered to be “psychological morbidity” and in addition, definitions of psychological morbidity vary. Finally, different data collection tools with different cut-off point, even for the same tool have been used to denote “depression”.

In the following part of this results section, the data collection tools used, and prevalence of social morbidities related to maternal ill-health during and after pregnancy reported in the included studies is described. The associations between the different types of maternal morbidity are described separately at the end of the results section of the chapter.

Social morbidity

In total, 20 studies assessed at least one form of social morbidity. The most commonly assessed type of social morbidity was domestic violence in 12 studies (Chersich 2009, Karmaliana 2009, Hassan 2014, Hanlon 2009, Nasreen 2011, Ntaganir 2008, Romero-Gutiérrez 2011, Rees 2016, Shamu 2014, Shamu 2016, Stöckl 2010, Tsai 2016). Substance misuse was assessed in six studies, mostly alcohol abuse (Faisal-Cury 2009, Isaken 2015, Hassan 2014, Hanlon 2009, Prost 2012, Wong 2017). Different forms of social morbidity were also assessed in three studies (Brittian 2017, Wado 2014, Waqas 2015). These different types of social morbidity included measures of social support and unplanned pregnancy.

In the following part of the results section of this chapter, each form of social morbidity is described, including the data collection tool used, and the prevalence reported in the included studies.

Domestic violence

A total of 12 studies assessed domestic violence, and there were various types of data collection tools used and described. Most authors used their own definitions and questions to screen for domestic violence and other authors used all or part of internationally recognised questionnaires. A table of the three data collection tools used in the included studies, with an explanation of the purpose, the country of origin, the author and date of first publication of the data collection tool is displayed in **Table 2.9**. All were developed in English and validated in high income countries.

Table 2.9: Description of data collection tools used in included studies to assess social morbidity

Data collection tool to assess psychological morbidity	Type of social morbidity assessed	International abbreviation	Details	Country of origin, author, date
Index of Spousal Abuse	Domestic violence	ISA	The Index of Spousal Abuse (ISA) is a 30-item self-report scale developed to measure the severity of physical and non-physical aggression inflicted on a woman by her spouse or partner (Hudson 1981).	USA, Hudson 1981
Severity of Violence against Women scale	Domestic violence	SVAWS	The Severity of Violence Against Women Scales (SVAWS) is a 46-item scale to assess the frequency and severity of physical aggression against women by their male partners. The main purpose of the SVAWS is to tap, in a comprehensive manner, the psychological effects of intimate partner abuse. This scale has subscales that differ in the degree of severity (i.e., threats of violence, acts of violence, and sexual aggression). These scales can be further categorized into nine dimensions with each item weighted for severity (Marshall 1992).	USA, Marshall 1992
Questionnaire from the WHO Multi-country study on Women's Health and Domestic Violence against Women	Domestic violence	Not applicable	The WHO have developed an extensive questionnaire consisting of a household questionnaire, and a woman's questionnaire. The woman's questionnaire has 12 sections to obtain details about the woman and her community, her general and reproductive health, her financial autonomy, her children, her partner, her experiences of partner and non-partner violence, and the impact of violence on her life. This questionnaire was used in the WHO multi-country study WHO Multi-country study on Women's Health and Domestic Violence against Women in 2005 (WHO 2005).	WHO, Geneva 2005

Prevalence of domestic violence

The prevalence of domestic violence and data collection tools used (if any) are described below for included studies.

Chersich et al did not describe the source of questions used to assess domestic violence but reported 21% of 500 women self-reported intimate partner violence (Chersich 2009). Karmaliana et al used their own questions to assess domestic violence and 15% of women reported physical and/or sexual abuse and 30% of women reported verbal abuse in this study (Karmaliana 2009).

Hassan et al developed their own screening questions regarding sexual abuse by a partner, and defined a woman with at least one positive response to any of the questions regarding physical, emotional or sexual violence as a “woman experiencing violence” (Hassan 2014). In this study, 72% of 1300 women self-reported that they had experienced intimate partner violence during their last pregnancy (Hassan 2014). Hanlon et al used their own questions and reported that 2.3% of 1065 women self-reported physical assault during pregnancy (Hanlon 2009).

Nasreen used their own questions to assess intimate partner violence and reported that 79.2% of 720 women had experienced forced sex; 33.8% of women reported multiple acts of physical violence; and 18.1% had experienced physical violence during pregnancy (Nasreen 2011). Ntaganir et al used their own questions to assess intimate partner violence and reported 35.4% of 600 women reported intimate partner violence in the past 12 months (Ntaganir 2008).

Romero-Gutiérrez et al used the Index of Spousal Abuse (ISA) and the Severity of Violence against Women scale (SVAW) to assess domestic violence and reported that 43.8% of 1623 women self-reported violence during pregnancy. Of these women 79.1% experienced mild violence and 20.9% experienced severe violence (Romero-Gutiérrez 2011). Rees et al used the WHO measurement to assess intimate partner violence and reported that only 10.8% of 1672 women reported no abuse, and 32.9%

did not feel respected. Overall, in this study 30.6% of women reported severe psychological abuse; 6.2% reported physical abuse and 19.5% reported both physical and psychological abuse (Rees 2016).

Shamu et al used the WHO measurement to assess intimate partner violence and reported that 60% of 842 women reported at least one episode of physical, sexual or emotional intimate partner violence in the past 12 months (Shamu 2014). The same authors state that 65.4% of women reported any form of intimate partner violence in another publication (Shamu 2016). Stöckl et al categorised a woman as having experienced violence during pregnancy if she answered yes to the question “Was there ever a time when you were beaten or physically assaulted by (any of) your partner(s) whilst you were pregnant?”. Based on this question 19% of women reported having experienced violence during pregnancy (Stöckl 2010).

Tsai et al enquired about the “frequency with which a woman’s current or previous intimate partner had, during the past 12 months, slapped or thrown anything at her; pushed or shoved her; hit her with a fist or another object; or threatened or attacked her with a gun, knife, or other weapon”. Responses were scored on a four-point Likert type scale ranging from 1 (“never”) to 4 (“many”). At this baseline assessment of this study, the prevalence of intimate partner violence varied and was reported as a range of 4.4-30.2% in 1328 pregnant women (Tsai 2016).

Table 2.10 displays the summary of reported prevalence of social morbidity in the form of domestic violence reported in included studies. Different types of domestic violence with varying severity were assessed in the included studies, with wide ranges of prevalence for some conditions. Some descriptions of domestic violence were described as aggregates or a summative condition, for example, terms such as “multiple acts of physical violence”, “physical and/or sexual abuse”, and “physical and psychological abuse” were used to report prevalence.

Table 2.10: Summary table of prevalence of social morbidity (domestic violence)

Social morbidity	Reported prevalence (%)	
One form of domestic violence	Disrespect	32.9
	Forced sex	79.2
	Intimate partner violence	21.0; 35.4;
	Physical assault	2.3; 4.4; 6.2; 18.1; 19.0; 30.2
	Severe psychological abuse	30.6
	Verbal abuse	30.0
	Violence (no details of type)	43.8
Combination of types of domestic violence	At least one form of physical, emotional or sexual violence	60.0; 72.0
	Multiple acts of physical violence	33.8
	Physical and/or sexual abuse	15.0
	Physical and psychological abuse	19.5

Substance misuse

A total of seven studies assessed one or more forms of substance misuse and four different types of internationally recognised data collection tools were used. A table of the three data collection tools used in the included studies, with an explanation of the purpose, the country of origin, the author and date of first publication of the data collection tool is displayed in **Table 2.11**. All were developed in English and validated in high income countries.

Table 2.11: Description of data collection tools used in included studies to assess social morbidity

Data collection tool to assess psychological morbidity	Type of social morbidity assessed	International abbreviation	Details	Country of origin, author, date
Alcohol Use Disorders Identification Test	Alcohol use	AUDIT	The full AUDIT provides 10 alcohol identification questions, and is a simple method of screening for excessive drinking and to assist in brief assessment. It can help identify excessive drinking as the cause of the presenting illness. It provides a framework for intervention to help risky drinkers reduce or cease alcohol consumption and thereby avoid the harmful consequences of their drinking. The AUDIT also helps to identify alcohol dependence and some specific consequences of harmful drinking (Babor 2001).	WHO, Switzerland, Babor 2001
Maternity Social Support Index	Social support	MSSI	The Maternal Social Support Index is a 21-item questionnaire designed to quickly assess qualitative and quantitative aspects of a mother's social support (Pascoe 1988).	USA, Pascoe 1988
Social Provisions Scale	Social support	SPS	To examine the degree to which respondent's social relationships provide various dimensions of social support. The instrument contains 24 items, four for each of the following: attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance. Half of the items describe the presence of a type of support and the others describe the absence of a type of support (Cutrona 1990).	USA, Cutrona 1987

Chersich et al used the Alcohol Use Disorders Identification Test (AUDIT) tool for harmful alcohol use and reported that less than 10% of 500 women reported any alcohol use during or after pregnancy (Chersich 2009). Faisal-Cury et al used their own questions to assess alcohol and tobacco use, did not report the actual prevalence but did report that substance misuse was higher in women with common mental disorders (Faisal-Cury 2009). Hassan et al assessed tobacco use in 1300 women and reported that 52.6% of pregnant women were smokers (Hassan 2014). Hanlon et al used their own questions to assess substance misuse and reported that 5.0% of women used alcohol weekly or more, and 12.9% of women used “khat” (a local plant stimulant), weekly or more (Hanlon 2009). Isaken et al conducted a secondary data analysis of a database of 34,090 women and reported that alcohol consumption in women during pregnancy decreased from 49.5% in 2000 to 21.5% in 2010 (Isaken 2015). Prost et al used their own questions to assess alcohol use and reported that 43.9% of 5801 women used a local form of alcohol “handia” in pregnancy (Prost 2012). Wong et al used the AUDIT tool to assess alcohol misuse and reported that among 625 HIV positive women, 21% reported alcohol-related harm and 16% reported risky alcohol use (Wong 2017).

Table 2.12 displays the summary of reported prevalence of social morbidity in the form of substance misuse in included studies. Different types of substances were assessed in the included studies, with wide ranges of prevalence for alcohol use.

Table 2.12: Summary table of prevalence of social (substance use) morbidity

Substance misuse (author description)		Reported prevalence (%)
Alcohol	Alcohol use	5.0; 10.0; 21.5; 43.9; 49.5
	Alcohol-related harm	21.0
	Risky alcohol use	16.0
Stimulants	“Khat” (stimulant)	12.9
Tobacco	Smoker	52.6

Other forms of social morbidity assessed

Wado et al used the Maternity Social Support Scale (MSSS) to assess social support but did not report prevalence (Wado 2014). Waqas et al used the Social Provision Scores (SPS) to assess social morbidity but did not report prevalence. They did report that 73.0% of women had an unplanned pregnancy (as a suggested form of possible social morbidity) (Waqas 2015).

Associations between types of morbidity

Overall, most (18) studies reported on associations (or not) between the two or more types of maternal morbidity, as defined for this systematic review. Studies used the odds ratio, adjusted odds ratio, risk ratio and logistic regression, univariate and/or multivariate analysis to present the strength of the associations.

One study assessed the association between physical infectious and social morbidity (Shamu 2014). Seven studies assess associations between physical medical/obstetric and psychological morbidity (four studies report association that were statistically significant; three report association that were not) (**Table 2.13**). Three studies assess the association between physical medical/obstetric and social morbidity (Hassan 2014, Romero-Gutiérrez 2011, Surkan 2017). Five studies assess the association between psychological and social morbidity (Karmalian 2009, Nasreen 2011, Rees 2016, Tsai 2016, Stockl 2010). One study assessed the association between adverse pregnancy outcomes and psychological morbidity as the main finding (Prost 2012).

Table 2.13 reports the details of associations between the different types of morbidity and the strength of these associations. For ease of readability, the main associations are presented below. More details for each study are in **Summary Table** in **Appendix 1** and **Appendix 2**.

Shamu et al reported that positive HIV status was associated with domestic violence (Shamu 2014). Surkan et al reported (in models adjusted for sociodemographic

factors and co-morbidities), all postpartum illnesses were associated with an increased relative risk of depressive symptoms by 6 months postpartum (Surkan 2017). The risk ratio for each postpartum physical illness is in **Table 2.13**. Zafar et al reported that complications during a previous pregnancy, infective morbidity, intra or postpartum haemorrhage were associated with psychological morbidity in both Malawi and Pakistan (Zafar 2015). Other associations are detailed in **Table 2.13**.

Faisal-Cury et al reported that obstetric complications were independently associated with common mental disorders during pregnancy; but were not associated with risk of preterm birth or low birth weight. Karmaliana et al reported that psychological distress was associated with an unwanted pregnancy (as a possible measure or proxy for social morbidity). Hanlon et al reported that increasing levels of antenatal common mental disorders symptoms were associated both with prolonged labour >24 hours and delayed initiation of breast-feeding (Hanlon 2009).

Nasreen et al reported that partner violence showed strong associations with depression and anxiety (Nasreen 2011). Natasha et al reported no statistically significant association between depression and gestational diabetes (Natasha 2015). Prost et al reported that an unwanted pregnancy, small perceived infant size and a stillbirth or neonatal death were all independently associated with an increased risk of psychological distress in the postnatal stage (Prost 2012). The loss of an infant or an unwanted pregnancy increased the risk of psychological distress considerably (Prost 2012). Rees et al reported that for women who reported four or more traumatic events, and either physical abuse alone or in combination with severe psychological abuse, there was a 10-fold increase in depressive and other mental health symptoms (Rees 2016).

Tsai et al reported that after multivariable adjustment, intimate partner violence intensity had a strong and statistically significant association with depression symptom severity (Tsai 2016). Wado et al reported that an unwanted pregnancy, prenatal depression and social support were associated with low birth weight (Wado 2014). Waqas et al reported that higher anxiety scores were significantly associated

with less social support, abortion, Caesarean delivery and unplanned pregnancies (Waqas 2015). Wong et al reported that thoughts of self-harm were likely in younger women with HIV, compared to older women with HIV (Wong 2017).

Hassan et al reported a significant association between domestic violence and preterm labour, Caesarean section, antenatal hospitalization and vaginal bleeding (Hassan 2014). Romero-Gutiérrez et al reported that women who had obstetric complications were more likely to have experienced domestic violence. Women who experienced sexual violence were more likely to report maternal complications, and women who experienced psychological violence were more likely to report neonatal complications (Romero-Gutiérrez 2011). The odds ratios were not reported for these associations. Stöckl et al reported that women were more likely to drink alcohol during their last pregnancy if they had experienced violence during pregnancy. Violence during pregnancy was also associated with having had a child or infant that died. Violence during any pregnancy was not significantly associated with ever having had a miscarriage, or low birthweight of the last-born child (Stöckl 2010).

Table 2.13: Reported associations between types of maternal morbidity and reported strength of these associations

Main type of morbidity	Name of study	Country	Study design	Associations between different types of morbidity and strength of the association
Physical	Shamu 2014	Zimbabwe	Cross sectional	Positive HIV status was associated with intimate partner violence: partially adjusted OR 1.43: (95%CI:1.00-2.05).
	Surkan 2017	Bangladesh	Population based	In models adjusted for sociodemographic factors and co-morbidities, all postpartum illnesses were associated with an increased relative risk of depressive symptoms by 6 months postpartum. These morbidities included uterine prolapse (RR 1.20, 95% CI 1.04–1.39), urinary tract infection (RR 1.24, 95% CI 1.11–1.38), stress related incontinence (RR 1.49, 95% 1.33–1.67), simultaneous SRI and continuously dripping urine (RR 1.60–2.96), headache [RR 1.20 (95% CI 1.12–1.28)], convulsions (RR 1.67, 95%CI 1.36–2.06), night blindness (RR 1.33, 95% CI 1.19–1.49), anemia (RR 1.38, 95% CI 1.31–1.46), pneumonia (RR 1.24, 95% CI 1.12–1.37), gastroenteritis (RR 1.24, 95% CI 1.17–1.31) and hepatobiliary disease (RR 2.10, 96% CI 1.69–2.60).
	Zafar 2015	Malawi and Pakistan	Cross sectional	Multivariate logistic regression showed that for Malawi, after controlling for parity and pregnancy stage, antepartum bleeding increased the odds of psychological morbidity 5-fold (OR: 5.01; 95% CI 1.60, 15.70; p=0.006). Infective morbidity (i.e. for each additional infective morbidity) showed more than 2.5-fold increase in the odds of having psychological morbidity (OR: 2.58; 95% CI 1.92, 3.47; p=0.000). For Pakistan, results show a 56% increase in odds of psychological morbidity due to increasing burden of infective morbidity (OR: 1.56; 95% CI 1.36, 1.79; p = 0.000), and 78% increased odds due to increasing burden of non-infective morbidity (OR: 1.78; 95% CI 1.51, 2.11; p = 0.000), when controlling for the effect of complication during a previous pregnancy. Complications during a previous pregnancy, infective morbidity (p <0.001), intra or postpartum haemorrhage (p<0.02) were associated with psychological morbidity in both settings.

Psycho-logical	Faisal-Cury 2009	Brazil	Prospective observational	Age at current pregnancy and at first delivery, not having friends in the community, living in a crowded household, lower occupational status and history of previous psychiatric treatment was all independently associated with increased prevalence of common mental disorders. Current obstetric complications were independently associated with common mental disorders. Common mental disorders during pregnancy was not associated with risk of preterm birth (adjusted OR:1.03, 95% CI: 0.57-1.88) or low birth weight (adjusted OR:1.09, 95% CI: 0.62-1.91)
	Faisal-Cury 2010	Brazil	Prospective observational	Common mental disorders during pregnancy was not associated with risk of preterm birth (adjusted OR:1.03, 95% CI: 0.57-1.88) or low birth weight (adjusted OR:1.09, 95% CI: 0.62-1.91)
	Karmaliana 2009	Pakistan	Prospective observational	Psychological distress was associated with husband unemployment (p = 0.032), lower household wealth (p = 0.027), having 10 or more years of formal education (p = 0.002), a first (p = 0.002) and an unwanted pregnancy (p <0.001).
	Hanlon 2009	Ethiopia	Prospective observational	Increasing levels of antenatal common mental disorders symptoms were associated both with prolonged labour (>24 h) (SRQ 1-5: RR 1.4; 95% CI 1.0-1.9, SRQ ≥ 6: RR 1.6; 95% CI 1.0-2.6)
	Nasreen 2011	Bangladesh	Cross sectional	Women's literacy, poor household economy, poor relationship with husbands, and partner violence showed strong associations with depression and anxiety.
	Natasha 2015	Bangladesh	Cross sectional	No association with depression and gestational diabetes mellitus with other obstetric factors.
	Prost 2012	India	Cross sectional	Unwanted pregnancy for the mother, small perceived infant size and a stillbirth or neonatal death were all independently associated with an increased risk of psychological distress. The loss of an infant or an unwanted pregnancy increased the risk of distress considerably (AORs: 7.06 95% CI: 5.51-9.04 and 1.49, 95% CI: 1.12-1.97 respectively).

Rees 2016	Timor- Leste	Cross sectional	For any mental distress, the adjusted odds ratios for four or more traumatic events and severe psychological abuse was 3.60 (95% CI 2.08-6.23); for four or more traumatic events and physical abuse 7.03 (95% CI 3.23-15.29); and for four or more traumatic events and severe psychological and physical abuse the adjusted OR was 10.45 (95% CI 6.06-18.01). Of women who reported four or more traumatic events, and either physical abuse alone or in combination with severe psychological abuse, there was a 10-fold increase in depressive and other mental health symptoms.
Tsai 2016	South Africa	Secondary data analysis of population based longitudinal study	After multivariable adjustment, intimate partner violence intensity had a strong and statistically significant association with depression symptom severity, regardless of the specification.
Wado 2014	Ethiopia	Prospective observational	Results of unadjusted log-binomial regression showed that unwanted pregnancy, prenatal depression and social support were associated with LBW. The relationship between antenatal depressive symptoms and LBW was mediated by the presence of social support, while the association between LBW and unwanted pregnancy remained after multivariable adjustment.
Waqas 2015	Pakistan	Cross sectional	Inferential analysis revealed that higher HADS scores were significantly associated with lower scores on the SPS, rural background, history of harassment, abortion, Caesarean delivery and unplanned pregnancies ($P < .05$). Social support (SPS score) mediated the relationship between the total number of children, gender of previous children and HADS score.
Wong 2017	South Africa	Cross sectional	Report of self-harming thoughts was 11 % in younger and 4 % in older women ($p = 0.002$).

Social	Hassan 2014	Iran	Cross sectional	A significant association was found between intimate partner violence and preterm labour [adjusted odds ratio (adjOR) 1.54, 95% confidence interval (CI) 1.16-2.03], caesarean section (adjOR 11.84, 95% CI 6.37-22.02), antenatal hospitalization (adjOR 6.34, 95% CI 3.82-10.52) and vaginal bleeding (adjOR 1.51, 95% CI 0.9-2.3).
	Romero-Gutiérrez 2011	Mexico	Cross sectional	Maternal complications were higher in women who experienced violence (30.2% vs 23.6%, p=0.004). Women who experienced sexual violence had more maternal complications (43.2%), and women who experienced psychological violence had more neonatal complications (54.2%).
	Stöckl 2010	Tanzania	Household survey	Women's odds of drinking during their last pregnancy were significantly increased if they had experienced violence during pregnancy. Violence during pregnancy was also associated with having had a child or infant that died.

2.5 Discussion

A systematic review of the literature was conducted to assess studies that have measured the prevalence of and/or associations between at least two types of maternal morbidity in LMIC.

Statement of principal findings

The main finding is that there is evidence of a high burden of ill-health related to and/or aggravated by pregnancy reported by, and/or confirmed by clinical examination and investigations, during and after pregnancy in women in several LMIC. There is emerging evidence of association between the different types of maternal morbidity. However, a wide variety of tools and assessment stages are used, making comparison difficult, and an estimation of overall burden of maternal morbidity cannot be estimated from existing studies.

Study design

Of the 26 included studies, the majority were cross sectional studies that collected primary data from women during and after pregnancy by face-to-face interview and/or clinical assessment of the women.

Three studies used existing databases to describe estimates of maternal morbidity (Isaken 2015, Surkan 2017, Tsai 2016). The use of databases to identify and estimate maternal morbidity can have many strengths and advantages. Such data involves generally large populations of women, is comprehensive in nature and often covers a longer period of time. For secondary data analysis, the data is often readily available, (usually electronically) and secure for referencing. However, in the absence of a validated set of uniform identification criteria for maternal morbidity, the nomenclature, types and severity of maternal morbidity is difficult to measure with confidence in a standardised way. Furthermore, since the databases were not primarily designed to collect data regarding maternal morbidity, there is a risk that the data obtained is inadequate, as important measurements of morbidity may not

be included in the original data collection tool and therefore not entered into the database.

A cross sectional study design was employed to collect primary data regarding maternal morbidity in most of the studies reviewed. This study design is simple, relatively cheap and appropriate for face-to-face interviews (Mann 2003). A cross sectional study design can determine prevalence. However, using a method and approach that allows for important comparisons across and between settings is important.

Collection of primary data was the most common approach with nearly all studies collecting self-reported data in face-to-face interviews with women during and after pregnancy. In three studies, women were also examined and basic investigations were performed.

In terms of geographical distribution, similar numbers of studies collected primary data in low income countries, and in middle income countries. This pattern suggests that in the absence of robust electronic data collection systems and databases, researchers based in LMIC tend to employ primary data collection using self-reporting symptoms, for studies on maternal morbidity. There was no mention in any study if electronic data collection was used. The strength of primary data collection can be that the participating woman has an opportunity to self-report their symptoms, have a clinical assessment performed and data collected to identify and then to provide care or refer on if any health problems are detected.

Given the lack of resources in many LMIC settings, the research team may have spent more time with the women and may have then had the opportunity to provide “better than average” care allowing for correct diagnosis of women’s health needs, and providing appropriate treatment or referral. This may result in “better” or higher estimates of maternal morbidity than if retrospective self-reported or documented symptoms and signs are elicited.

The sample size in most of the studies in this review was less than 750 women. Limiting factors have included the cost and technical expertise required of healthcare providers or research assistants in LMIC to fully assess maternal morbidity during and after pregnancy. For a more accurate measurement of maternal morbidity, a larger sample size and a multi-country approach is required. Ultimately, population level data on maternal morbidity would be ideal, but this would be difficult to capture by primary data collection.

Of the studies, that collected primary data, most (19/21) assessed women during pregnancy at one point of time. Less studies (6/21) assessed women after pregnancy. It would be beneficial to assess women at different stages of pregnancy. This would help to compare prevalence of maternal morbidity during and after pregnancy and allow to assess if morbidity changes during pregnancy and/or over time. In addition, the burden and type of maternal morbidity can be expected to be different; for example, maternal morbidity detected in the early antenatal stage may be different to that in the late antenatal stage, and likewise for the various postnatal stages.

Types of maternal morbidity assessed

There were many varied and different types of physical, psychological and social morbidity assessed in the included studies, with wide ranges of prevalence of and/or association between different types of maternal morbidity. **Table 2.8**, **Table 2.10**, and **Table 2.12** have displayed the best estimates available for the maternal morbidities assessed in the studies included in this review. Although maternal morbidity is known to be under-reported in LMIC, these estimates show widespread ill-health.

HIV was assessed in six studies; anaemia in five studies, malaria in three studies, and tuberculosis in two studies. Considering that some LMIC are endemic areas for these conditions, this was a surprising finding. This finding suggests that assessment of burden of HIV, malaria and anaemia are often conducted as separate singular studies and that there is a lack of information regarding tuberculosis during and after

pregnancy. This may be because studies that these morbidities are assessed in isolated in the literature.

There was a lack of standardisation of definitions and data collection tools used to measure different types of physical morbidity. The EPDS was the most common validated data collection tool to assess psychological morbidity in the included studies, but with different cut-off scores used to determine the risk of “depression” or not. A variety of different validated data collection tools were used to assess domestic violence and substance misuse as components of social morbidity. Many descriptions of physical, psychological and social morbidity were described as aggregates or summative measures, limiting the comparability of the reported prevalence. Aggregation or comparison of data is problematic because of the differences in methodology and tools, and because data is situation specific. Hence the estimates of the prevalence of maternal morbidity at best portray local or regional specific situations.

Strengths and weaknesses of the study

To the best of the lead researcher's knowledge, this is the first systematic review to assess the prevalence of maternal morbidity (physical, psychological, social) and/or associations between two or more types of maternal morbidity in women in LMIC.

Limitations

In the following sections, the main limitations are discussed. The following are highlighted; sample size of included studies, recall bias, self-reported subjective symptoms and quality assurance of translation of validated data collection tools are discussed.

Sample size

This review did not include studies if the sample size was less than 500 women, of which there were 14 studies excluded. The details of these studies have been included for reference in **Appendix 5, Table A** and **Table B**. Furthermore, only studies that assessed women within 12 weeks postnatal were included. As a result, maternal morbidity prevalence in smaller studies and that first developed or manifested beyond 12 weeks postnatal was not assessed.

Recall bias

Many included studies relied on recall of health problems or complications by women over various ranges of time. A few studies asked women to recall information regarding complications in previous pregnancies and in one study, women were interviewed after birth and were asked to remember symptoms over the course of their pregnancy (Prost 2012). When a woman is asked to remember complications over a longer time frame, there is a higher risk of recall bias and women may not be able to provide a complete account of events during and after pregnancy.

Recall bias is a common issue in studies that use self-reporting and is a type of information bias. Recall bias can also be described as responder bias, and can

be unintentional due to a woman's poor or incomplete memory recall, or it can be intentional, for example, because the women felt embarrassed or uncomfortable to report psychological ill-health (for example, severe depression and suicidal ideation) (Sedgwich 2012). There may have been higher levels of responder bias in studies assessing maternal morbidity that assesses potentially sensitive or socially unacceptable conditions, for example domestic violence. Responder bias may contribute to pre-existing belief systems, for example women may not report different types of maternal morbidity as these conditions are concerned "normal" or there may be a belief that complaining of the symptom may pre-empt ill-health in the specific cultural setting (Sedgwich 2012). The reported prevalence based on recall must be interpreted with caution.

As an example, a study included in this review by Stewart et al compared self-reported data collected through interviews with that extracted from women's clinical records to examine concordance regarding their study participants' maternal morbidity conditions (Stewart 2014). They highlighted the weakness of interview-based diagnosis, showing that women's response to questions to elicit morbidity could not compare to the "gold-standard" diagnosis as recorded in case notes (Stewart 2014). The authors concluded that interviews may only be useful to determine prevalence of symptoms of interest but not clinical diagnosis (Stewart 2014). This review highlights the further need to correlate what women recall compared to accurately documented clinical diagnosis extracted, for example from medical records.

Self-reporting symptoms

In studies included in this review, much of the primary data collected was largely symptom based rather than "diagnosed" maternal morbidity conditions per se. In this review, only three studies triangulated self-reported symptoms with findings from clinical examination and/or basic investigations. This may mean that the assessment of prevalence of ill-health is over-estimated, as most prevalence estimate were based

on women's subjective self-reporting, rather than a confirmed clinical diagnosis. The issues regarding the "validity" of subjective self-reporting is important as it relates to the WHO definition of maternal morbidity, that is "any health condition that is attributed to or aggravated by pregnancy and childbirth which has a negative impact on the woman's wellbeing" (Firoz 2013). For example, a woman may feel "well" and state that she feels that there is no health condition having a negative impact on her wellbeing. However, after a healthcare provider conducts a clinical examination and basic investigations, the woman may be diagnosed with pre-eclampsia. Conversely, for example, a woman may report nausea and vomiting that is having a significant negative impact on her wellbeing but when a healthcare provider conducts a clinical examination and basic investigations, all parameters are normal. The limitations of self-reporting are well recognised but it could be argued that these are signs and symptoms which women themselves consider as significantly contributing to "non-health" or associated with adverse pregnancy outcome. This requires further exploration. This review highlights the need to further explore the experiences of women with regards to their understanding of ill-health during and after pregnancy, compared to a clinical condition diagnosed as ill-health by a healthcare provider.

Data collection tools

No study included in this review described or used an internationally recognised data collection tool to assess physical morbidity. Each author group described and measured physical morbidity in different ways. A variety of internationally recognised data collection tools were used to assess psychological and social morbidity, but most were developed in English and validated in high income country settings, but have been used for studies in low and middle-income countries. The translation and back-translation versions of standardised data collection tools were mentioned in a few studies but the quality assurance of the translation and validation is uncertain for every setting.

Furthermore, in several of the included studies, the authors emphasised that if the EPDS data collection tool is used as a screening tool for psychological morbidity in a

clinical setting, it should be administered by a general healthcare provider under the supervision and support of a specialised psychiatric nurse and/or psychiatrist. Many of the authors highlighted that the data collection tools used to assess psychological and social morbidity, are not designed to be “diagnostic” and that no checklist should replace the role of a healthcare provider trained in diagnosing and treating each specific type of maternal morbidity.

There is a need to use standardised tools and cut-off scores and definitions with correct translation, ensuring relevance in (all) settings and at each stage during and after pregnancy that is feasible for use at primary and secondary healthcare level.

Summary

In this review, the estimated prevalence of different types of physical, psychological, and social maternal morbidity were not based on standardised, well documented and transparent methodologies and tools, and therefore have limited usefulness and validity for informing efforts to address the global burden of maternal morbidity during and after pregnancy (Gülmezoglu 2004, Chou 2016). The findings of this systematic review would suggest that three major issues have limited valid, routine, and comparable measurements of maternal morbidity to date (Chou 2016). These are the lack of:

- a) common definitions and identification criteria for different types of physical, psychological, and social maternal morbidity,
- b) standardised and validated data collection tools that can be used in different languages and at all levels of healthcare: community, primary, secondary and tertiary healthcare levels,
- c) validation of self-reported measurements of maternal morbidity (experienced by women themselves) compared to clinical assessment, investigations and diagnosis determined by a healthcare provider.

Implications for research

The findings of this review have research implications and contributes to the ongoing debate on the need for an internationally accepted assessment methodology to assess maternal morbidity. As a reflection of the new concept of maternal morbidity, only two of the studies in this review used the term “maternal morbidity”. To date a range of methods and tools have been used to assess maternal morbidity in different languages, in different settings across different LMIC, each with their strengths and weaknesses. The validity of many of the standardised data collection tools used in LMIC is unknown and the quality of translation, acceptability and feasibility of standardised data collection tools is uncertain.

Unanswered questions and future research

The review highlights significant discrepancy in the literature concerning how different types of maternal morbidity are measured and defined. There is a need for a validated data collection tool that allows for consistent standardised measurement of maternal morbidity across settings and time. This literature review illustrates that there is a need to agree on a framework and system for measuring maternal morbidity that is useable and applicable across different country and income settings. The new WHO definition of maternal morbidity in principle provides such a framework, but challenges remain to map out comprehensive, feasible and acceptable assessment stages, approaches and tools.

The findings of this systematic review of the literature highlights the limitations of various methods and measurements that have previously been used to assess different types of maternal morbidity in different LMIC to assess components of maternal morbidity. The maternal morbidity estimates generated using these methodologies and tools, while useful as a guide, are not truly representative of the burden and range of maternal morbidity conditions that have a negative impact on a woman’s wellbeing during and after pregnancy.

To date, the measurements that have reported prevalence of different types of maternal morbidity are not based on standardised, well documented, and transparent methodologies. Comprehensive and routine measurements of maternal morbidity are necessary to inform policy and program decisions and resource allocations that will also help to improve maternal health and well-being and to decrease long-term suffering and disability. Improved systems of the measurement of maternal morbidity will also allow for comparison of the burden across settings within and between countries.

The lessons learnt in the efforts to measure maternal mortality previously may provide useful insights to improve how maternal morbidity is assessed in LMIC. For example, it may not be feasible to use the exact same approach across all countries, but having an internationally agreed standardized method and data collection tool could then be adopted and adapted by countries based on their level of technological development and affordability at costs they can afford.

2.6 Chapter summary

This chapter has presented a systematic review of studies that have measured the prevalence of and/or associations between different types of maternal morbidity in women in LMIC. This chapter has described how the systematic review of literature as conducted starting with the conceptualisation of maternal morbidity and the categories selection into types or components including physical, psychological and social morbidity. A total of 26 studies met the inclusion criteria and the main findings are presented and discussed using a narrative synthesis, alongside summary tables.

This chapter has positioned the objective of this research project in the context of available evidence, critically appraised methods used, presented the main findings, as well as strengths and weaknesses and implications for research have been given.

In the next chapter, the methodology of the study design for this research project is described.

CHAPTER 3: METHODOLOGY

3.1 Introduction

In this chapter, the approach used to measure maternal morbidity using physical, psychological and social health in a comprehensive and standardised way in women during and after pregnancy at different healthcare levels in India, Pakistan, Kenya, Malawi is described.

At the start of this chapter firstly, the positionality of the research project and author contribution is considered. This chapter then describes the study design, study settings, study population and sampling. How the sample size is determined and the data collection tool and the process of piloting is described. This chapter describes the process of data collection, processing, cleaning, coding and analysis. This chapter concludes with how the quality of the data was assured and ethical considerations are described and addressed.

3.2 Positionality of researcher

At the time of writing, the lead researcher was a Senior Specialist Registrar in Obstetrics and Gynaecology and was undertaking a four year “Out of Programme in Research” placement at the Centre of Maternal and Newborn Health (CMNH) at the Liverpool School of Tropical Medicine (LSTM). At the time of writing, the lead researcher was a full-time member of staff at CMNH-LSTM, as a Clinical Research Associate and qualifications included BSc Med Sci, MBChB, MRCOG, PgCert. Before this research placement, the lead researcher had worked as a full-time volunteer doctor with Voluntary Services Overseas in South Ethiopia, East Africa for one year.

At CMNH-LSTM, the lead researcher led, developed and delivered the maternal morbidity research project that comprises this PhD project. The lead researcher coordinated and supervised all the research activities. It is noted that as a medical doctor, the lead researcher may have a bias towards over-medicalisation of health.

The lead researcher conducted the following activities:

- Developing the study protocol
- Performing the systematic literature review
- Supporting ethical approval in each country
- Developing training manuals for research assistants and supervisors
- Piloting and refining the data collection tool
- Training data collectors /research assistants and research supervisors
- Quality assurance of the translation and delivery of the data collection tool
- Chairing weekly research meetings with research supervisors and team members
- Monitoring and supervising the data collection process
- Writing the data analysis plan
- Leading the cleaning, processing, coding of the datasets
- Conducting basic data analysis
- Conducting the univariate and multivariate analysis, with the support of a senior statistician
- Presenting the results of each country
- Interpreting the results of each country
- Discussing the meaning of the results and implications for further research
- Writing and submitting the manuscripts for publication

For this large multi-country maternal morbidity project, other members of the CMNH-LSTM team contributed. Professor Nynke van den Broek conceived the study idea, study design, and data collection tool. Dr Sunday Ajadi obtained ethical approval from LSTM and started the ethical approval process in each country. Fiona Dickinson formatted the data collection tool for electronic data collection onto hand held tablets. Dr Barbara Madaj supervised and monitored data collection remotely for each country. Professor Pratima Mittal supervised data collection in India, Professor Shamsa Rizwan in Pakistan, Dr Pamela Godia in Kenya, and Dr Sarah Bar-Zeev in Malawi. Christopher Murray and Clare Smart imported data from Malawi using

Formic®. Dr Mamuda Aminu and Katrin Metsis imported electronic data from email attachments, cleaned, processed, coded part of the datasets. Dr Bethany Levick conducted preliminary univariate and multivariate analysis. Dr Sarah White checked all basic and advanced data analysis and performed further analysis.

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Research questions

In this research study, there were four research questions, that are answered in the results chapter and explained in the discussion chapter.

Table 3.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

3.3 Study design

To answer research question number one and two, this research study employed an observational descriptive cross-sectional study. The data collection tool was administered to women attending for routine antenatal or postnatal care or birth at selected healthcare facilities in India, Pakistan, Kenya and Malawi. The survey involved the administration of a questionnaire in a face-to-face interview, clinical examination and urine and serological investigations, to obtain information on women's subjective and objective health during and after pregnancy. A cross-sectional study design was chosen in order to compare different population groups at a single point in time, and to allow for comparison of many different variables within the same time (Mann 2003). Cross sectional surveys using questionnaires are easy to administer and are widely used as a key tool for conducting primary

descriptive research (Mann 2003). The methods are presented here following the STROBE guidelines for reporting cross sectional studies (Elm 2007).

A cross-sectional study design was used in this study to make comparisons across the following five assessment stages, during and after pregnancy (**Table 3.2**).

Table 3.2. Definitions of assessment stages

Number	Stage	Abbreviation	Time frame
1.	Early antenatal	EAN	≤ 20 weeks' gestation of pregnancy*
2.	Late antenatal	LAN	>20 weeks gestation of pregnancy*
3.	Delivery	DEL	≤ 24 hours from time of childbirth
4.	Early postnatal	EPN	from day 1-7 (>24 hours up ≤ day 7) from time of childbirth
5.	Late postnatal	LPN	from week 2-12 (>day 7 and ≤ week 12) from time of childbirth

*For the antenatal assessments, gestation was calculated based on the women's last menstrual period or the results of a dating scan, if available.

3.4 Study settings

This study was conducted in two countries in South Asia (India and Pakistan) and two countries in sub-Saharan Africa (Kenya and Malawi). Malawi and Pakistan were purposively chosen as a previous maternal morbidity baseline survey has been conducted in these settings by the research team at CMNH-LSTM (Zafar 2015). Kenya and India were selected opportunistically by the research team at CMNH-LSTM to include one further country from sub-Saharan Africa and Asia to enable comparisons between the study populations in Malawi and Pakistan. Countries were also chosen due to poor maternal health indicators and to reflect the diversity of epidemiology with regards to the prevalence of HIV, TB, syphilis and malaria. **Table 3.3** displays the

total population, life expectancy at birth (years) for females and the proportion of women who attend for at least one ANC visit in each country study setting.

The following table contain information derived from the World Health Statistics document 2016 (WHO 2016). The original source of information is given in the footnotes of the two following tables.

Table 3.3: Background country details for study settings

Background	Date of reference	India	Pakistan	Kenya	Malawi	Global
Total population (000s) ^a	2015	1311051	188925	46050	17215	7313015
Life expectancy at birth (years) female ^b	2015	69.9	67.5	65.8	59.9	73.7
Healthy life expectancy at birth (years) ^b	2015	59.5	57.8	55.6	51.2	63.1
At least one antenatal visit (%) ^c	2015	75	73	92	96	83

^a World Population Prospects, the 2015 revision (WPP2015). New York: United Nations DESA, Population Division.

^b WHO annual life tables for 1985–2015 based on the World Population Prospects on the data held in the WHO Mortality Database and on HIV mortality estimates prepared by UNAIDS.

^c World Health Statistics. Geneva: World Health Organization; 2015. Available at: http://www.who.int/gho/publications/world_health_statistics/2015/en/

Table 3.4 presents health indicators used to monitor the SDG for each study country and a global estimate.

Table 3.4: Background health indicators for each country study setting and the global estimate related to the relevant SDG targets

SDG	SDG Target	Year of reference	Indicators	India	Pakistan	Kenya	Malawi	Global
Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least-developed countries, to implement programmes and policies to end poverty in all its dimensions	1.a	2015	1.a.2 Proportion of total government spending on essential services (education, health and social protection). General Government Health Expenditure (GGHE) as % of general government ^d	5.0	4.7	12.8	16.8	n/a
By 2030, reduce the global maternal mortality ratio to less than 70 per 100 000 live births	3.1.1	2015	Maternal mortality ratio (per 100 000 live births) ^e	174	178	510	634	216
	3.1.2	2005-2016	Proportion of births attended by skilled health personnel (%) ^f	81	52	62	90	78
By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries	3.2.1	2015	Under-five mortality rate (per 1000 live births) ^g	47.7	81.1	49.4	64.0	42.5
	3.2.2	2015	Neonatal mortality rate (per 1000 live births) ^g	27.7	45.5	22.2	21.8	19.2

aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births								
By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	3.3.1	2015	New HIV infections among adults 15–49 years old (per 1000 uninfected population) ^h	0.11	0.16	3.52	3.82	0.5
	3.3.2	2015	TB incidence (per 100 000 population) ⁱ	217	270	233	193	142
	3.3.3	2015	Malaria incidence (per 1000 population at risk) ^j	18.6	8.6	166.0	188.8	94.0
	3.3.4	2015	Infants receiving three doses of hepatitis B vaccine (%) ^k	87	72	89	88	84
	3.3.5	2015	Reported number of people requiring interventions against NTDs ^l	497396247	31056287	13642040	11426323	1591109130
By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment	3.4.1	2015	Probability of dying from any of CVD, cancer, diabetes, CRD between age 30 and exact age 70 (%) ^m	23.3	24.7	17.8	20.2	18.8

and promote mental health and well-being	3.4.2	2015	Suicide mortality rate (per 100 000 population) ^m	15.7	2.1	6.5	5.5	10.7
Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol	3.5.2	2016	Total alcohol per capita (≥15 years of age) consumption (litres of pure alcohol), projected estimates ⁿ	5.0	0.2	4.4	2.4	6.4
By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes	3.7.1	2005-2015	Proportion of married or in-union women of reproductive age who have their need for family planning satisfied with modern methods (%) ^o	63.9	47.0	75.4	73.6	76.7
	3.7.2	2005-2014	Adolescent birth rate (per 1000 women aged Male Female Both sexes 15–19 years) ^p	28.1	44.0	96.0	143.0	44.1

^d WHO Global Health Expenditure Database [online database]. Geneva: World Health Organization (<http://apps.who.int/nha/database/Select/Indicators/en>). Global and regional aggregates are unweighted averages.

^e WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Trends in maternal mortality: 1990 to 2015. Estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. Geneva: World Health Organization; 2015.

^f WHO global database on maternal health indicators, 2016 update [online database]. Geneva: World Health Organization (http://www.who.int/gho/maternal_health/en/).

^g Levels & Trends in Child Mortality. Report 2015. Estimates Developed by the UN Interagency Group for Child Mortality Estimation. New York (NY), Geneva and Washington (DC): United Nations Children’s Fund, World Health Organization, World Bank and United Nations; 2015.

^h UNAIDS/WHO estimates; 2015.

ⁱ Global tuberculosis report 2015. Geneva: World Health Organization; 2015 (http://apps.who.int/iris/bitstream/10665/191102/1/9789241565059_eng.pdf?ua=1).

^j World Malaria Report 2015. Geneva: World Health Organization; 2015 (<http://www.who.int/malaria/publications/world-malariareport-2015/report/en>).

^k WHO/UNICEF coverage estimates 2014 revision. (http://www.who.int/immunization/monitoring_surveillance/routine/coverage/en/index4.html).

^l Global Health Observatory [website]. Geneva: World Health Organization (<http://www.who.int/gho/en/>), and the Preventive Chemotherapy and Transmission Control (PCT) databank. Geneva: World Health Organization (http://www.who.int/neglected_diseases/preventive_chemotherapy/databank/en/).

^m Global Health Estimates 2013: Deaths by Cause, Age and Sex, Estimates for 2000–2012. Geneva: World Health Organization; 2014 (http://www.who.int/healthinfo/global_burden_disease/en/).

ⁿ WHO Global Information System on Alcohol and Health [online database]. Geneva: World Health Organization; 2015 (<http://apps.who.int/gho/data/node.main.GISAH?showonly=GISAH>).

^o World Contraceptive Use 2016. New York (NY): United Nations, Department of Economic and Social Affairs, Population Division; 2016. Forthcoming. Regional aggregates are estimates for the year 2015, taken from model-based estimates and projections of family planning indicators 2015. New York: United Nations, Department of Economic and Social Affairs, Population Division; 2015 (http://www.un.org/en/development/desa/population/theme/family-planning/cp_model.shtml).

^p World Fertility Data 2015. New York (NY): United Nations, Department of Economic and Social Affairs, Population Division; 2015. (<http://www.un.org/en/development/desa/population/publications/dataset/fertility/wfd2015.shtml>).

Further background to the study settings are also given in the following country specific settings.

India

India is a lower-middle-income country and one of the most populous countries in the world, with an estimated population of 1.3 billion (WHO 2017e). India is a federal union of states comprising 28 states and seven union territories. The states and union territories are further subdivided into 640 districts (Census of India 2011). The MMR in India is 174 per 100,000 with wide disparities across the states (WHO 2015a). Skilled birth attendance is 81% and neonatal mortality rate (NMR) is 27.7 per 1000 live births. (WHO 2015c). India does not have the highest rates of MMR and NMR globally, but it does have the highest absolute numbers of women and newborn babies who die per year (WHO 2015c). With regard to healthcare coverage and uptake, the proportion of women who attend for at least one ANC visit is 75% and skilled attendance at birth (or institutional delivery) is 81% (WHO 2015c). This study was conducted in the Department of Obstetrics in Safdarjung Hospital, in New Delhi, the capital of India and this selection was opportunistic. The Safdarjung Hospital is a 1600-bed tertiary level healthcare facility and is one of the largest public government hospitals in New Delhi, India. It serves as a referral centre for several public and private health facilities in New Delhi and neighbouring states.

Figure 3.1: Map of India



(Source of map: <https://www.readmeindia.com/india-maps/2016>)

Table 3.5: Study site in India

Country	Regions	District	Healthcare facility (HCF) level	Name of facility
India	New Delhi	New Delhi	Secondary	Safdarjung Hospital

Pakistan

Pakistan is a lower-middle income country with an estimated population of 188 million (WHO 2017f). Pakistan is divided into four provinces and 102 districts. The MMR for Pakistan is 178 per 100,000 live births with skilled birth attendance estimated to be 52% (WHO 2017d). The neonatal mortality rate is 45.5 per 1,000 live births (WHO 2017c). With regard to healthcare coverage and uptake, the proportion of women who attend for at least one ANC visit is 73% and skilled attendance at birth (or institutional delivery) is 52.0% (WHO 2015c).

The study was carried out in the Punjab province and Islamabad Capital Territory (ICT) situated in the north of Pakistan. These provinces were purposively selected to include both urban and rural women seeking care at primary or secondary level healthcare facilities. Two hospitals in the ICT and three district hospitals for three districts in Punjab were chosen purposively. Five primary level health centres were selected using simple random sampling from all the primary rural health centres that refer to the selected secondary level healthcare facilities included in this study in the Attock district of Punjab.

Figure 3.2: Map of Pakistan



Table 3.6: Study sites in Pakistan

Country	Region	District	HCF level	Name of health care facility
Pakistan	Islamabad Capital Territory	Rawalpindi	Secondary	Pakistan Railway Hospital PESSI Hospital Islamabad I-12
	Punjab	Attock	Secondary	District Headquarter Hospital Attock Tehsil Headquarters Hospital Hassan Abdal Tehsil Headquarters Hospital Fateh Jang
			Primary	Rural Health Centre Maghian Rural Health Centre Bahter Tehsil Rural Health Centre Chhab Rural Health Centre Rango Tehsil Hazro Rural Health Centre Domail

Kenya

Kenya is a low-income country with an estimated population of 46 million (WHO 2017g). The MMR is estimated 510 per 100,000 livebirths and skilled birth attendance rate is 62% (WHO 2017c). The neonatal mortality rate is 22.2 per 1,000 live births (WHO 2017c). With regard to healthcare coverage and uptake, the proportion of women who attend for at least one ANC visit is 92% and skilled attendance at birth (or institutional delivery) is 62.0% (WHO 2015c).

Kenya is divided into eight geopolitical regions: Central, Coast, Eastern, Nairobi, North Eastern, Nyanza, Rift Valley and Western provinces (**Figure 3.3**). The study was carried out in three secondary level and six primary level healthcare facilities in the Central region of Kenya. In each district, the main hospital was purposively selected and in addition two health centres which referred to this hospital were selected using simple random sampling, to reflect a cross-section of two levels of healthcare (primary and secondary). For the purposes of this study, these facilities consisted of three clusters of three healthcare facilities in which each cluster included a district-level healthcare facility or above and two primary health facilities which refer to it.

Figure 3.3: Map of Kenya



Table 3.7: Study sites in Kenya

Country	Regions	District	HCF level	Name of facility
Kenya	Central	Nyeri	Secondary	Nyeri Provincial General Hospital
			Primary	Naromoru Health Centre Endarasha Health Centre
		Murang'a	Secondary	Murang'a County Referral Hospital
			Primary	Kandara Sub-County Hospital Kigumo Sub-County Hospital
		Kiambu	Secondary	Kiambu Hospital
			Primary	Githunguri Health Centre Karuri Health Centre

Malawi

Malawi is a low-income country with an estimated population of 17 million (WHO 2017h). The MMR is 634 per 100,000 with an estimated 90% of women delivering at health centres with skilled birth attendants (WHO 2017c). The NMR is estimated at 21.8 deaths per 1,000 live births (WHO 2015a). With regard to healthcare coverage and uptake, the proportion of women who attend for at least one ANC visit is 96% and skilled attendance at birth (or institutional delivery) is 90.0% (WHO 2015c).

The country is divided into three regions: the northern, central and southern regions. There is a total of 28 districts in the country. Six are in the northern region, nine in the central region and 13 are in the southern region (**Figure 3.4**)

The study was carried out in three secondary level and six primary level healthcare facilities in Malawi (**Table 3**). These facilities consist of three clusters of three healthcare facilities in which each cluster includes a district secondary level healthcare facility and two primary health facilities which refer to it. For Malawi, in each district, to reflect a cross-section of two levels of healthcare (primary and

secondary) the main hospital was purposively selected and in addition, two health centres which referred to this hospital were selected using simple random sampling.

Figure 3.4: Map of Malawi

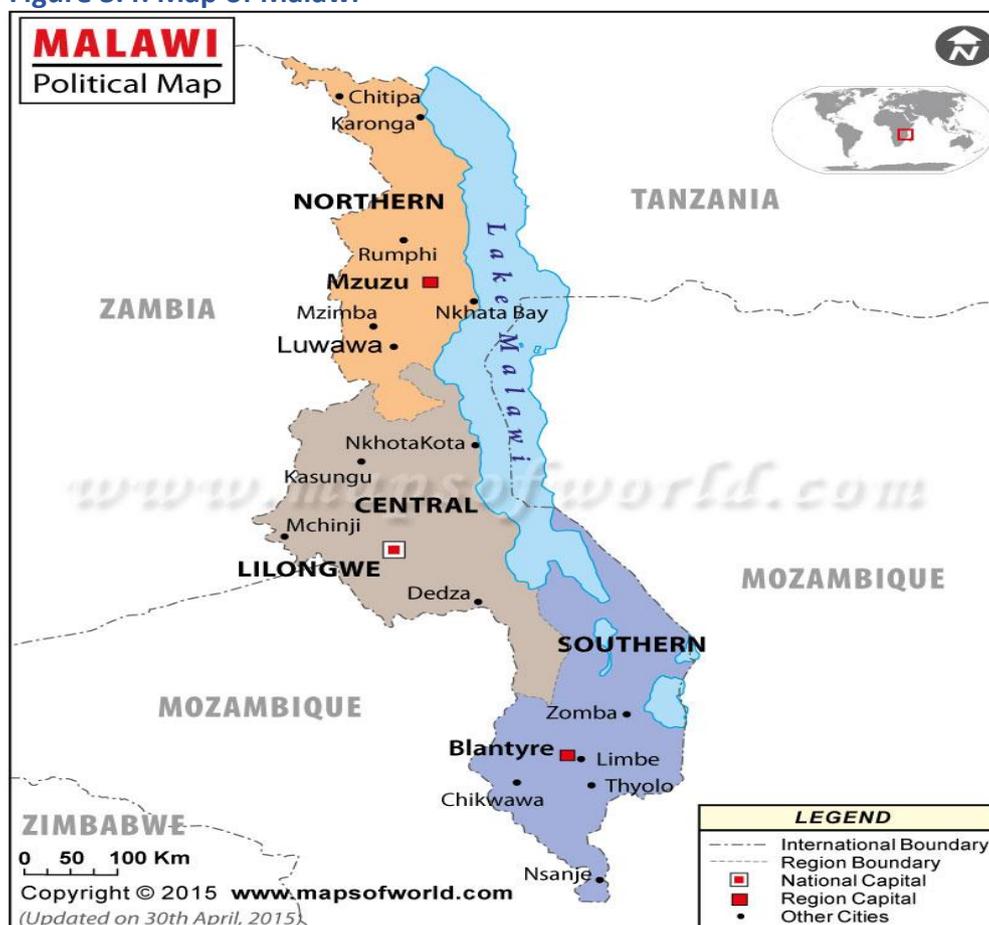


Table 3.8: Study sites in Malawi

Country	Region	District	HCF level	Name of healthcare facility
Malawi	South	Blantyre	Secondary	Limbe Health Centre
			Primary	Ndirande Health Centre
				Bangwe Health Centre
		Mulanje	Secondary	Mulanje District Hospital
			Primary	Chonde Health Centre
		Mwanza		Mulomba Health Centre
			Secondary	Mwanza District Hospital
			Primary	Thambani Health Centre
		Tulonkhondo Health Centre		

Summary of study sites

Overall, the study population was from a total of 12 secondary and 17 primary care level facilities across the four countries (**Table 3.9**).

Table 3.9: Details of study sites and healthcare level

Country	Region	District	Healthcare Level	Name of health care facility
India	New Delhi	New Delhi	Secondary	Safdarjung Hospital
Pakistan	Islamabad Capital Territory	Rawalpindi	Secondary	Pakistan Railway Hospital PESSI Hospital Islamabad I-12
	Punjab	Attock	Secondary	DHQ Hospital Attock THQ Hospital Hassan Abdal THQ Fateh Jang
			Primary	RHC Maghian RHC Bahter Tehsil RHC Chhab RHC Rango Tehsil Hazro RHC Domail
Kenya	Central	Nyeri	Secondary	Nyeri Provincial General Hospital
			Primary	Naromoru Health Centre Endarasha Health Centre
		Murang'a	Secondary	Murang'a County Referral Hospital
			Primary	Kandara Sub-County Hospital Kigumo Sub-County Hospital
		Kiambu	Secondary	Kiambu Hospital
			Primary	Githunguri Health Centre Karuri Health Centre
Malawi	South	Blantyre	Secondary	Limbe Health Centre
			Primary	Ndirande Health Centre Bangwe Health Centre
		Mulanje	Secondary	Mulanje District Hospital
			Primary	Chonde Health Centre Mulomba Health Centre
		Mwanza	Secondary	Mwanza District Hospital
			Primary	Thambani Health Centre Tulonkhondo Health Centre

DHQ-District headquarter, THQ-Tehsil headquarter, RHC - rural health centre

Study population

The study involved consenting pregnant women and women who were within 12 weeks of childbirth attending for maternity care at the selected study healthcare facilities.

Inclusion criteria

All women who attended for routine antenatal or postnatal care or birth at the study healthcare facilities, were eligible for inclusion.

Exclusion criteria

Women who are too ill to participate were excluded. These criteria excluded women with altered conscious level, admission to high dependency unit or intensive care unit, as this population of women represent those with a severe acute maternal morbidity. Women below the age of consent for sex in each study setting were excluded: India (18); Kenya (18) and Malawi (16). There is no age of consent in Pakistan, as all sexual activity outside of marriage is illegal. The minimum age of marriage is 16 for women, although women are sometimes allowed to marry at age 14.

Study period

Data was collected for this study was conducted for one year in 2015.

Sampling procedure

Research question number two was: “What is the burden of maternal morbidity at different stages of pregnancy?” To answer the question, women were recruited at five stages of pregnancy along the antenatal and postnatal continuum of pregnancy and childbirth. For this study, the five stages of pregnancy have been displayed in **Table 3.2.**

Sample size calculation

$$n = \frac{p(1-p)Z^2}{ME^2}$$

The formula: $n = \frac{p(1-p)Z^2}{ME^2}$ was used to calculate the sample size, where n = sample size, p = estimated prevalence, Z (for a 95% confident interval) = 1.96 and ME = margin of error (0.05).

However, there are currently no estimates of comprehensive maternal morbidity rates in the study countries, so 'p' is unknown. Extrapolating 'p' from the prevalence of a range of common and less common maternal morbidity conditions such as anaemia, eclampsia, syphilis and obstetric fistula and, the values of n, as shown below (with ME of 5% at 95% confidence interval)

Anaemia 'p' = 0.5

Eclampsia 'p' = 0.05

Syphilis 'p' = 0.02

Fistula 'p' = 0.002

Based on these calculations, using a value of 50% (estimated prevalence of anaemia in pregnancy), a sample size of 384 is required to estimate proportions with a margin of error not exceeding 5%, using a 95% confidence level. Since estimation is required for five assessment stages, this number of women will be interviewed for each of the five stages bringing the total required sample size to 1920 participants. With sample sizes of 384 and for comparable reasons, 1,500 women per assessment stage, the margin of error for estimation of various proportions without accounting for clustering is as indicated in the **Table 3.10**.

Table 3.10: Estimated margin of error

Proportion:	0.50	0.20	0.10	0.05	0.02	0.002
ME if n=384	0.05	0.04	0.03	0.022	0.014	NA
ME if n=1500	0.025	0.02	0.015	0.011	0.007	0.002

If the design effect resulting from use of cluster sampling is 1.5 and the sample size 576 is the lowest, the prevalence that can be expected to be detected (95% chance that it occurs in at least one women in the sample) is 8 per 1000. If the sample size is

doubled (for example combining the early and late postnatal samples to estimate obstetric fistula) to give a sample size of 1152, the lowest prevalence would be 4 per 1000. To detect a prevalence of 2 per 1000 a sample size of 3000 is required. With the assistance of a senior statistician, the sample size per country was calculated as 2880.

In Pakistan, Kenya and Malawi for each of the five assessment stages, the sample size was a minimum of 576 women across two levels of healthcare facility (primary and secondary) selected by stratified cluster sampling. In India, as the study was conducted in one facility (secondary level) a cluster sampling approach was not required, giving an amended sample size of 1900 with a minimum of 380 women per assessment stage. This sample size had 95% power to detect the presence of any morbidity with a prevalence greater than 1%.

3.5 Data collection tool

For this study, a data collection tool that was developed with inputs from the WHO Maternal Morbidity Working Group in line with the agreed criteria for maternal morbidity (Chou 2016). The maternal morbidity assessment tool used in this study included the following sections displayed in **Table 3.11** and **Appendix 6**.

Table 3.11: Sections of the data collection tool

1.	Identification of research assistant, date of interview and site of healthcare facility
2.	Social, economic and demographic items
3.	History of previous pregnancies and maternal and/or adverse neonatal outcomes
4.	Obstetric interview with questions regarding current symptoms and extent to which women feel bothered by these
5.	Mental health (past seven days)
6.	Quality of life (past three months)
7.	Risk factors to pregnancy (drugs, substance abuse and domestic violence) (past three months)

8.	Clinical examination including general, obstetric and pelvis (if clinically indicated)
9.	Urinary and serological investigations including haemoglobin, C-Reactive Protein (CRP), malaria, syphilis, HIV
10	Additional comments

All women were administered the same questionnaire (**Appendix 6**). The obstetric examination part of the questionnaire was not required and therefore not completed for women who were assessed in the postnatal stages.

Variables

Demographics factors assessed including age, marital status, occupation and educational level.

Socioeconomic status

Socioeconomic status (SES) was measured using an amended Kuppuswamy's scale in India and Pakistan (Sharma 2014). The Kuppuswamy's scale is a composite score of education and occupation of the head of the family along with the monthly income of the family. This scale classifies the study populations into SES categories. However, the income ranges in the scale lose their relevance following the depreciation in the value of the country's currency; and therefore, at the time of development of the tool, the most updated version of the scale was used (Bairwe 2013, Sharma 2014). For the purposes of this study, we used women as head of household. Wealth index was derived using principal component analysis for Malawi and Kenya (Braun 2006, Vyas 2006).

A systematic screening of current physical symptoms was assessed using a total of 76 questions. The severity of each symptom was assessed on a scale of how much the symptom bothers the woman. The 76 questions covered five main organ systems and one group was miscellaneous: cardiopulmonary, gastrointestinal, musculoskeletal, uro-gynaecology, obstetric and breast, and miscellaneous (dermatology, endocrine, neurological, immunology, ear-nose-throat).

Psychological health

Psychological health was assessed using the 10-question EPDS (Cox 1987). The EPDS is a valuable and efficient screening tool to identifying women at risk for depression and/or suicidal ideation (Gibson 2009). The EPDS is easy to administer and has proven to be an effective screening tool, validated for both HIC and LMIC (Gibson 2009). The EPDS is a screening tool that be conducted in complement to a clinical assessment to confirm a diagnosis. The EDPS indicates how the woman has felt during the previous week. The EDPS will not detect women with anxiety neuroses, phobias or personality disorders. Women who score above 10 are likely to have symptoms of depression. Women who score above 13 are likely to be suffering from a depressive illness of varying severity (Cox 1987). The last question asks regarding thoughts of self-harm and the authors of the EPDS recommend that this question can be used to detect women with suicidal ideation.

For the purposes of this study psychological ill-health was defined as an EPDS score of ≥ 10 and/or thoughts of self-harm.

Table 3.12: Example of how to ask one of the questions from the EPDS

“As you are pregnant or have recently had a baby, we would like to know how you are feeling. Please check the answer that comes closest to how you have felt in the past 7 days, not just how you feel today. Here is an example, already completed”.

- I have felt happy:
- Yes, all the time; **Yes, most of the time**; No, not very often; No, not at all.

This would mean: “I have felt happy most of the time during the past week.”

Quality of life

Eight questions regarding quality of life (QOL) and satisfaction with health were derived from the WHO QOL Spirituality, Religiousness and Personal Beliefs (SRPB) questionnaire (WHO 2002). The WHO QOL SRPB questionnaire produces a quality of life profile, derived from four domain scores. The four domain scores indicate an individual's perception of quality of life, with higher domain scores correlating with

higher quality of life (WHO 2002). Two items can be examined separately and these were included in this study questionnaire: overall perception of quality of life and overall perception of their health (WHO 2002).

Table 3.13: Example of how to ask one of the questions from the quality of life assessment

“The following questions ask how you feel about your quality of life, health, or other areas of your life. I will read out each question to you, along with the response options. Please choose the answer that appears most appropriate. If you are unsure about which response to give to a question, the first response you think of is often the best one. Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last four weeks.”

- How satisfied are you with your health?
- Very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied and **very dissatisfied**

This would mean: “I am very dissatisfied with my health.”

Domestic violence

The UN define domestic violence as "any act of gender-based violence that results in, or is likely to result in, physical, sexual or mental harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life" (UN 1993). The “Hurt, Insulted, Threatened, Screamed at” (HITS) questionnaire was used to assess domestic violence firstly from the husband or partner and adapted to be used to assess domestic violence from other family members (Sherin 1998). Responses with a score of >10 indicates abuse.

Table 3.14: Example of how to ask one of the questions from the HITS questionnaire

“How often does your partner: physically hurt you, insult you or talk down to you, threaten you with harm, and scream or curse at you?”

Women respond to each of these items with a 5-point frequency format: never, rarely, sometimes, fairly often, and frequently.

Score values could range from a minimum of 4 to a maximum of 20.

The HITS questionnaire is not the first, short domestic violence screening tool to be developed for outpatient clinical settings. Other short instruments, such as the Abuse Assessment Screen (McFarlane 2001), have been developed for the same purpose, but the HITS instrument is as effective and shorter than others. The HITS questionnaire has only four items, two each that address verbal and physical aggression (Sherin 1998).

Substance misuse

WHO developed the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) in 1997 in response to the public health burden associated with psychoactive substance use worldwide. The ASSIST has since undergone significant testing to ensure that it is feasible, reliable, valid, flexible, comprehensive and cross-culturally relevant, and able to be linked to brief interventions (WHO 2008). The ASSIST was developed principally for use in primary health care settings to identify substance use that is not dependent, but still causing harm to an individual. The ASSIST is an interviewer-administered questionnaire and screens for all levels of problem or risky substance use (WHO 2008). A risk score is provided for each substance, and scores are grouped into low, moderate or high risk. The risk score determines the level of intervention (treatment as usual, brief intervention or referral to specialist treatment). The revised version of the ASSIST v2.0 consisted of eight questions covering tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants (including ecstasy), inhalants, sedatives, hallucinogens, opioids and “other drugs”, that could be answered by individuals in around 10 minutes. For the purposes of this

study four questions from the “Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)” questionnaire was included (WHO 2008).

Table 3.15: Example of how to ask one of the questions from the ASSIST questionnaire

“Thank you for agreeing to take part in this brief interview about alcohol, tobacco products and other drugs. I am going to ask you some questions about your experience of using these substances in the past three months. While we are also interested in knowing about your use of various substances, please be assured that information on such use will be treated as strictly confidential.

In the past three months, how often have you used the substances you mentioned: Never, Once or Twice, Monthly, Weekly, Daily or Almost, Daily.”

Clinical assessment

All consenting women were offered full clinical observations: pulse rate, respiratory rate, blood pressure, and oral temperature were measured and the conjunctiva, sclera, breast, abdomen (general and obstetric) and pelvis (speculum and digital vaginal examination if clinically indicated) were examined.

Investigations

Urine assessment

Urinalysis was performed using Multistix 10 SG[®]. These reagent strips are firm plastic strips to which are affixed several separate reagent areas. Multistix 10 SG[®] strips provide tests for glucose, bilirubin, ketones, specific gravity, blood, pH, protein, urobilinogen, nitrite, and leukocytes in urine. Test results may provide information regarding the status of carbohydrate metabolism, kidney and liver function, acid-base balance, and urinary tract infection.

Serological assessments

A simple finger prick test was used to obtain one capillary (<0.5ml) of blood for use in four rapid diagnostic tests: haemoglobin (Hemocue[®]), malaria (Humasis[®]), syphilis

and HIV (SD BIOLINE HIV/Syphilis Duo[®]) and C-reaction protein (QuickRead[®]). All laboratory investigations were all provided by the research team and all research assistants were trained to conduct the investigations using the exact same method of testing. The Hemocue[®] and QuickRead[®] machines were calibrated as per operating instructions in each study setting by specially trained research supervisors to ensure the readings were accurate.

Haemoglobin

Haemoglobin was measured using a hand held Hemocue[®] machine as this device has been used extensively across LMIC to measure haemoglobin. It is portable, easy to use, does not require a laboratory and is relatively inexpensive. The HemoCue[®] device requires a small drop of capillary or venous blood and provides an immediate numerical haemoglobin value. Many studies have examined the accuracy and precision of HemoCue[®] results compared with automated haematology analysers in different adult populations (Nkrumah 2011, Adams 2017, Hinnouho 2017).

Malaria

The Humasis[®] malaria plasmodium falciparum/Pan antigen test is a rapid diagnostic test, that detects the specific antigen, HRP-II (Histidin-rich protein-II) to plasmodium falciparum and the specific antigen in common, pLDH (plasmodium lactate dehydrogenase), to plasmodium vivax, plasmodium ovale and plasmodium malaria (Mouatcho 2013). Using the test principle of HRP-II for plasmodium falciparum, the test demonstrates a sensitivity of 99.5% and specificity of 99.5% and the result is available within 10 minutes (Mouatcho 2013).

HIV and Syphilis

The SD BIOLINE HIV/Syphilis Duo[®] is a common rapid diagnostic test that uses enzyme immunoassay and polymerase chain reaction to allow for simultaneous detection of HIV-1/2 and syphilis antibodies test using one device. One droplet of blood is required, easily obtained by finger-prick. The results of both tests are available within 15 minutes. When compared to other single rapid diagnostic test kits, the sensitivity and specificity for HIV diagnosis has been reported as 100% and 99.96–100% respectively (Shakya 2016). The sensitivity and specificity for syphilis diagnosis has

been reported as 95.5% and 99.9% respectively (Shakya 2016). As with all tests for HIV, a positive test must be repeated using a different kit to rule out a false positive.

C-Reactive Protein

C-reactive protein (CRP) is an acute-phase protein secreted by the liver in response to inflammation. It is not specific for infection but is a marker used for the diagnosis of many infective and inflammatory conditions. During infectious or inflammatory disease states, CRP levels rise rapidly and when the inflammation or tissue destruction is resolved, CRP levels fall, making it a useful baseline measure for control of infection and a marker for monitoring treatment (Jain 2011, WHO 2014).

There are several point-of-care quantitative testing kits available for measuring CRP: (1) NycoCard by Axis-shield (2) QuickRead by Orion Diagnostica (3) Afinion by Axis-shield and (4) Smart 546 by Eurolyser. In this study, QuickRead machine was used as it is portable, easy to use, does not require a laboratory or specialised skills to use the machine, and can be performed on a finger-prick sample of capillary blood. The results are reliable and of high quality comparable to laboratory tests and provide a range of less than five and up to 200 mg/L. Results are available within two minutes and the accuracy has been shown to be comparable to laboratory measurements of CRP (Diar 2012, Ivaska 2015).

There is lack of literature regarding the appropriate cut-off points of CRP in women at different assessment stages, during and after pregnancy and there is no literature regarding this from LMIC. There is currently lack of agreed reference standards on what is a normal and what is an abnormal CRP level at different stages of pregnancy and after childbirth (Trochez-Martinez, 2007). The WHO report that normal CRP levels in a general population are less than 10 mg/L (WHO 2014) and the reported normal CRP level in a non-pregnant woman is 0.2–3.0 mg/L. In UK clinical practice an abnormal CRP is considered greater than 5 mg/L. As labour and childbirth is a physiological inflammatory state, a higher CRP cut-off of 10 was used within 24 hours of childbirth. Therefore, as a pragmatic approach and for the purposes of this study,

a “raised CRP” was defined as >5mg/L at each assessment stage, apart from at delivery (within 24 hours of childbirth) where raised CRP was defined as >10mg/L.

In this research project, due to logistical and financial constraints, CRP was performed on a sub-sample of the study populations attending for care at secondary level healthcare facilities in Malawi and Pakistan. All women in the study populations in Kenya and India had their CRP performed.

3.6 Training of research team

All research assistants were invited to be data collectors if they were skilled birth attendants (doctors, medical officers, nurses and midwives) actively involved in the routine antenatal and postnatal care of women at the selected healthcare facilities and were competent in history taking, clinical assessment, blood sampling and completion of paper or electronic questionnaires.

In Pakistan, Kenya and Malawi, research assistants were reimbursed for their time for each woman recruited to the study with a completed questionnaire. Research assistants used their routine working hours to invite women to take part in the study and recruited women from the antenatal outpatient clinic, postnatal outpatient clinic, or the family planning outpatient clinic, where they were working as healthcare providers. A sub-sample (<10%) of women were recruited from the antenatal or postnatal wards of the healthcare facility, where they were either awaiting childbirth or discharge. Each woman was given a written information leaflet and an appointment was arranged to meet with the women at a time that suited the women, outside normal working hours to ensure that routine maternity care was not interrupted.

All research assistants in Pakistan, Kenya and Malawi completed the research consultation and questionnaire outside their routine work hours, during their lunchbreak or evenings or when they had a rest day. In India, four female doctors

were employed as full-time research assistants for six months for the purposes of this study and women were recruited to this study as part of their routine day-to-day work.

All research assistants and supervisors were trained using standardised training manuals and workshops at the start of the research programme in each country by the lead researcher. Induction and theoretical training of all research assistants and supervisors took place in a lecture theatre or conference room for three days in each study setting (**Appendix 7**). For the first and second day PowerPoint presentations were used to introduce each session, with question and answer sessions and detailed discussion sessions. Day three involved supervision of research assistants practicing and undertaking informed consents from women, conduction of the interviews, performing clinical examination and completing the paper or electronic data collection tool (**Appendix 6**).

All research assistants were supervised taking blood samples and conducting the rapid diagnostic testing prior to the start of data collection. The Hemocue[®] and QuickRead[®] machines, and all rapid diagnostic tests were purchased in Liverpool and distributed to each study site to ensure all women's samples were tested with the same machines and rapid diagnostic test kits. The Hemocue[®] and QuickRead[®] machines were calibrated as per operating instructions in each study setting by specially trained research supervisors.

During data collection, all research assistants were supervised by an in-country research supervisor, who worked as a collaborator for the purposes of this research study. After initial training and supervision, all research activities were co-ordinated and supervised by the lead researcher remotely in Liverpool. If there was a need (for example, problems sending electronic data in Pakistan), the lead researcher travelled to the study setting to resolve the issue.

Introducing the tool

During the three-day training sessions, all research assistants were trained to approach women and to give them written and verbal information regarding the study including a brief overview of the research aims and objectives (**Appendix 8 and 9**). Each research assistant was trained to introduce themselves using their name, title, role and responsibility, including primary place of work. The expectations at each stage of the consultation (interview, examination and investigation) were carefully explained to the women. All research assistants were trained to pause to ensure that their explanation was clearly understood and allowed time for questions and comments to clarify. All research assistants were trained to reassure women that they could decline or discontinue the study at any point without any consequence. There was no payment to the women for the completion of the interview.

Obtaining consent

Each research assistant was trained to obtain informed consent. It was emphasised that obtaining consent occurs in two stages: (1) time for women to read the information leaflet to ensure full understanding of the women, allowing time for questions and comments about any aspect of the study and (2) signing the consent form by signature in the appropriate space. If a woman was illiterate, the information form was read to her by the research assistant and the women used her thumb print to indicate written consent. Another signed copy of the consent form was offered to the women, as her own copy.

All women were administered the same questionnaire in a face-to-face interview (**Appendix 6**). The obstetric examination part of the questionnaire was not required and therefore not completed for women who were assessed postnatally and who had given birth.

Women were approached in the outpatient clinics and inpatient wards of each health care facility. Recruitment took place sequentially until the target sample size for each

assessment stage was reached in each study healthcare facility. All women were interviewed in the local language spoken both by the women and the trained research assistant. All women who consented to take part in the study were interviewed and had a full clinical examination and urine and serological investigations performed by the trained healthcare provider, in their capacity as a research assistant. After training, the average interview lasted 45 minutes, with an average of 15 minutes for examination and taking of samples for investigations. Data was collected using a standardised structured questionnaire.

Definitions of conditions were given

Explanation of what conditions were being screened for was given during the training to ensure standardisation across settings. Internationally agreed definitions of conditions were used.

Clinical examination

All research assistants were trained to conduct systematic examination of the conjunctiva and sclera, pulse rate, respiratory rate, temperature, blood pressure, breasts and abdomen in the same way. All research assistants were trained to conduct pelvic examination (external, internal digital and speculum examination) if clinically indicated, for example, vaginal discharge, abnormal vaginal bleeding. All research assistants were trained to ensure confidentiality and provide privacy to the best of their ability in accordance with local setting standards. All research assistants were trained to expose only the part of the body to be examined at a time in a systematic approach. All research assistants were trained to ensure that women were aware that they could opt out of the examination at any point and to document this discussion on the consent form. All research assistants were trained on how to accurately enter the clinical findings details into the appropriate section of the data collection tool.

Specific training of the research assistants

All research assistants were trained to be courteous and gentle to each woman, to welcome them with a smile and introduce themselves and any other member on the team; to listen to the woman's individual concerns and to provide a full explanation of the clinical assessment. All attempts were made to ensure a private room was available for the examination or an area was cornered off by a screen for the whole consultation. Adequate privacy and confidentiality was emphasised. All research data assistants were trained not to conduct the interview unless these pre-requisites are in place and that the woman felt comfortable with the local set up in the healthcare facility. All research assistants were trained on how to deal with any maternal morbidity detected during the data collection process, how to discuss any abnormal finding with the women, and to provide care themselves or to refer to another member of the clinical team in that healthcare facility. All research assistants were trained to document the reason for referral in the questionnaire. For any detected cases of morbidity that were "new" or for which the research assistant was unsure whether the morbidity was being managed by the routine clinical team, all research assistants were trained to discuss each case with a senior staff member identified in each health care facility and/or research supervisor. The roles and responsibilities were clearly set out to each research assistant (**Table 3.14**) and standardised training was provided in each study setting for each group of research assistants and their supervisors.

Table 3.16: Roles and responsibilities of research assistants

1.	Give verbal information regarding the project in lay language.
2.	Give and explain written information and gain informed consent.
3.	Conduct face-to-face interviews with women at different stages of pregnancy.
4.	Perform obstetric examination on pregnant women and basic clinical examination on postnatal women.
5.	Perform basic obstetric investigations, including urinalysis; rapid diagnostic testing for haemoglobin HIV, malaria, syphilis and CRP.
6.	Ensure all questionnaires are completed correctly and accurately on the hand held computerised device (or on paper if using paper questionnaire).

7.	Ensure the computerised devices (or paper questionnaires) are kept safe and stored securely in an agreed space.
8.	Endorse and display the core values of patient privacy and confidentiality and good medical practice.
9.	Respect the values and culture of the woman.
10.	Support maternity care provision as required when on site for data collection.
11.	Refer women involved in the study to higher level healthcare providers in the study setting if any new maternal morbidity is discovered.
12.	Attend training and orientation at the beginning of the study.
13.	Other duties related to the study as may be assigned by the research supervisor.

Research supervision

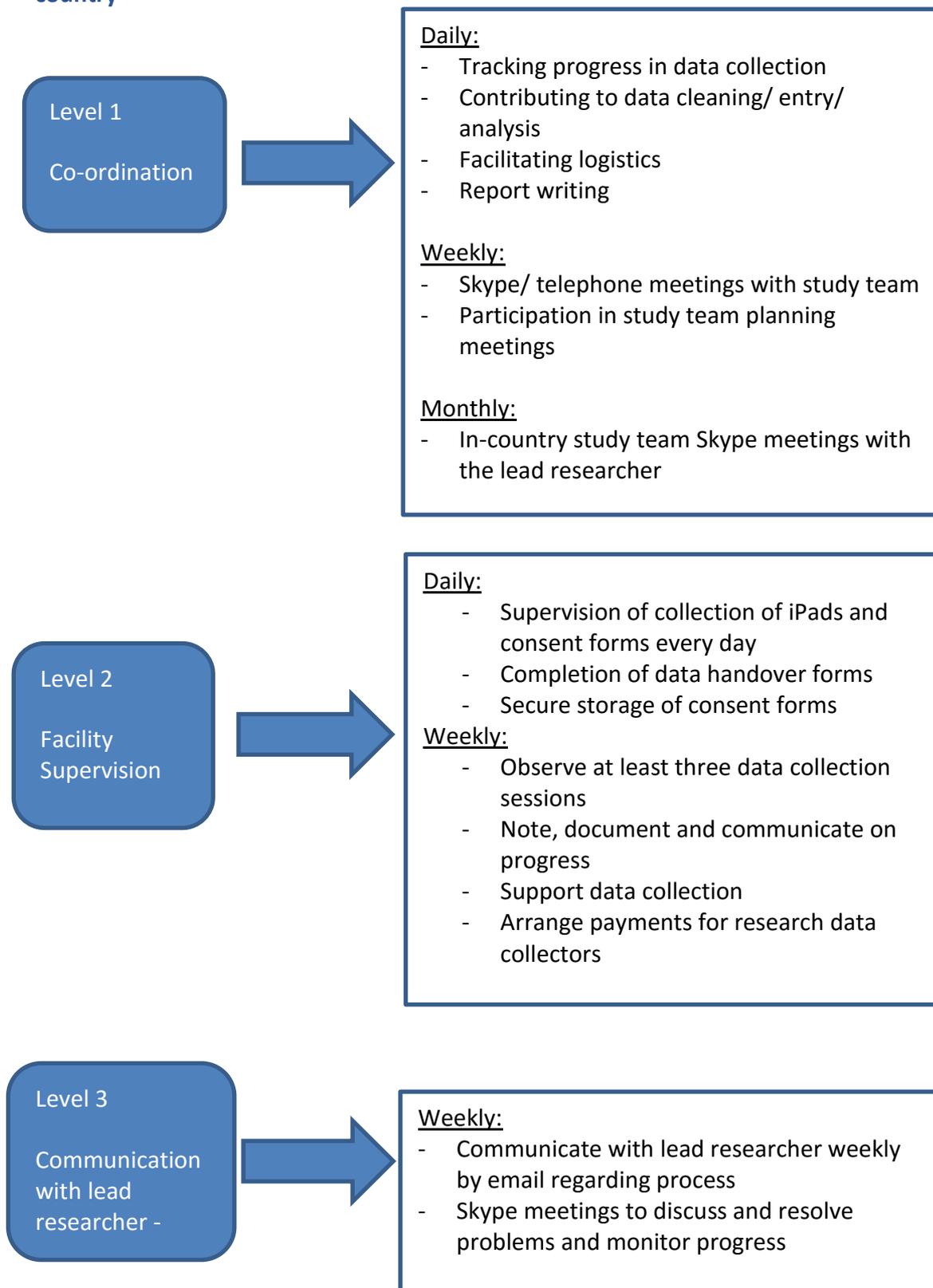
One research supervisor was recruited per secondary level healthcare facility per country and trained in each study setting to provide regular supervisory visits to all research assistants (**Table 3.17**).

Table 3.17: Roles and responsibilities of research supervisors

1.	Visit and introduce the study to healthcare facilities.
2.	Supervisory visits to study sites.
3.	Track and monitor progress of the equal recruitment of women across five assessment stages, with a minimum of 576 women per assessment stage (380 per assessment stage in India).
4.	To ensure accurate and timely payment of research assistants.
5.	To supervise 10% of interviews to ensure quality assurance.
6.	To conduct regular calibration of the machines used to test haemoglobin and CRP for quality assurance.
7.	To clarify any concerns or questions that the research assistants may have.
8.	To motivate the research assistants to continue data collection in their facility.
9.	To collect the completed paper questionnaires in Malawi.
10.	To ensure electronic data is sent correctly in India, Pakistan and Kenya.

Figure 3.5 outlines the study management arrangements with roles and responsibilities at each level. The study was coordinated by the lead researcher in Liverpool with in-country research supervisors directly supervising data collection and facilitating the sending of the data to Liverpool.

Figure 3.5: Levels of supervision and responsibilities of research supervisors per country



Verification of completed data collection tools

All research supervisors were trained to document and monitor the rate of refusal, partially completed forms, duration of data collection and any practical problems and challenges encountered for the research assistants in each study setting and this information was discussed weekly with the lead researcher in Liverpool.

Pilot Study

A pilot study was undertaken in each study setting to validate the effectiveness of the data collection tool and to field test the feasibility and acceptability of the data collection tool and to check the questions were understood as meant (in all settings) in English and after translation into local language. The pilot test was used to assess the flow, limitations, or weaknesses within the questionnaire and to enable necessary revisions to be made prior to the implementation of the full study. Ten women were involved in the pilot-test in each study setting (40 women in total). Women were recruited according to the inclusion criteria for the main study. The pilot test highlighted the need for a standardised explanation to women for certain symptoms and procedures. Based upon initial field experience in all four countries, the questionnaire was revised to improve the quality and clarity. Examples are presented in **Table 3.18**.

Table 3.18: Pilot testing amendments

No.	Issue and resolution
1.	An introductory statement was introduced to each new section of the questionnaire to ensure a better understanding for the woman of what to expect.
2.	A standardised reference list of explanation of words or phrases considered ambiguous by the research assistants was developed to ensure uniform understanding of questions. WHO international definitions were given to clarity for example: stillbirth (24 or 28 weeks), antenatal haemorrhage (amount).
3.	Questions considered to be potentially sensitive were introduced in more detail to ensure the women was at ease; for example: questions regarding domestic violence and thoughts of self-harm.
4.	The HITS questionnaire to assess domestic violence was expanded to assess domestic violence perpetrated by the husband/partner and/or family members.
5.	Some questions screening for symptoms were re-structured so that the flow of questioning was smoother.
6.	During the pilot study, some study sites faced a problem with electronic data collection due to due to lack of availability of internet access. Portable 3G devices were then provided or a local source of Wi-Fi was located.

3.7 Data collection

Data management

The process of data collection was the same in India, Pakistan and Kenya but different in Malawi. Due to lack of internet capacity in the study settings in Malawi, paper questionnaires were developed and formatted for use with Formic® for paper-based data collection in Malawi. The same questionnaire was formatted with Filemaker® for electronic data collection using hand held devices (iPads®) in India, Pakistan and Kenya.

Formic® data collection

Formic® software is a means of processing paper-based data collection forms electronically via an optical scanner. Once the paper questionnaires were completed and returned to the main office in Malawi, they are scanned into the Formic® software programme that can read the handwriting and process it into a digital format suitable for analysis with Excel software. This has the advantage of being a low-tech solution at the point of data collection, whilst allowing for relatively rapid processing of large amounts of data into an electronic format for analysis.

Filemaker® data collection

An electronic version of the questionnaire was formatted using Filemaker® software and downloaded onto iPads®. Hand held devices were programmed with FilemakerGo® software. All iPads were programmed with restrictive access for use of the internet, personal email or other programmes out with the scope of this study. Each iPad® was engraved with the LSTM logo and a tracking device was set up to enable monitoring of the location of the iPad® using remote location software. Each iPad® had a specific security code known only to the research assistant and their supervisor. Each iPad® was set up with a unique email account. At a designated time,

each week, the completed questionnaires were either uploaded directly to a remote server or sent by email using 3G or Wi-Fi connections to Liverpool.

In India, electronic data was sent from the hand-held tablet using a 3G internet connection to a central server set up by an external company in Liverpool. For electronic data collection in Pakistan and Kenya, electronic data was sent from the electronic hand-held tablet as an email attachment using 3G internet connection to an email account set up in Liverpool. The data was downloaded from each email attachment and imported into an Excel file for cleaning and storage.

Prior to data collection in each country internet connectivity was mapped out for each study setting. Prior to training of research assistants, sim cards were purchased in-country by the lead researcher, configured and activated to ensure 3G internet connection for each hand-held tablet. In Pakistan, there was no internet connectivity in several rural study sites. In these cases, data was stored on the hand-held tablets and the in-country research supervisor would collect the tablets on a weekly basis and use a Wi-Fi connection in the urban setting to send the data by email attachment.

For the electronic data collection, it was possible to review the time spent to complete each questionnaire and the time data was sent by email. This helped with the quality assurance of the data collection process and to monitor the number of women recruited per assessment stage per country remotely from Liverpool also.

All study materials including the iPads® were distributed to the research assistants. Each research assistant, research supervisor and/or head of facility signed a handover of equipment form and accepted the responsibility of the storage and use of the iPads. It was agreed that if the iPads were damaged or missing, it was the responsibility of the in-country research team to replace them. Each iPad® was password protected and all data management complied with standard operating privacy and confidentiality procedures.

Storage and distribution of data collection materials in study sites

All study materials were stored in a designated office within each healthcare facility. From there, research assistants collected the iPads daily and returned the completed consent forms for filing. All research assistants were trained with regards to the utmost importance of security and privacy. Locked cabinets accessible only to the research team were used to store the study materials including completed consent forms. In Malawi, completed paper forms were stored in locked purpose-built cupboards before being transported to the CMNH-LSTM office in Lilongwe and scanned to Liverpool monthly. In Liverpool, the data was then scanned into the Formic[®] scanner and downloaded onto Excel software where it is stored and cleaned.

Electronic data collected in India, Pakistan and Kenya was either uploaded directly to the remote server or sent by email attachment by research assistants to an email account based in CMNH-LSTM. The data is imported into an Excel file, checked for duplication, and missing information or incomplete entries by the research team at CMNH-LSTM. The lead researcher in Liverpool monitored the electronic data uploading, importing and maintenance of database and data cleaning of database on a weekly basis.

Data storage

Once data was received by the research team in Liverpool, data was cleaned and coded in four separate Excel files, one per country. A data dictionary was used to code each variable, to enable summative assessments for example, socio-economic status, and EPDS, HITS and ASSIST scores.

Once all data had been cleaned and coded for each country, Excel files were merged to create one large database. Basic analysis was conducted using SPSS and advanced analysis was conducted using STATA[®] software. Standardised operating protocols were used for all data collection, cleaning and monitoring of data as per the institute guidelines.

All data was treated confidentially and electronic data was password protected and only accessible to the research team. To protect privacy and confidentiality, a unique identification number was allocated to each completed the questionnaire. Names were not included in the database. All standard procedures to ensure high quality data collection, processing, storage and analysis were employed, according to LSTM institutional protocols. Raw data has been stored and will remain protected for at least five years before it is destroyed, as stipulated by national data protection recommendations.

Data analysis

Descriptive statistical analysis was used to describe frequency, mean, median. Data analysis was conducted using the software programs SPSS® v22 and STATA® version 12.1. Occurrence of each symptom and sign was individually evaluated. Where possible, documentation of symptoms, signs and investigations were “triangulated” and grouped as indicative of specific maternal morbidities e.g. headache, visual disturbances, upper abdominal pain, raised blood pressure plus proteinuria indicative of pre-eclampsia. A reported symptom of a productive cough of more than two weeks, was used to indicate either a possible chest infection or suspected TB.

Definitions

At the time of writing, there are no WHO recommendations on the use of different haemoglobin cut-off points for anaemia by stage of pregnancy, but it is recognized that during the second trimester of pregnancy, haemoglobin concentrations decrease slightly due to haemodilution. In absence of alternative cut-offs and for the purposes of this study, anaemia was classified as per WHO, as haemoglobin less than 110 g/l (WHO 2011b). Anaemia is further classified and presented as mild (100-109 g/l); moderate (70-99 g/l); and severe <70 g/l) (WHO 2011b) to illustrate differences in severity of anaemia in the five different assessment stages, during and after pregnancy. Hypertension was classified as BP \geq 140/90 (Brown 2001). Pre-eclampsia was defined as BP \geq 140/90, and proteinuria (Pr++ on urinalysis) after 20 weeks' gestation (Brown 2001). Antenatal haemorrhage was defined as a woman who self-

reported bleeding per vaginum during pregnancy and/or had this confirmed on examination. Incontinence was defined as a woman who self-reported any incontinence of urine and/or had this confirmed on examination.

The Systematic Inflammatory Response Syndrome (SIRS) (Balk 2014) was adapted by the lead researcher to define possible early infection as the presence of two or more of the following:

- (1) $T > 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$,
- (2) PR > 90 beats per minute;
- (3) RR > 20 breaths per minute or
- (4) Raised CRP

For the purposes of this study, a raised CRP was defined as $> 5\text{mg/L}$ at each assessment stage, apart from at delivery where raised CRP was defined as $> 10\text{mg/L}$. For the purposes of this research project individual conditions were then aggregated into different types of maternal morbidity: physical; psychological; and social. Summative physical morbidity was defined as (1) infectious or (2) medical/obstetric. Infectious physical morbidity included: HIV, malaria, syphilis, possible chest infection, and a SIRS score of ≥ 2 . Medical/obstetric morbidity included: anaemia, hypertension, pre-eclampsia, antenatal haemorrhage and incontinence. Psychological morbidity was defined as an EPDS score of ≥ 10 and/or thoughts of self-harm. Social morbidity was defined as women reporting any domestic violence (HITS score > 4) and/or any substance misuse.

Statistical methods

A p-value of < 0.05 was used to determine statistical significance and estimates provided with 95% confidence intervals. Odds Ratios (OR) were estimated using univariate and multivariate logistic regression models for binary and categorical variables. Variables statistically significant in univariate analyses were considered for inclusion in multivariable analyses. Likelihood ratio tests were used to compare logistic regression models.

To examine evidence of associations between morbidities, loglinear models were used. Firstly, exploration of associations between countries were performed to assess whether there was evidence of heterogeneity between countries using loglinear models. The following variables were included in the fullest possible loglinear model: country and infectious, medical/obstetric, psychological and social morbidity. All possible interactions, up to the five-way interaction between country and each of the four morbidities were explored. All interactions involving country were then eliminated from the model and a likelihood ratio test was used to compare the sub-model with the full model and thereby testing for evidence of heterogeneity in effect between countries.

For each country, strength of associations of all the different types of interactions between the four different types of morbidities were explored using a loglinear model. For each country, firstly the full model was fitted using all main effects of the four morbidities and all the possible interactions. Terms which were not statistically significant at the 5% level were then eliminated from the model to identify the simplest sub-model which was not a significantly poorer fit. In the final set of analyses, only two-way interactions were considered. Those that were not statistically significant were eliminated from the model, to identify the simplest sub-model which was not a significantly poorer fit of the model with two-way interactions only.

Unless otherwise stated, all percentages reported use the total sample size for the relevant country. Where a substantial proportion of women had data missing for a variable, this is stated in the text, but the numbers missing are not displayed in the tables.

3.8 Ethical considerations

This study involved face-to-face interviews, clinical examination and basic laboratory investigations conducted in one consultation with women during or after pregnancy.

Key ethical concerns associated with the study are presented in **Table 3.19**.

Table 3.19: Ethical considerations for this research project

Number	Ethical consideration
1.	Length of the questionnaire and potentially sensitive nature of some of the questions e.g. domestic violence
2.	Clinical examination and investigations performed on women who may not have complained of any symptoms
3.	The implications of HIV and syphilis testing for the women themselves regarding partner notification
4.	Ensuring privacy for the women during interviews and examination
5.	Confidentiality of data collected from women
6.	Providing care for cases of morbidity detected during the study
7.	Disruption of services at healthcare facility where the study was conducted
8.	Collecting information that is part of routine ANC and PNC as a researcher, rather than a healthcare provider

The following steps were taken to address these concerns:

1. Length of the questionnaire and potentially sensitive nature of some of the questions e.g. domestic violence

Local healthcare providers were trained to be efficient and concise and observe the skips in the questionnaire to avoid asking irrelevant questions whilst administering the questionnaire. All research assistants were trained on the approach to ask sensitive questions and how to handle any concerns raised by the items in the questionnaire and/or finding of examination and investigations. The length of interview did vary depending on whether significant maternal morbidity was uncovered. This did mean that more

time was required to counsel and refer the woman onto another care giver as necessary if morbidity was detected.

2. Clinical examination and investigations performed on women who may not have complained of any symptoms

To address concerns about examination and carrying out tests in the absence of any perceived symptoms, explanations were provided to women that the examination and investigations are not different from the assessments provided for women as part routine maternity care. Research assistants emphasised the potential benefits of detecting ill-health that the woman did not recognise, for example pre-eclampsia. Opportunities were provided and women were made aware of options to decline any part of the examination and investigations they find uncomfortable without any repercussions.

3. The implications of HIV and syphilis testing for the woman and partner notification.

All women were invited to consider undertaking a voluntary HIV and syphilis rapid diagnostic test. If the woman declined the test this decision was respected. If the women freely accepted to partake in the rapid diagnostic testing of both HIV and syphilis, further in-depth pre-test counselling and consenting was undertaken in accordance with local protocols. All research assistants were trained to ensure that all women were made fully aware of the implications of the results of the HIV test. The national guidelines for each country provided detailed standards and protocols for disclosure of HIV status and partner notification and accordingly the research assistants were trained to assess the women's views and ability regarding disclosure of this information to the women's husband. All research assistants were trained to recommend to the women that the husband should attend the healthcare facility as soon as possible to undergo testing also. All research assistants were trained to conduct a second confirmatory test for the women using another test method in the local laboratory to ensure the accuracy of any HIV positive result. Confidentiality was respected always and all decisions made in conjunction with the woman.

All research assistants were staff members of the healthcare facility that the women are interviewed in and they, therefore, were available to counsel, support, monitor and follow up the women post-test as per national guidelines recommendations. If the research assistants felt this counselling was beyond their capacity, the research assistant was trained to ensure that the woman and her husband were referred to the most senior local healthcare provider for further follow up of the management of HIV and/or syphilis.

4. Privacy for women during interviews and examination

To protect privacy and confidentiality, a unique identity number was allocated to each questionnaire. Names and addresses were not recorded anywhere in the questionnaire or any data collection form connected to women. Data collection whether during interviews or clinical examination were in private and all samples collected for investigations were treated with confidentiality in line with local guidelines. If any need occurred to refer a woman for further treatment, local guidelines were followed to ensure that information was given on a need to know basis only.

5. Confidentiality of data collected from women

All data collected was treated confidentially whether on paper or electronic format. No one had access to the data other than the study staff. Paper formats were filed under lock and key and electronic data were password protected only accessible to the research team. Data was used only for the study and names of women were not recorded.

6. Providing care for cases of morbidity detected during the study

The research team were trained and oriented to support the provision of care while collecting data. Any new morbidity detected was recorded in the woman's medical records and discussed with the appropriate healthcare provider who was responsible for the ongoing care of the women.

7. Disruption of services at service delivery points where the study was conducted

In Pakistan, Kenya and Malawi, research assistants were reimbursed for their time for each woman recruited to the study with a completed questionnaire. Research assistants used their routine working hours to invite women to take part in the study. Each woman was given a written information leaflet and an appointment was arranged to meet with the women at a time that suited the women, outside normal working hours to ensure that routine maternity care was not interrupted. All research assistants in Pakistan, Kenya and Malawi completed the research consultation and questionnaire outside their routine work hours, during their lunchbreak or evenings or when they had a rest day. In India, four female doctors were employed as full-time research assistants for six months for the purposes of this study and women were recruited to this study as part of their routine day-to-day work.

Health promotion

As part of the training, all research assistants were trained and encouraged to counsel the women regarding general well-being in pregnancy, birth spacing and general reproductive health promotion throughout the interview.

Disclosure of domestic violence

All research data collectors were trained extensively to approach these questions with sensitivity and to counsel women per the options available to them to make an informed choice of action. For example, written and verbal information was offered regarding non-governmental organisations in the area, who could provide support for women suffering from domestic violence. In many cases, the research assistants were also full-time members of staff in the healthcare facilities that the women were attending and, therefore, they were available to offer further counselling, support and follow up for the women, later as necessary.

Dissemination

Preliminary feedback was given to in-country collaborators. Final results of this study will be published in peer review journals. Copies of the published work will be made available to all heads of each healthcare facility for distribution to research supervisors and research assistants involved in this study.

Ethical approval

LSMT granted full ethical approval (LSTM14.025). Ethical approval was obtained from each country specific research ethics committee (**Table 3.1**). Written informed consent was obtained from each woman who participated in the study.

Table 3.20: Ethical approval from each country research committee

Country	Research committee	Reference number
India	Research and Ethics Committee, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi	IEC/SJH/VMMC/Project/September-14/19/482
Pakistan	National Bioethics Committee, Islamabad	4-87/14/NBC-159/RDC/1850
Kenya	Kenyatta National Hospital and University of Nairobi, Ethics and Research Committee, Nairobi	P574/09/214
Malawi	The College of Medicine Research and Ethics Committee, College of Medicine, Blantyre	P.07/14/1600

3.9 Chapter summary

This chapter has described the approach used to measure maternal morbidity using physical, psychological and social health in a comprehensive and standardised way in women during and after pregnancy at different healthcare levels in India, Pakistan, Kenya, Malawi. The positionality of the lead researcher and contribution was considered. The study design, study settings, study population and sampling was then described. How the sample size was determined and the data collection tool and the process of piloting was described. This chapter described the process of data collection, processing, cleaning, coding and analysis. This chapter concluded with how the quality of the data was assured and ethical considerations were described and addressed. The next chapter is the first chapter that describes the results of this study.

CHAPTER 4: RESULTS ONE

4.1 Introduction

This is the first of four chapters that report on the results of this research project. The four chapters that present the main results of the research study, are structured in sequence to address each main research question. For the purposes of this thesis, results for the study settings are presented per country in the following sequence: India, Pakistan, Kenya and Malawi. Where appropriate, results are presented as a combined study population.

In this chapter, the prevalence and types of ill-health (symptoms, signs and investigations) that contribute to maternal morbidity are described per country study population and as a combined study population.

- Chapter 5, the second results chapter, presents the prevalence of maternal morbidity per assessment stage of pregnancy per country and as a combined study population.
- Chapter 6, the third results chapter, presents the factors associated with maternal morbidity per country.
- Chapter 7, the fourth results chapter, presents the associations between different types of maternal morbidity per country.

Results are presented in a narrative text accompanied by tables and figures. Where supplementary information is necessary, this is presented in the appendices. At the end of each results chapter, the main findings are summarised and compared to published literature. Further positioning of the findings from all the results chapters are further compared to available literature in the main discussion chapter of this thesis in more detail.

In this research study, there were four research questions.

Table 4.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

In this chapter, research question one is addressed. For standardisation, study populations are described firstly for India, Pakistan, Kenya and then Malawi throughout. When describing the study populations from each country, for standardisation, the country name is used. This does not mean that the study population from each country is representative of the remainder of the country.

Unless otherwise stated, all percentages reported use the total sample size for the relevant country. Where a substantial proportion of women (more than 10%) had data missing for a variable, this is stated in a footnote, but for ease of readability, the numbers missing are not tabulated.

4.2 Study population

A total of 11454 women across four LMICs were assessed: India (2,099; 18.3%), Pakistan (3,287; 28.7%), Kenya (3,145; 27.5%) and Malawi (2,923; 25.5%). **Table 4.2** displays the study sites, the healthcare level and number of women recruited per study site across the four LMIC.

Table 4.2: Number of women recruited per health facility per country and total.

Country	Region	District	Healthcare Level	Name of health care facility	Number of women recruited
India	New Delhi	New Delhi	Secondary	Safdarjung Hospital	2,099
				TOTAL	2,099
Pakistan	Islamabad Capital Territory	Rawalpindi	Secondary	Pakistan Railway Hospital	181
				PESSI Hospital Islamabad I-12	307
	Punjab	Attock	Secondary	DHQ Hospital Attock	509
				THQ Hospital Hassan Abdal	350
				THQ Fateh Jang	395
	Primary	RHC Maghian	113		
		RHC Bahter Tehsil	707		
RHC Chhab	289				
RHC Rango Tehsil	246				
Hazro					
RHC Domail	190				
				TOTAL	3,287
Kenya	Central	Nyeri	Secondary	Nyeri Provincial General Hospital	356
			Primary	Naromoru Health Centre	250
		Murang'a	Secondary	Endarasha Health Centre	189
			Primary	Murang'a County Referral Hospital	670
		Kiambu	Secondary	Kandara Sub-County Hospital	235
			Primary	Kigumo Sub-County Hospital	209
	Secondary	Kiambu Hospital	330		

			Primary	Githunguri Health Centre Karuri Health Centre	246 660		
				TOTAL	3,145		
Malawi	South	Blantyre	Secondary	Limbe Health Centre	1,073		
			Primary	Ndirande Health Centre Bangwe Health Centre	180 159		
		Mulanje	Secondary	Mulanje District Hospital	740		
			Primary	Chonde Health Centre Mulomba Health Centre	277 57		
		Mwanza	Secondary	Mwanza District Hospital	135		
			Primary	Thambani Health Centre Tulonkhondo Health Centre	121 181		
						TOTAL	2,923
		TOTAL NUMBER OF WOMEN INCLUDED ACROSS FOUR COUNTRIES					11454

DHQ -District headquarter, THQ-Tehsil headquarter, RHC-Rural health centre

This study was a cross sectional study. The minimum sample size in Pakistan, Kenya and Malawi was estimated as 2880, with a minimum sample size for each of the five assessments stages of 576. In India, the study was conducted in one facility (secondary level) giving an amended sample size of 1900 with a minimum of 380 women per assessment stage.

Some research assistants across the four LMIC collected more data from women at various assessment stages. Instead of discarding this data, all data was included in the final analysis. Similar proportions of women were recruited for each assessment stage from each country setting with more women recruited from late antenatal and late postnatal stages (**Table 4.3**).

Table 4.3: Women recruited per healthcare facility level per assessment stage per country and per total.

Variable and category	India (n=2,099)		Pakistan (n=3,287)		Kenya (n=3,145)		Malawi (n=2,923)		Total (n=11454)	
	n	%	n	%	n	%	n	%	n	%
Stage of pregnancy										
Early antenatal	416	19.8	607	18.5	592	18.8	589	20.2	2204	19.2
Late antenatal	397	18.9	768	23.4	684	21.7	576	19.7	2425	21.2
Delivery	423	20.2	654	19.9	592	18.8	581	19.9	2250	19.6
Early postnatal	432	20.6	618	18.8	620	19.7	594	20.3	2264	19.8
Late postnatal	431	20.5	640	19.5	657	20.9	583	19.9	2311	20.2
Healthcare facility level										
Secondary	2099	100	1740	52.9	1686	53.6	1,948	66.6	7473	66.7
Primary	0	0	1547	47.1	1459	46.4	975	33.4	3981	33.3

Overall, more women, 7473 (66.7%) were assessed in secondary healthcare facilities (those provided comprehensive emergency obstetric care), compared to primary level (those provided basic emergency care), 3,981 (33.3%). In India, one large teaching secondary level healthcare facility was included in the study, and hence, 100% of women in this study population in India were from secondary level healthcare facility. In Pakistan, 52.9% of women were recruited from a secondary level healthcare facility and 47.1% of women were recruited from a primary level healthcare facility. In Kenya, 53.6% of women were recruited from a secondary level healthcare facility and 46.4% of women were recruited from a primary level healthcare facility. In Malawi, 66.6% of women were recruited from a secondary level healthcare facility and 33.4% of women were recruited from a primary level healthcare facility.

Overall, the refusal rate was low and this main reason for giving refusal was mainly due to the woman reporting a lack of time. The refusal rate was 1.1%, 2.5%, 1.7% and 2.1% for India, Pakistan, Kenya and Malawi respectively. Overall, following recruitment and after taking a clinical history, 150 women (1.3%) declined clinical examination and 138 women (1.2%) declined laboratory investigations. There was no difference in the percentage of women who declined clinical examination and investigations across the four LMIC.

In the following tables and, percentages reported are derived from the number of women who responded. Missing data was less than 10% for each variable presented.

Social-demographic items

Age

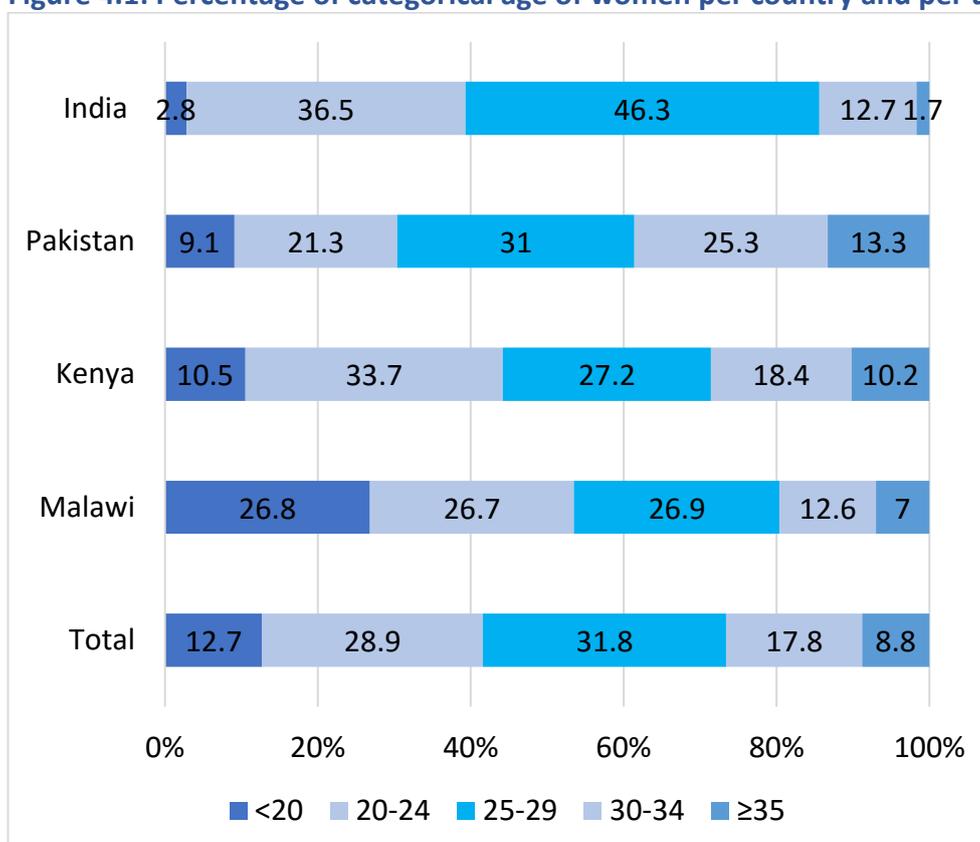
Overall, 12.7% of the combined study population were adolescents (<20 years at time of assessment) (**Table 4.4** and **Figure 4.1**). The mean standard deviation (SD) age at recruitment was 26 (5.9) years and broadly similar across the countries: India 26 (3.7), Pakistan 27 (6.1), Kenya 26 (5.9) and Malawi 24 (6.5). There were higher numbers of teenage pregnancies in Malawi (26.8%) and Kenya (10.5%) compared to Pakistan (9.1%) and India (2.8%). More women in Malawi and Kenya were younger compared to India and Pakistan, with the majority aged 20-24 years in Malawi (26.7%) and in Kenya (33.7%). Women in India and Pakistan were older with the majority aged 25-29 years (46.3%) and (31.0%) respectively. In Pakistan, there were more women (13.3%) aged over 35 years.

Table 4.4: Percentage of women per categorical age per country and per total

Category	India	Pakistan	Kenya	Malawi	Total
Number of women	2,099	3,287	3,145	2,923	11,454
Percentage*	%	%	%	%	%
Age category (years)					
<20	2.8	9.1	10.5	26.8	12.7
20-24	36.5	21.3	33.7	26.7	28.9
25-29	46.3	31.0	27.2	26.9	31.8
30-34	12.7	25.3	18.4	12.6	17.8
≥35	1.7	13.3	10.2	7.0	8.8
TOTAL	100	100	100	100	100.0

*Percentages reported are derived from the number of women who responded.

Figure 4.1: Percentage of categorical age of women per country and per total



Marital status

Overall, 93.2% of women assessed were married and 5.4% were single. Overall, 1.3% of women did not answer or were widowed. There were more single women in Kenya (15.9%) and Malawi (4.0%), compared to India (0.2%) and Pakistan (0.2%) (**Table 4.5**).

Table 4.5: Marital status per country and per total

Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n= 11454)	
	n	%	n	%	n	%	n	%	n	%
Single	4.0	0.2	7.0	0.2	501	15.9	116	4.0	628	5.4
Married	2094	99.8	3267	99.4	2573	81.8	2748	94.0	10682	93.2
Other	1.0	0.1	13	0.4	71	2.3	59	1.9	144	1.3
Total	2099	100	3287	100	3145	100	2923	100	11454	100

Level of formal education completed

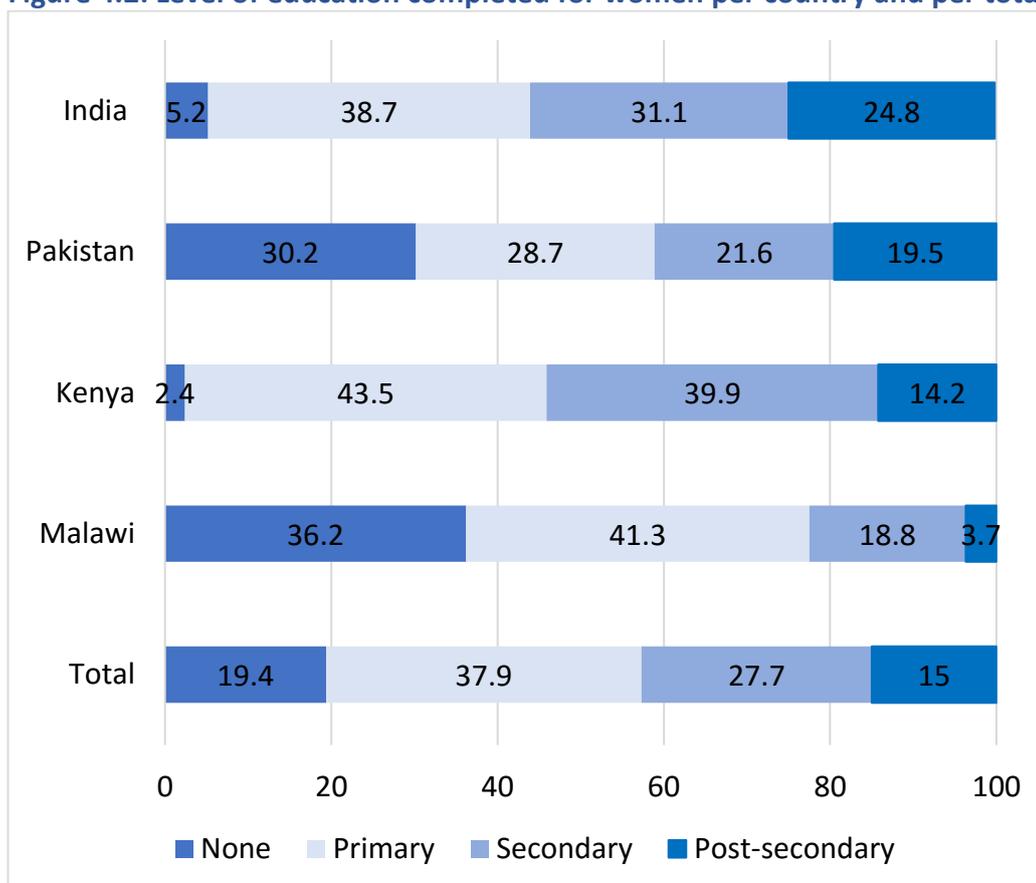
Overall, 19.4% of women had no education, 37.4% completed primary level, 27.7% completed secondary level and 15.0% completed post-secondary level education (**Table 4.6** and **Figure 4.2**). The highest percentages of women with no education level completed was in in Malawi (36.2%) and then Pakistan (30.2%). More women were educated to graduate level in India (24.8%). Overall, there were more educated women in Kenya (97.6%) compared to the other country settings. The median (IQR) number of years of formal education was 10 (7-12) in India, 5 (0-10) in Pakistan, 12 (8-12) in Kenya, 8 (5-11) in Malawi.

Table 4.6: Level of education completed for women per country and per total

Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n= 11454)	
	n	%*	n	%*	n	%*	n	%*	n	%*
No level completed	111	5.2	955	30.2	74	2.4	1,055	36.2	2195	19.4
Primary	812	38.7	911	28.7	1,363	43.5	1,202	41.3	4288	37.9
Secondary	653	31.1	683	21.6	1,253	39.9	547	18.8	3136	27.7
Post-secondary	522	24.8	616	19.5	445	14.2	107	3.7	1690	15

*Percentages reported are derived from the number of women who responded

Figure 4.2: Level of education completed for women per country and per total



Socio-economic status

Overall, 9.7% of women were in the 5th quintile (lower), 11.8% in the 4th quintile, 26.9% in the 3rd quintile, 30.3 % in the 2nd and 13.5% in the 1st quintile (upper) SES level (**Table 4.7**). Overall, most women (30.3%) were in the 2nd/upper middle SES level.

In India and Pakistan, an adapted Kuppuswamy's score was used to assess SES and hence the calculations are comparable. More women were in the upper (1st quintile) SES level in Pakistan (15.2%) compared to India (0.4%). More women were in the upper lower (2nd quintile) SES level in India (59.5%) compared to Pakistan (35.1%). More women were in the middle (3rd quintile) SES level in Pakistan (45.1%) compared to India (28.5%). More women were in the upper lower (4th quintile) and lower (5th quintile) SES level in India (9.1% and 2.5%) compared to Pakistan (3.7% and 0.7%) (**Table 4.7**).

Due to the relative nature of the calculation of SES in Kenya and Malawi (wealth index), similar proportions of women were split into the five quintiles with the top 20% of the highest wealth index level in the 5th quintile, the next 20% in the 4th quintile and so forth. The measure of SES was not an absolute measure of SES in this setting but enabled aggregation of women in different wealth quintiles for comparison in further analysis. In Kenya, 28.4% of women did not answer all the questions required to calculate wealth index and therefore this data was missing. *Therefore, the percentages for women in Kenya in **Table 4.7** do not add up to 100.

Table 4.7: Socio-economic status of women per country and per total

Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n= 11454)	
	n	%*	n	%*	n	%*	n	%*	n	%*
Socio-economic status										
1st quintile (upper)	9	0.4	501	15.2	448	14.2	591	20.2	1549	13.5
2nd quintile	1248	59.5	1153	35.1	452	14.4	613	21.0	3466	30.3
3rd quintile	599	28.5	1484	45.1	450	14.4	547	18.7	3080	26.9
4th quintile	190	9.1	124	3.7	450	14.4	588	20.1	1352	11.8
5th quintile (lower)	53	2.5	25	0.7	451	14.4	583	19.6	1112	9.7

*Percentages reported are derived from the number of women who responded

Number of previous pregnancies

For standardisation, the term “pregnancy” is used to represent a birth (including livebirth and stillbirth) after 28 weeks. Overall, 13.7% of women had no previous pregnancy, 35.2% had one previous pregnancy, and most (45.9%) had two to four previous pregnancies. A small subsample 5.2% had at least five or more previous pregnancies (**Table 4.8**).

In India, 45.6% of women had one previous pregnancy; 39.3% of women had two to four previous pregnancies; 14.6% had no previous pregnancy and 0.5% had five or more previous pregnancies. In Pakistan, 50.5% of women had two to four previous pregnancies; 29.0% had one previous pregnancy, 11.8% had no previous pregnancy and 8.7% had five or more previous pregnancies. In Kenya, 43.6% of women had two

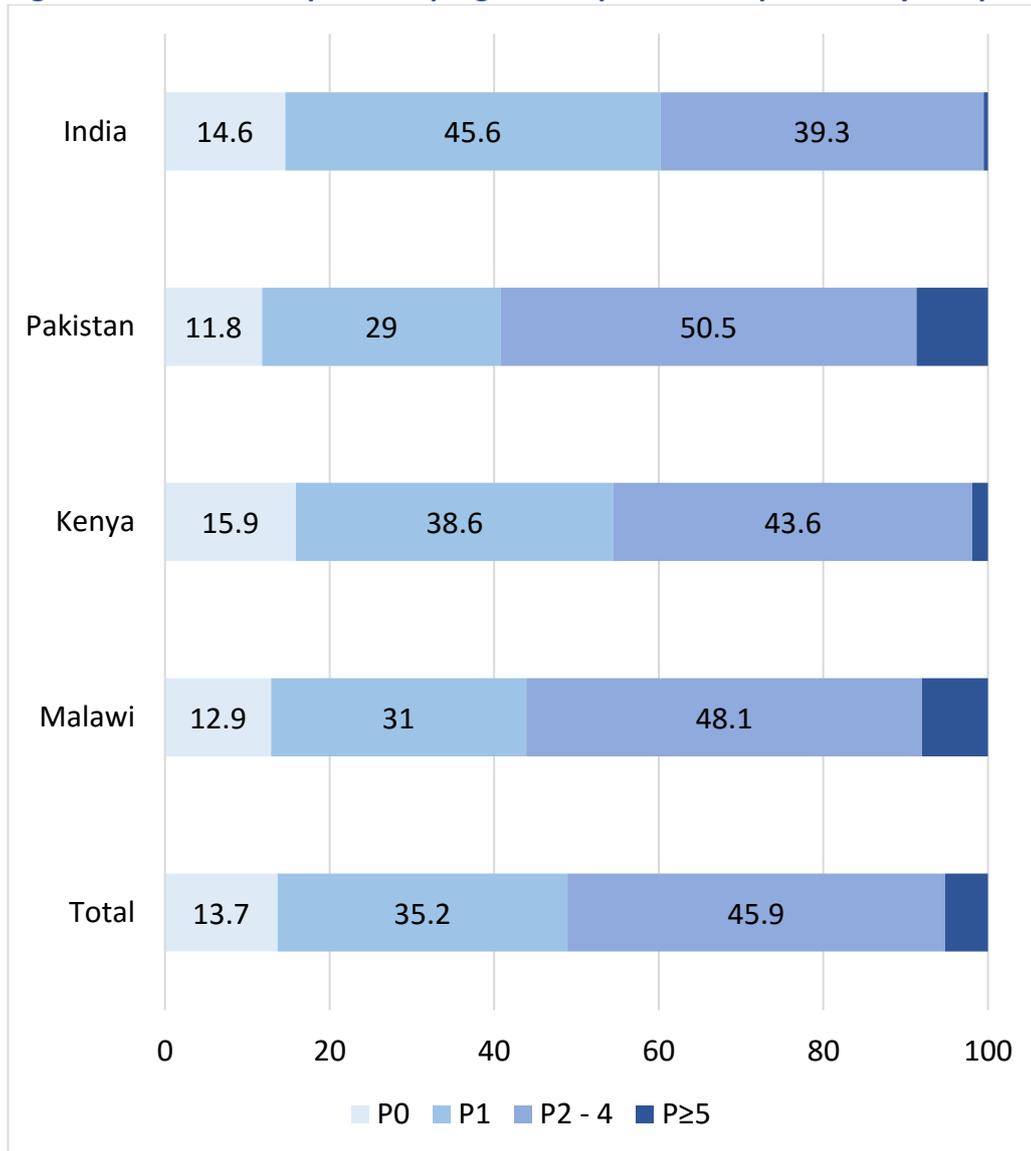
to four previous pregnancies, 3% had one previous pregnancy, 15.9% had no previous pregnancy and 1.9% had five or more previous pregnancies. In Malawi, 48.1% of women had two to four previous pregnancies, 31.0% had one previous pregnancy, 12.9% had no previous pregnancy and 8.0% had five or more previous pregnancies. Higher proportions of women were multiparous (P2-4) in Pakistan (50.5%) and Malawi (48.1%), compared to Kenya (43.6%) and India (39.3%). Similar percentages of women were grand multiparous (P≥5) in Malawi (8.0%) and Pakistan (8.7%). The highest percentage of women with one previous pregnancy was in India (45.6%). (Table 4.8 and Figure 4.3).

Table 4.8: Number of previous pregnancies for women per country and per total

Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n= 11454)	
	n	%*	n	%*	n	%*	n	%*	n	%*
0	285	14.6	353	11.8	486	15.9	375	12.9	1499	13.7
1	893	45.6	865	29.0	1175	38.6	901	31.0	3834	35.2
2-4	770	39.3	1508	50.5	1326	43.6	1398	48.1	5002	45.9
≥5	9	0.5	258	8.7	56	1.9	232	8.0	555	5.2

*Percentages reported are derived from the number of women who responded

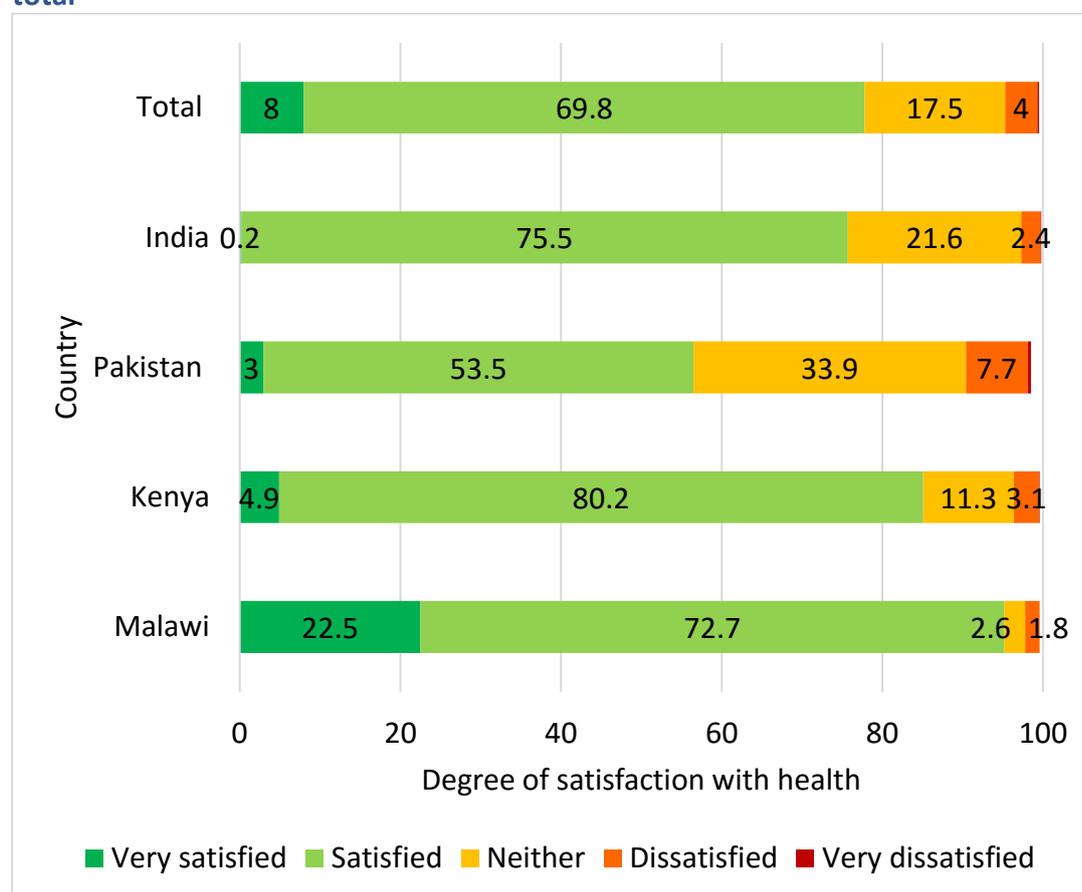
Figure 4.3: Number of previous pregnancies per woman per country and per total



4.3 Self-reported measures of health

Overall, 8.0% of women were very satisfied, 69.8% were satisfied, 17.5% were neither satisfied or dissatisfied, 4.0% were dissatisfied and 0.2% were very dissatisfied with their health. Overall, most women (77.8%) were very satisfied or satisfied with their health. More women were very satisfied in Malawi (22.5%) and more women were satisfied (80.2%) in Kenya, compared to the other country settings. In Pakistan, 7.7% of women were dissatisfied and 0.4% were very dissatisfied with their health. In India, 21.6% of women were neither satisfied or dissatisfied with their health (Figure 4.4).

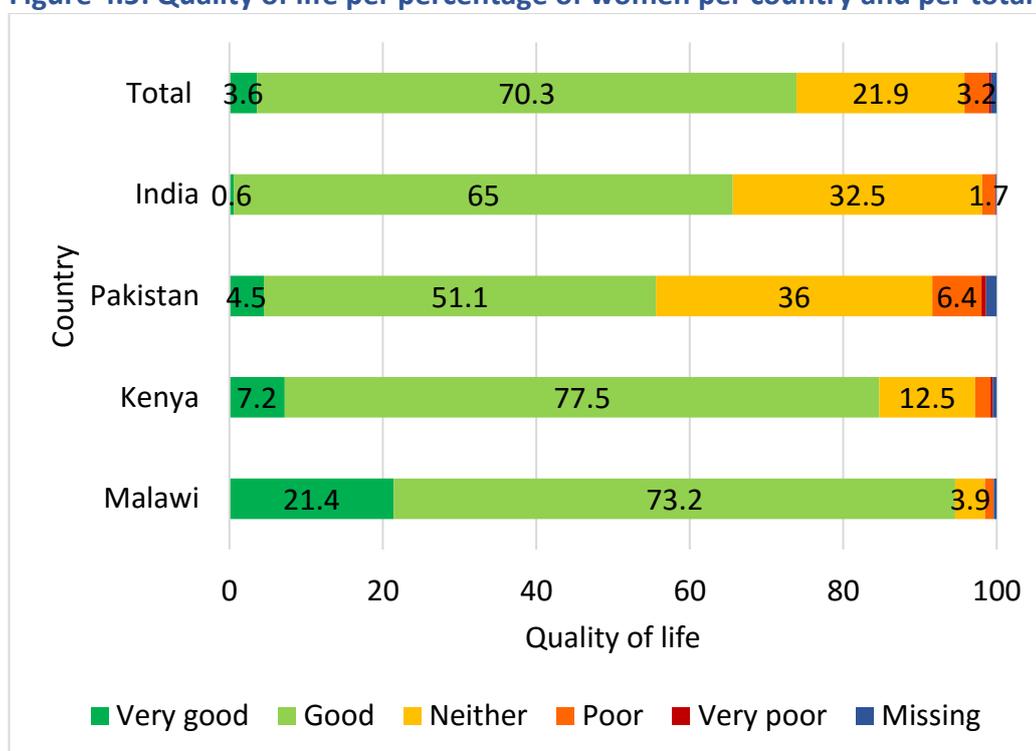
Figure 4.4: Satisfaction with health per percentage of women per country and per total



Quality of life

Overall, most women (73.9%) reported a very good or good quality of life. More women reported a very good quality of life in Malawi (21.4%) and more women reported a good quality of life in (77.5%) in Kenya. More women reported poor (6.4%) or very poor (0.6%) quality of life in Pakistan. In India, 32.5% of women reported neither a good or poor quality of life. The results for reporting of quality of life are like satisfaction with health (Figure 4.4 and 4.5).

Figure 4.5: Quality of life per percentage of women per country and per total



Number of symptoms

A detailed clinical history was obtained. Almost three quarters of all women, (8,425; 73.5%) reported at least one clinical symptom with a median (IQR) of 4.2 (0-27) symptoms per woman. Women in Pakistan and India most frequently reported symptoms (92.2% and 90.6% of women respectively).

Table 4.9: Categories of symptoms per country and per total

Variable and category	Country								TOTAL (n=11454)	
	India (n= 2099)		Pakistan (n=3286)		Kenya (n=3145)		Malawi (n=2923)		n	%*
	n	%*	n	%*	n	%*	n	%*		
Current physical symptoms										
None	199	9.5	258	7.9	1228	39.1	1344	46.0	3029	26.4
1-3	1036	49.4	710	21.6	1148	36.5	1201	41.1	4095	35.7
≥4	864	41.2	2319	70.6	769	24.4	378	12.9	4330	37.8

*Percentages reported are derived from the number of women who responded

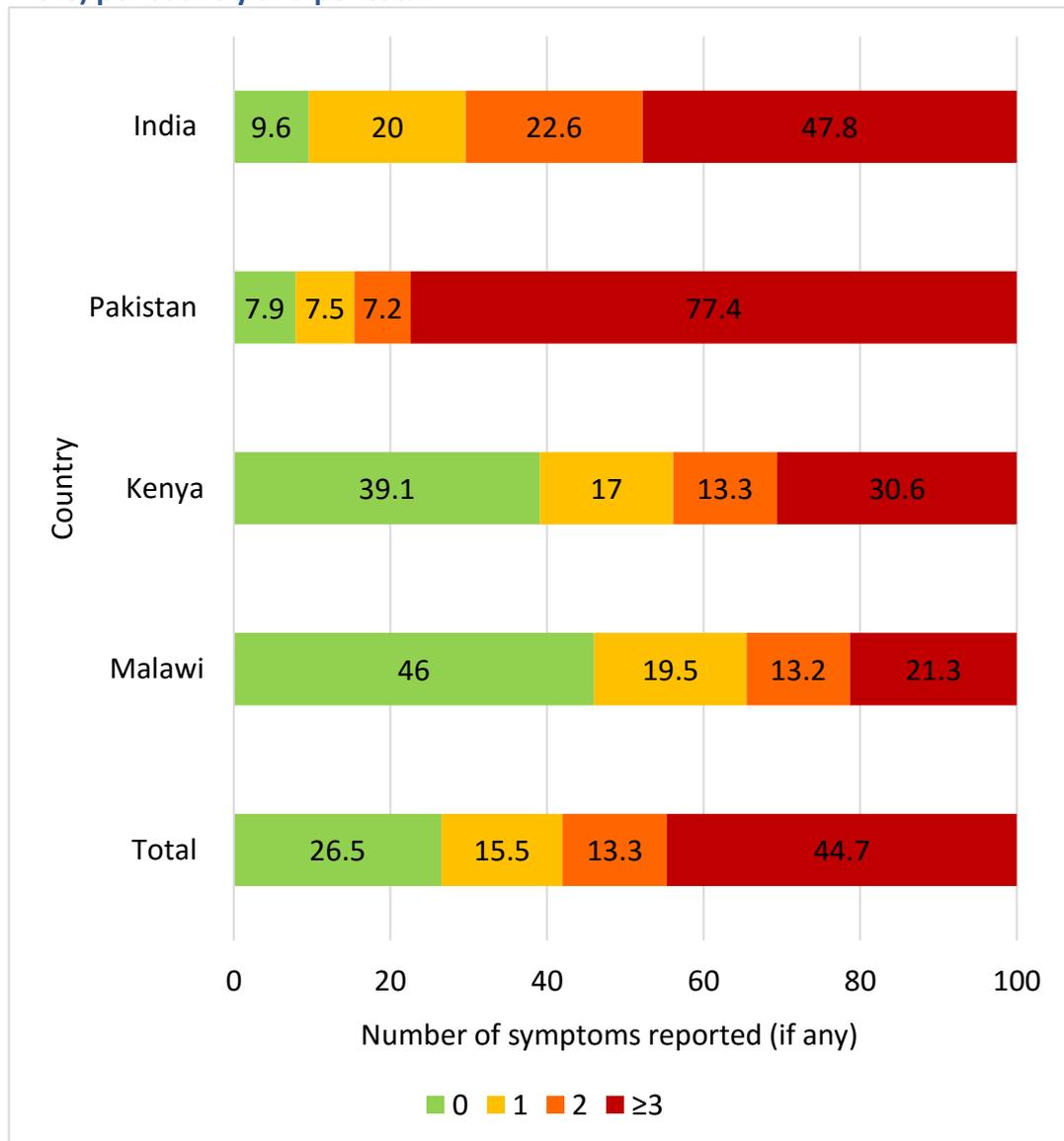
Overall 26.4% of women did not report any symptoms and, overall 73.5% of women reported at least one symptom. Overall, 15.5% of women reported one symptom, 13.3% reported two and 44.7% reported three or more symptoms (**Figure 4.6**).

In India, more women (49.4%) reported one to three symptoms, 41.2% of women reported four or more symptoms and 9.5% of women denied any symptoms. In Pakistan, more women (70.6%) reported four or more symptoms, 21.6% of women reported one to three symptoms and 7.9% women denied any symptoms.

In Kenya, more women (39.1%) denied any symptoms, 36.5% of women reported one to three symptoms and 24.4% of women reported four or more symptoms. In Malawi, more women (46.0%) denied any symptoms, 41.1% of women reported one to three symptoms and 12.9% of women reported four or more symptoms.

Overall, more women did not report any symptoms in Malawi (46.0%) and Kenya (39.1%). More women reported four or more symptoms in Pakistan (70.6%) and India (49.4%) compared to Kenya (24.4%) and Malawi (12.9%).

Figure 4.6: Percentage of women reporting symptoms (none, one, two, or three or more) per country and per total

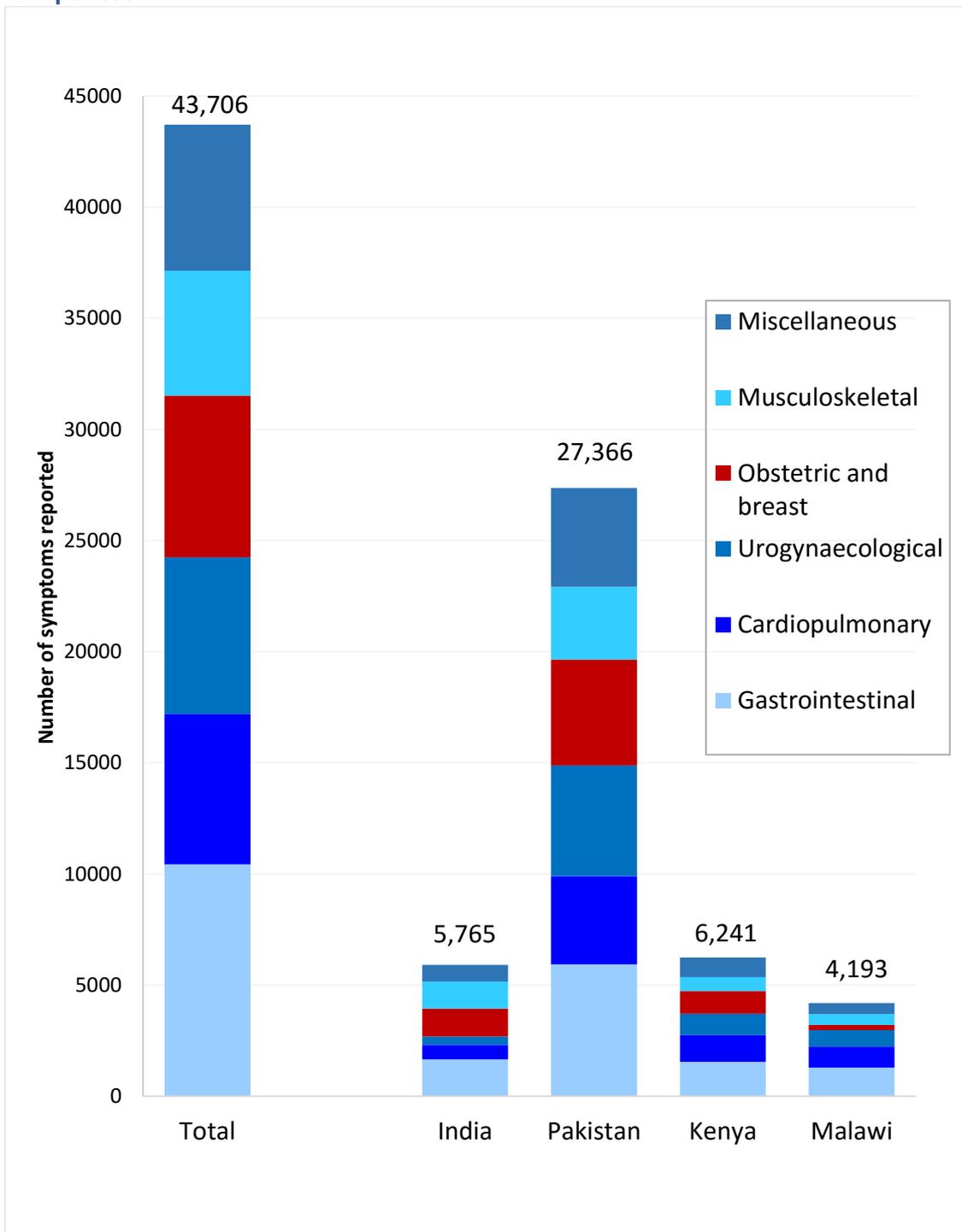


Organ systems

Overall 8425 (73.5%) of women reported at least one symptom. These 8425 women reported a combination of 43706 symptoms. More women reported symptoms in Pakistan (62.6%) compared to Kenya (14.3%), India (13.2%) and Malawi (9.6%).

When categorised by organ system, overall symptoms were most frequently related to the gastrointestinal tract (23.9% of all symptoms reported) followed by obstetric and breast (16.7%), uro-gynaecological (16.1%) cardiopulmonary (15.5%), musculoskeletal (12.8%) and miscellaneous (including immunology, dermatology, and endocrine) (15.0%). There were slight variations in the trend but the commonest was gastrointestinal symptoms in all four countries followed by cardiopulmonary symptoms in Malawi and Kenya, uro-gynaecological in Pakistan, and obstetric or breast related in India. These trends are presented visually in **Figure 4.7**.

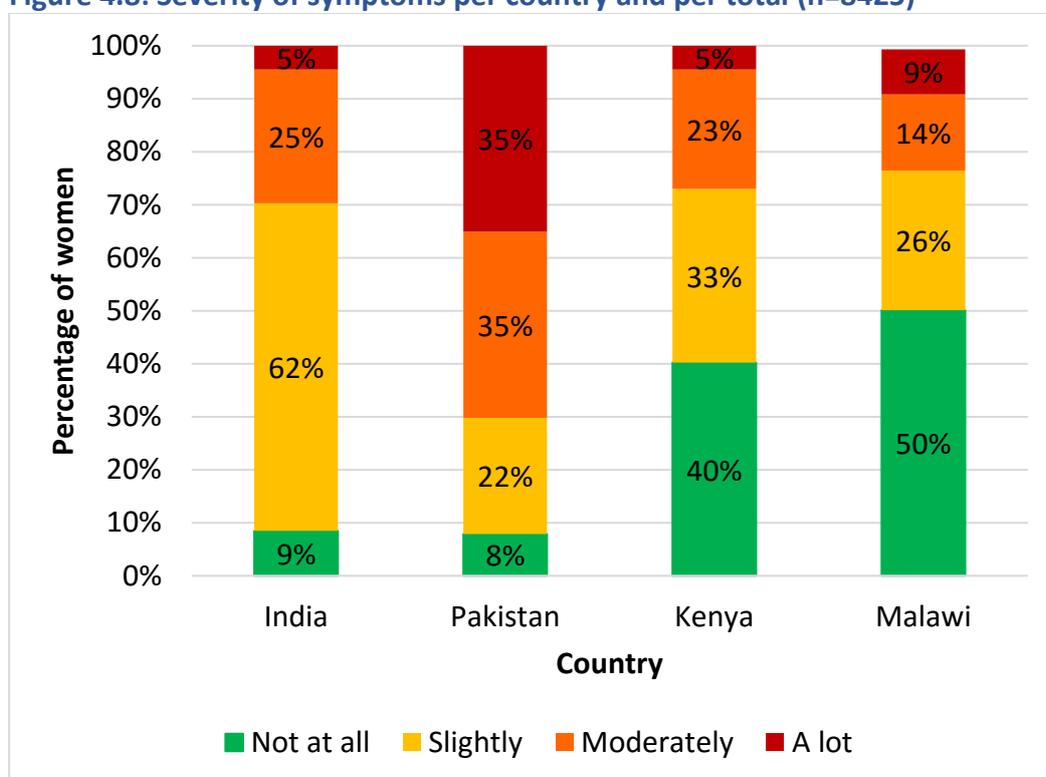
Figure 4.7: Number of symptoms reported by women by organ system, by country and per total



Severity of symptoms

Of all the symptoms reported per country, more women reported more severe symptoms in Pakistan compared to the other country settings, where women reported that symptoms bothered them “moderately” (35.0%) and “a lot” (35.0%). Women in Malawi (50%) and Kenya (40%) reported that their symptoms bothered them “not at all”. The results for reporting of number of symptoms are in line with the reporting of severity of symptoms (**Figure 4.6** and **Figure 4.8**).

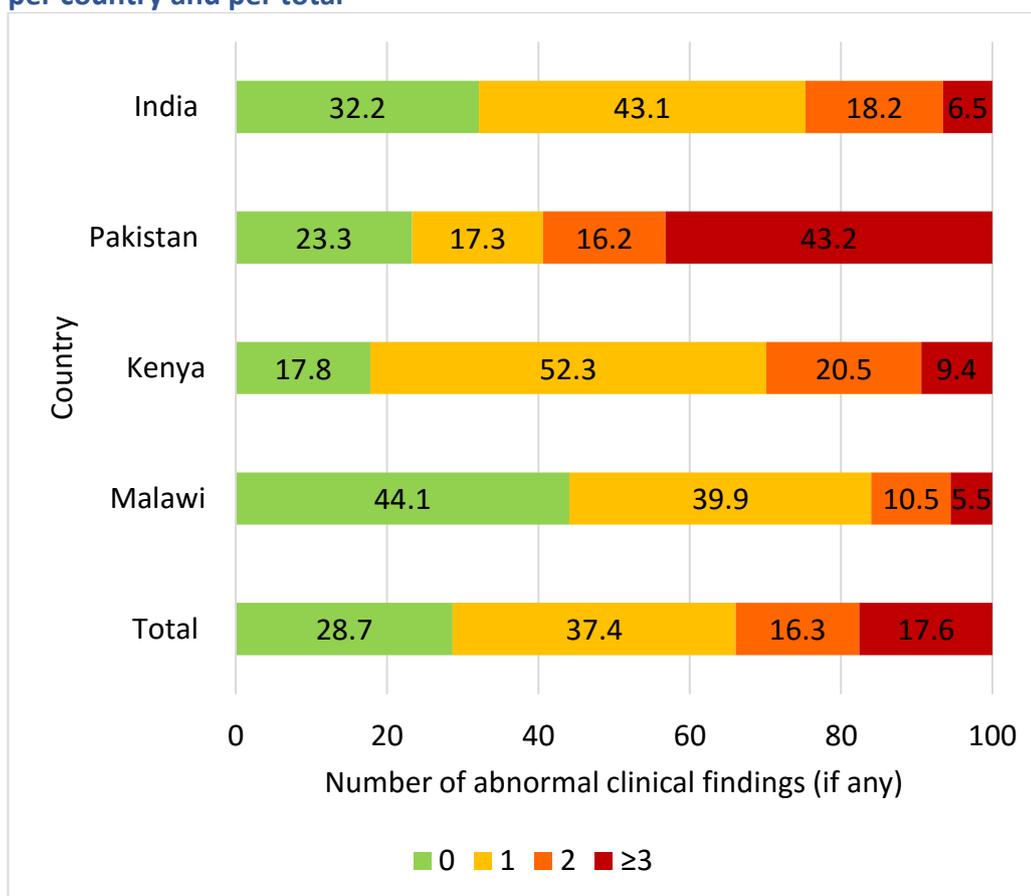
Figure 4.8: Severity of symptoms per country and per total (n=8425)



Clinical examination

Overall, following recruitment and after taking a clinical history, 150 women (1.3%) declined clinical examination and 138 women (1.2%) declined laboratory investigations. Overall, 28.7% of women had no abnormality on clinical examination. Overall, 37.4% of women had one abnormal finding, 16.3% had two abnormal findings and 17.6% had three or more abnormal findings (**Figure 4.9**).

Figure 4.9: Number of abnormal clinical examinations per percentage of women per country and per total



In India, 43.1% of women (had one abnormal finding, 32.2% of women had no abnormality, 18.2% had two abnormal findings and 6.5% had three or more abnormal findings on clinical examination. In Pakistan, 43.2% of women had three or more abnormal findings, 23.3% of women had no abnormality, 17.3% had one abnormal finding and 16.2% had two abnormal findings on clinical examination.

In Kenya, 52.3% of women had one abnormal finding, 20.5% of women had two abnormalities, 17.8% had no abnormal findings and 9.4% had three or more abnormal findings on clinical examination. In Malawi, 44.1% of women had no abnormal findings, 39.9% of women had one abnormality, 10.5% had two abnormal findings and 5.5% had three or more abnormal findings on clinical examination.

Of all the country settings, more women (43.2%) had three or more abnormal findings on clinical examination in Pakistan, and more women (44.1%) had no abnormal findings on clinical examination in Malawi. These abnormal findings are described in further detail in the following sections.

4.4 Clinical observations

Table 4.10 shows the percentage of women assessed with abnormal ranges of basic clinical observations per country and per total. Overall a large proportion of women assessed (42.3%) had an abnormal respiratory rate ($RR \leq 8$ or $RR \geq 20$). Overall 7.0% had an abnormal temperature ($T \leq 35$ or $T \geq 38.0^\circ\text{C}$); 6.2% an abnormal diastolic blood pressure (≤ 45 or ≥ 90 mmHg); 5.8% an abnormal systolic blood pressure (≤ 90 or ≥ 140 mmHg); and 4.5% an abnormal pulse rate ($PR \leq 50$ or $PR \geq 100$ beats per minute).

In India, 15.2% of women (15.2%) had an abnormal temperature; 3.0% an abnormal diastolic and 2.5% an abnormal systolic blood pressure; 0.7% an abnormal pulse rate and 0.1% an abnormal respiratory rate. In Pakistan, 39.0% of women (39.0%) had an abnormal respiratory rate, 11.6% an abnormal diastolic blood pressure; 10.6% an abnormal temperature; 7.3% an abnormal systolic blood pressure, and 1.8% an abnormal pulse rate.

In Kenya, 72.7% of women (72.7%) had an abnormal respiratory rate, 7.6% an abnormal systolic blood pressure; 7.3% an abnormal pulse rate, 4.3% an abnormal diastolic blood pressure, and 1.2% an abnormal temperature. In Malawi, 43.2% of women had an abnormal respiratory rate, 7.4% an abnormal an abnormal pulse rate, 4.4% an abnormal diastolic and systolic blood pressure; and 3.4% an abnormal temperature.

Table 4.10: Abnormal ranges of clinical observations per country and per total

Country		India	Pakistan	Kenya	Malawi	Total
Number of women assessed *		2099	3287	3145	2923	11454
Clinical examination - general						
Variable	Definition	%	%	%	%	%
Pulse rate (beats per minute)	PR≤50 or PR≥100	0.7	1.8	7.3	7.4	4.5
Respiratory rate (per minute)	RR≤8 or RR≥20	0.1	39.0	72.7	43.2	42.3
Temperature (°C)	T≤35 or T≥38	15.2	10.6	1.2	3.4	7.0
Systolic blood pressure (mmHg)	≤90 or ≥140	2.5	7.3	7.6	4.4	5.8
Diastolic blood pressure (mmHg)	≤45 or ≥90	3.0	11.6	4.3	4.4	6.2

Table 4.11: Abnormal findings on clinical examination per country and per total

Country		India	Pakistan	Kenya	Malawi	Total
Number of women assessed *		2099	3287	3145	2923	11454
Clinical examination -by organ system						
Organ system	Abnormal finding	%	%	%	%	%
General	Conjunctival pallor	40.9	43.9	6.1	4.7	23.0
	Sclera	0.7	3.5	0.1	0.0	1.2
	Goitre	0.2	6.3	0.2	0.2	2.0
	Peripheral pitting oedema	2.8	13.9	2.6	0.9	5.4
	Central pitting oedema	0.3	5.7	0.3	0.5	1.9
	Total	45.0	73.3	9.3	6.3	33.5
Skin	Skin rashes	3.5	9.2	1.4	0.7	3.7
	Skin ulcers	0.2	2.4	0.2	0.0	0.8
	Skin lump or growth	0.4	5.7	0.8	0.2	2.0
	Total	4.1	17.3	2.4	0.9	6.5
Oral cavity	Bleeding gums	0.8	14.5	5.3	0.1	6.0
	Oral thrush	0.3	9.3	0.5	0.3	3.0
	Mouth ulcers	1.6	9.3	0.3	0.1	3.1
	Total	2.7	33.1	6.1	0.5	12.1
Breast	Cracked nipples	0.3	12.3	1.3	0.8	4.2
	Abnormal engorgement	3.3	20.6	0.7	0.5	6.8
	Abnormal tenderness	1.3	11.1	1.0	0.8	3.9
	Abscess	0.3	0.9	0.2	0.3	0.4
	Lump	1.2	0.8	0.6	0.3	0.7
	Total	6.4	45.7	3.8	2.7	16.0
Abdominal	Abnormal tenderness	25.7	17.9	2.4	1.3	10.9
	Abnormal mass	0.1	6.3	0.2	0.0	1.9
	Total	25.8	24.2	2.6	1.3	12.8

*Percentage with abnormal findings calculated as proportion of those who consented to the examination. Proportion of total (n= 11 454) who provided consent for general examination 98.7%; skin and oral cavity examination 92.0%; breast examination 90.0%; and examination of the abdomen 97.4%.

In total, 73.1% of women had one or more abnormal findings at clinical examination (**Table 4.11**). The most common findings were; conjunctival pallor (23.0%), breast problems (16.0%), gum and oral cavity problems (12.1%), and abdominal tenderness (10.9%) (**Table 4.11**). Overall, more women (33.5%) had an abnormal clinical finding on general examination. Overall, 16% of women had breast, 12.8% abdominal, 12.1% mouth, and 6.5% abnormal skin findings.

In India, 45.0% of women had an abnormal clinical finding on general examination, with 40.9% of all women noted to have conjunctival pallor. In India, 25.7% of women had abdominal, 6.4% breast, 4.1% skin and 2.7% mouth abnormal findings. In Pakistan, 73.3% of women had abnormal clinical findings on general examination, with 43.9% of all women noted to have conjunctival pallor. In Pakistan, 24.2% of women had abdominal, 45.7% breast, 17.3% skin and 33.1% mouth abnormal findings.

In Kenya, 9.3% of women (had abnormal clinical findings on general examination, with 6.1% of all women noted to have conjunctival pallor. In Kenya, 6.1% of women had mouth, 3.8% breast, 2.6% abdominal, and 2.4% skin abnormal findings. In Malawi, 6.3% of women had abnormal clinical findings on general examination, with 4.7% of all women noted to have conjunctival pallor. In Malawi, 2.7% of women had breast, 1.3% abdominal, 0.9% skin and 0.5% mouth abnormal findings (**Table 4.11**).

Vaginal examination

Vaginal examination was only offered and consent obtained, if clinically indicated. Overall, perineum examination was indicated and performed in 54.9% (6,288) of women and speculum examination in 22.3% (2,555) of women.

Perineum examination was indicated and performed in more women in Pakistan, Kenya and Malawi compared to India. Overall, 25.9% of women had perineal problems (vaginal tears, excoriation, swelling), and 3.3% were noted to have leakage

of urine. This is equivalent to an overall estimated prevalence of 15.5% for perineal morbidity across the four countries but noted to be particularly high among women in Pakistan (**Table 4.12**).

Table 4.12: Abnormal findings on clinical examination per country and per total

Country		India	Pakistan	Kenya	Malawi	Total
Number of women assessed *		2099	3287	3145	2923	11454
Clinical Examination - Perineum and speculum examination *						
Number of women with indication and assessed		563	2654	2225	846	6288
Perineum		%**	%**	%**	%**	%**
	Leakage of urine	0.0	7.1	0.6	0.5	3.3
	Excoriation	0.0	12.0	0.5	2.2	5.5
	Swelling	1.2	18.2	1.1	3.2	8.7
	Tear	0.7	18.0	5.9	7.0	10.7
	Sub-Total	1.9	55.3	8.1	12.9	28.2
Proportion of total number of women included in study		0.5	44.6	5.7	3.7	15.5
Number of women with indication and assessed		365	1729	316	154	2555
Speculum examination		%**	%**	%**	%**	
	Abnormal vaginal discharge	11.8	43.5	17.2	52.6	36.4
	Abnormal bleeding	2.2	15.1	33.4	1.3	14.8
	Sub-Total	14.0	58.6	50.6	53.9	51.2
Proportion of total number of women included in study		2.4	30.8	5.1	2.8	11.4

*Vaginal examination was only offered and consent obtained if clinically indicated; for perineum examination 54.9% of women; for speculum examination 22.3% of women. **Percentages reported are derived from the number of women who had the examination performed.

Speculum examination was only offered, and consent obtained, if clinically indicated. Overall, speculum examination was indicated and performed in 22.3% (2,555) of women. Speculum examination was indicated and performed in more women in

Pakistan (52.6%) compared to India (17.4%), Kenya (10.0%) and Malawi (5.3%). Overall, 51.2% of women assessed had an abnormal finding on speculum examination.

In India, 14.0% of women who had speculum examination had an abnormal finding with the commonest finding being abnormal vaginal discharge (11.8% of all women assessed). In Pakistan, 58.6% of women who had speculum examination, had an abnormal finding with the commonest finding being abnormal vaginal discharge (43.5% of all women assessed).

In Kenya, 50.6% of women who had speculum examination had an abnormal finding with the commonest finding being abnormal bleeding (33.4% of all women assessed). In Malawi, 53.9% of women who had speculum examination had an abnormal finding with the commonest finding being abnormal vaginal discharge (52.6% of all women assessed). There was an overall estimated prevalence of 11.4% for vaginal morbidity across the four countries but prevalence was particularly high among women in Pakistan. Overall, 36.4% of women examined by speculum were noted to have abnormal vaginal discharge and vaginal bleeding was confirmed in 14.8% giving an overall estimated prevalence of between 2.4 and 5.1% in India, Kenya and Malawi but up to 30.8% among women in Pakistan (**Table 4.12**).

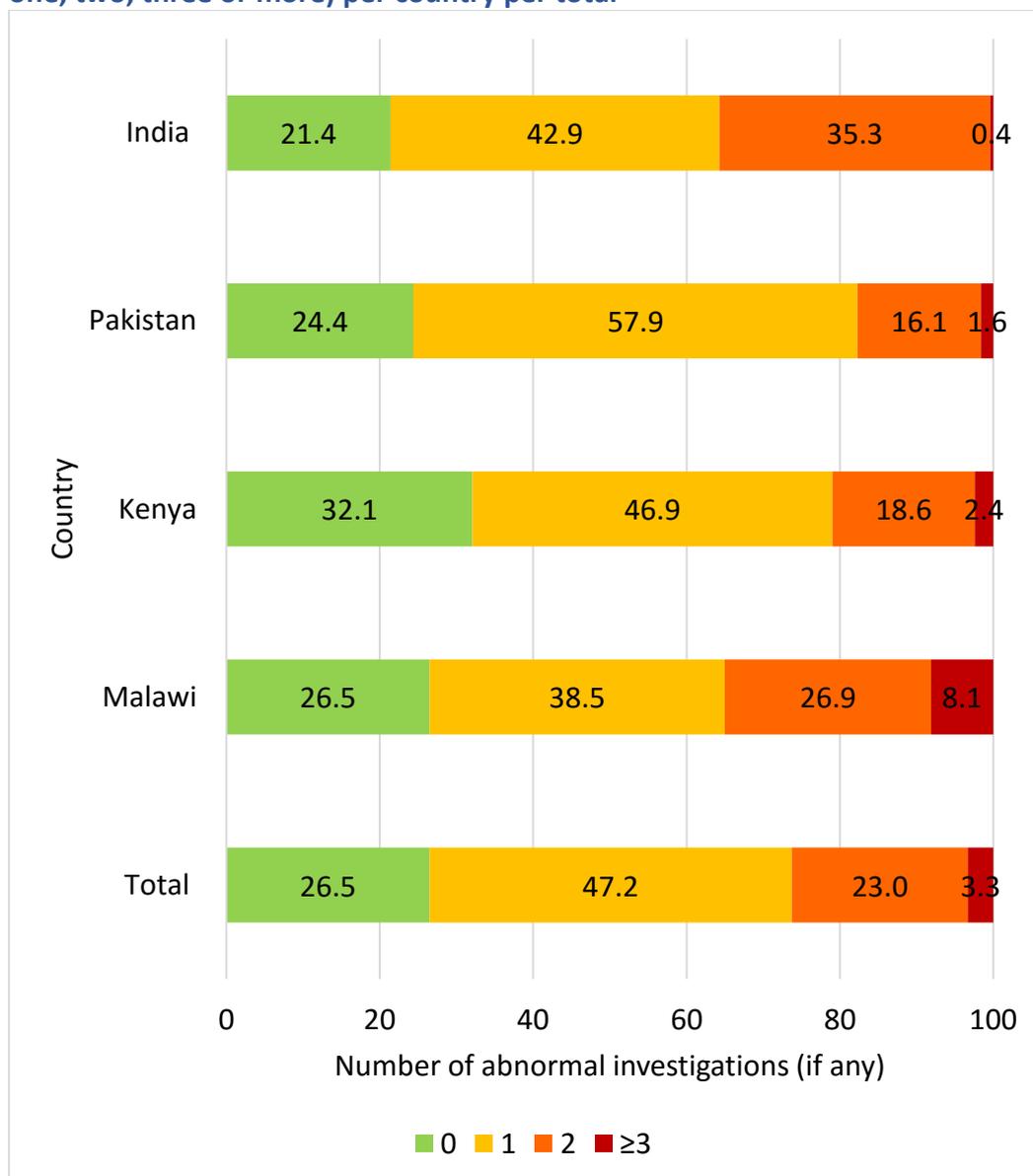
Point-of-care investigations

Overall, 26.5% of women did not have abnormal findings from investigations, and overall, 73.5% of women did have at least one abnormal investigation. Overall, 47.2% of women had one, 23.0% had two and 3.3% had three or more abnormal investigations (**Figure 4.10**).

In India, 42.9% of women had one abnormal investigation, 35.3% had two and 21.4% had no and 0.4% had three or more abnormal investigations. In Pakistan, 57.9% of women had one abnormal investigation, 24.4 had none, 16.1% had two and 1.6% had three or more abnormal investigations. In Kenya, 46.9% of women (46.9%) had one

abnormal investigation, 32.1 had none, 18.6% had two and 2.4% had three or more abnormal investigations. In Malawi, 38.5% of women had one abnormal investigation, 26.9% had two, 26.5% had none and 8.1% had three or more abnormal investigations. Overall, 26.5% of women had no abnormal investigations, and more women had no abnormal investigations in Kenya (32.1%). Overall, 23.0% of women had two abnormal investigations, with more women with two abnormal investigations in India (35.3%) compared to Pakistan (16.1%), Kenya (18.6%) and Malawi (26.9%).

Figure 4.10: Percentage of women with abnormal laboratory investigations (none, one, two, three or more) per country per total



4.5 Infectious morbidity

Overall, 4.8% of women tested positive for HIV, 2.7% for malaria and 0.9% for syphilis. In India, the percentage of women with HIV, malaria and syphilis was very low (0.1%, 0.1% and 0.0%) respectively. In Pakistan, the percentage of women with HIV, malaria and syphilis was very low (0.3%, 0.0% and 0.0%) respectively. In Kenya, the percent of women with HIV was 3.6% and malaria and syphilis was low (0.2% and 0.3%) respectively. Overall, HIV positive status was highest in Malawi (14.5%) as was malaria (10.4%) and syphilis (3.4%) (Table 4.13).

Table 4.13: Infectious conditions identified per country and per total

Country		India	Pakistan	Kenya	Malawi	Total
Number of women*		2099	3287	3145	2923	11454
		%	%	%	%	%
INFECTIOUS MORBIDITY						
Condition	Definition					
HIV	Positive	0.1	0.3	3.6	14.5	4.8
Malaria	Positive	0.1	0.0	0.2	10.4	2.7
Syphilis	Positive	0.0	0.0	0.3	3.4	0.9

*Percentages reported are derived from the number of women who had the investigation performed.

Table 4.14: SIRS identified per country and per total

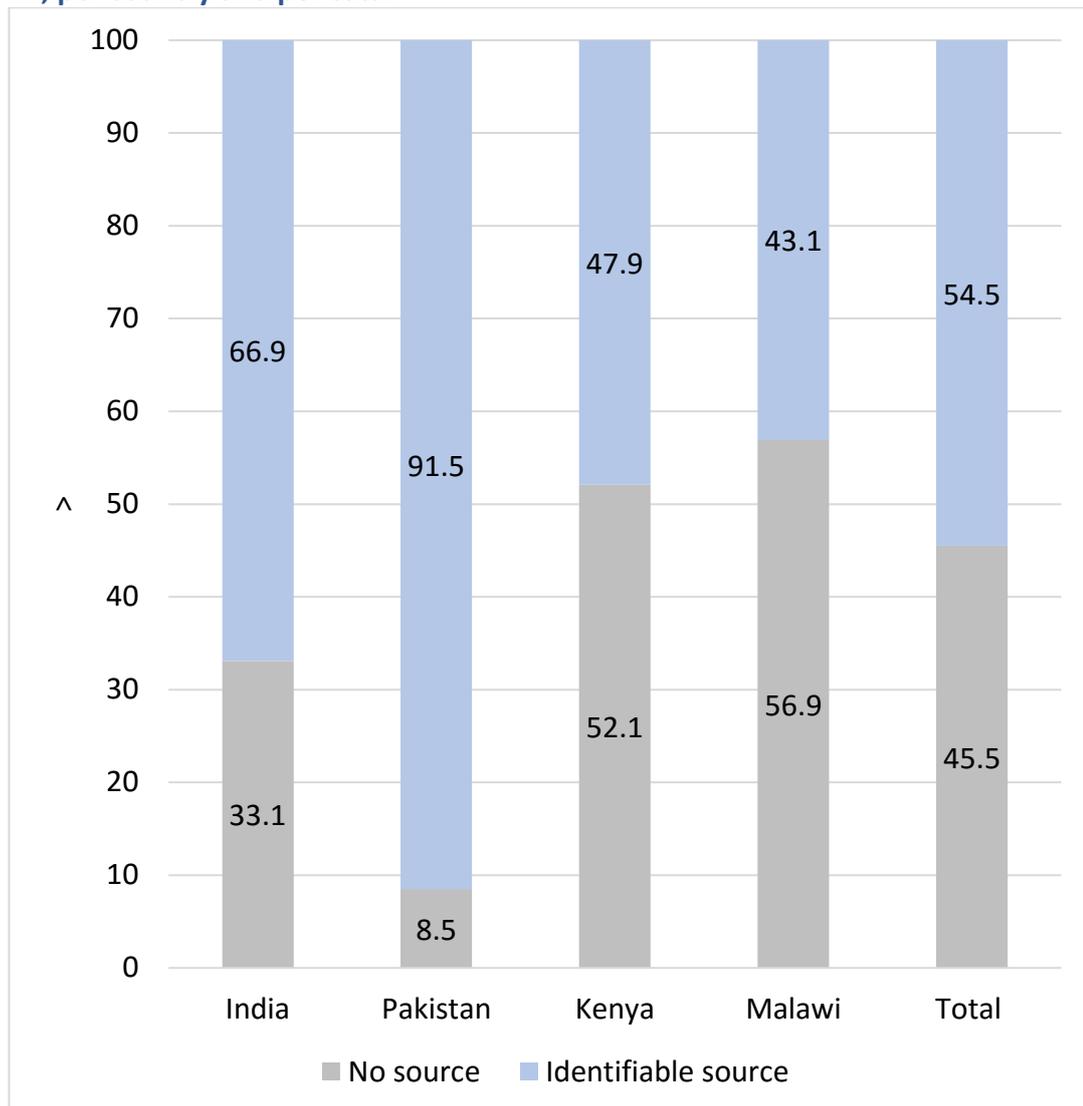
Country		India	Pakistan	Kenya	Malawi	Total
Number of women*		2099	3287	3145	2923	11454
		%	%	%	%	%
INFECTIOUS MORBIDITY						
SIRS**		13.8	11.2	36.5	28.7	23.1
	No source	33.1	8.5	52.1	56.9	57.1
	Identifiable source	66.9	91.5	47.9	43.1	42.9

*Percentages reported are derived from the number of women who had the investigation performed.

**Amended SIRS score any two of the following: PR>90 bpm; RR>20 per min; T<36°C or T>38°C; Raised CRP mg/L

Overall 23.1% of women had a SIRS score of ≥ 2 . More women had a SIRS score of ≥ 2 in Kenya (36.5%) Malawi (28.7%), compared to India (13.8%) and Pakistan (11.2%). Overall, in 2336 women with a SIRS score of ≥ 2 , based on symptoms, clinical examination and/or investigation findings, a source could be identified in 1002 (42.9%) women (**Table 4.14**). Of women with a SIRS score of ≥ 2 , more women had an identifiable source of possible infection in Pakistan (91.5%), India (66.9%), Kenya (47.9%) and Malawi (43.1%) (**Figure 4.11**).

Figure 4.11: Possible identifiable source of infection in women with SIRS score of ≥ 2 , per country and per total



Overall, of women with a SIRS score of ≥ 2 , and using triangulation of data of symptoms, signs and/or investigations, identifiable possible sources of early infection included gastroenteritis (18.8%), lower respiratory tract infection (13.0%), sexually transmitted infection (10.1%), urinary tract infection (9.6%), mastitis (7.4%), upper respiratory tract infection (4.4%), endometritis (2.0%), chorioamnionitis (1.6%) and wound infection (0.6%) (**Table 4.15**).

Table 4.15: Possible causes of infection in women identified with a SIRS score of ≥ 2 for all countries combined

Possible source of infection (if any)	Women with a SIRS score ≥ 2	
	n	%*
No source	1334	57.1
Possible source of infection based on symptoms and/or clinical examination findings	1002	42.9
Chorioamnionitis	39	1.6
Endometritis	46	2.0
Mastitis	174	7.4
Lower respiratory tract infection	307	13.0
Upper respiratory tract infection	103	4.4
Gastroenteritis	439	18.8
Sexually transmitted infection	252	10.1
Urinary tract infection	225	9.6
Wound infection	15	0.6
TOTAL	2336	100

*Percentages reported are derived from the number of women who had CRP performed.

4.6 Medical and obstetric morbidity

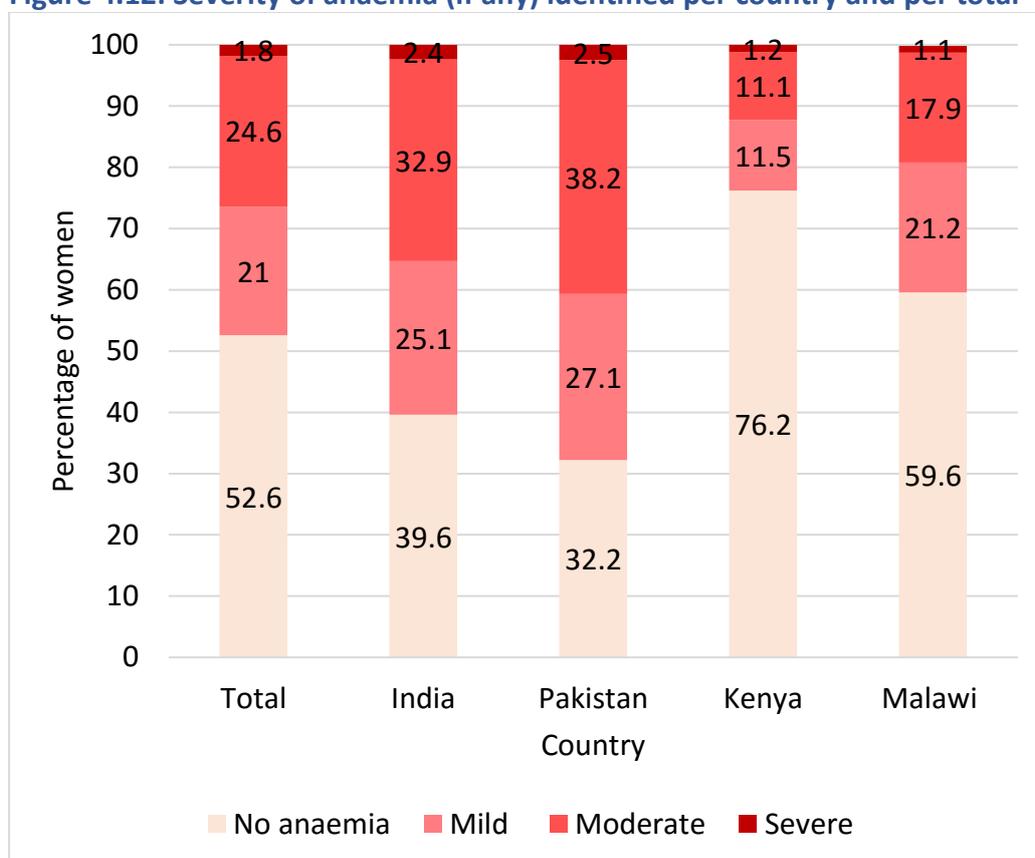
Table 4.16: Medical/obstetric conditions identified per country and for all countries combined

Country		India	Pakistan	Kenya	Malawi	Total
Number of women		2099	3287	3145	2923	11454
Medical/ obstetric morbidity		%	%	%	%	%
Anaemia	Hb <110 g/L	61.2	68.7	23.9	41.0	47.9
Hypertension	BP ≥140/90, no proteinuria	1.5	4.8	1.8	0.8	2.4
Pre-eclampsia	BP ≥140/90, proteinuria (PR ≥++)	0.1	1.5	0.4	0.3	0.6
Urine incontinence	Symptom and/or finding on examination	1.7	9.6	1.6	1.5	3.6
Antenatal haemorrhage	Symptom and/or finding on examination	5.3	8.2	5.2	0.6	4.9
Proportion of women with ≥1 medical and/or obstetric condition		61.1	69.3	25.2	41.0	45.5

Overall, 47.9% of women were diagnosed with anaemia. Overall, 4.9% of women were diagnosed with antenatal haemorrhage, 3.6% urinary incontinence, 2.4% hypertension, and 0.6% pre-eclampsia. In India, 61.2% of women were diagnosed with anaemia, 5.3% were diagnosed with antenatal haemorrhage, 1.7% urinary

incontinence, 1.5% hypertension, and 0.1% pre-eclampsia. In Pakistan, 68.7% of women were diagnosed with anaemia, 9.6% were diagnosed with urinary incontinence, 8.2% antenatal haemorrhage, 4.8% hypertension, and 1.5% pre-eclampsia. In Kenya, 23.9% of women were diagnosed with anaemia, 5.2% were diagnosed with antenatal haemorrhage, 1.6% urinary incontinence, 1.8% hypertension, and 0.4% pre-eclampsia. In Malawi, 41.0% of women were diagnosed with anaemia, 1.5% were diagnosed with urinary incontinence, 0.8% hypertension, 0.6% antenatal haemorrhage and 0.3% pre-eclampsia (**Table 4.16**).

Figure 4.12: Severity of anaemia (if any) identified per country and per total



Overall, 47.4% of women were anaemic. Overall, anaemia was most common in women in Pakistan (67.8%) and India (60.4%), compared to Kenya (23.8%) and Malawi (40.4%). More women had moderate anaemia in Pakistan (38.2%) and India (32.9%), compared with Malawi (17.9%) and Kenya (11.1%). More women had severe anaemia in Pakistan (2.5%) and India (2.4%) compared to Kenya (1.2%) and Malawi (1.1%) (**Figure 4.12**).

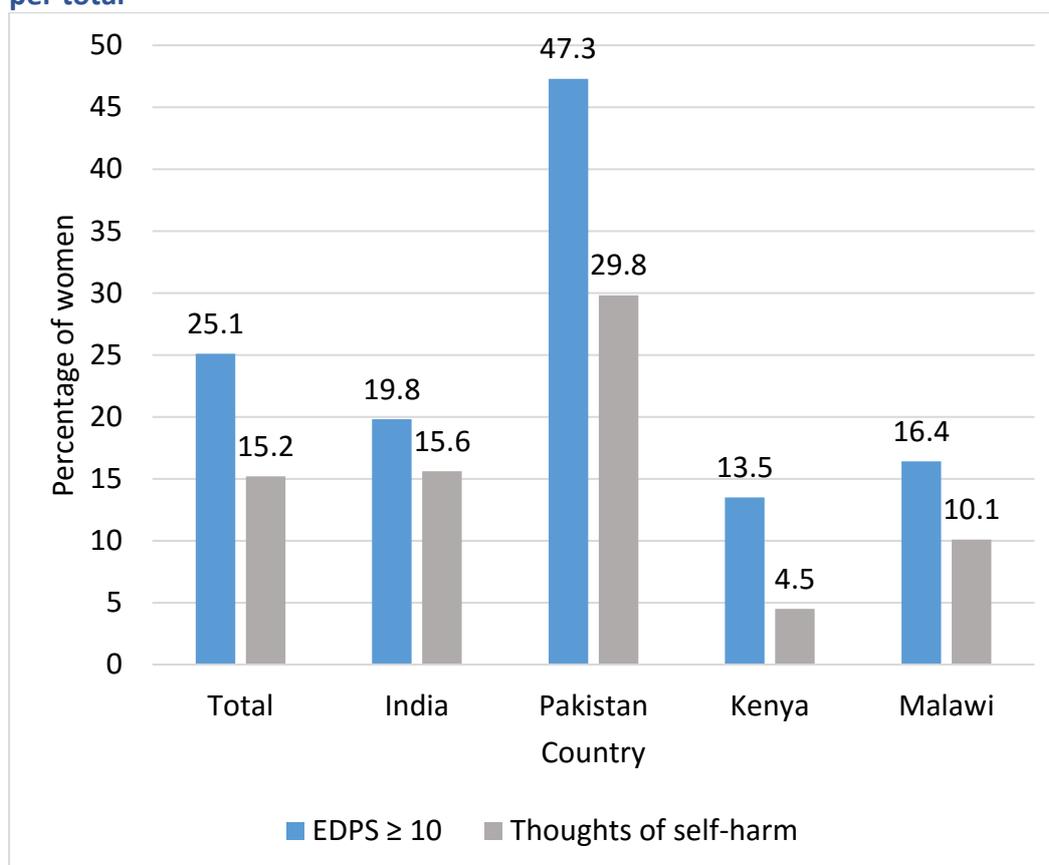
4.7 Psychological Morbidity

Psychological morbidity was assessed as part of the clinical history. Psychological morbidity (EDPS ≥ 10) was noted in 1 in 4 women (25.1%). More women had an EDPS ≥ 10 in Pakistan (47.3%) compared to India (19.8%), Malawi (16.4%) and Kenya (13.5%). Overall, 15.2% of women reported thoughts of self-harm. More women reported thoughts of self-harm in Pakistan (29.8%) compared to India (15.6%), Malawi (10.1%) and Kenya (4.5%) (Table 4.17). Figure 4.13 displays these trends visually.

Table 4.17: Psychological morbidity per country and per total

Category	India	Pakistan	Kenya	Malawi	Total
Number of women	2099	3287	3145	2923	11454
	%	%	%	%	%
PSYCHOLOGICAL MORBIDITY					
EDPS ≥ 10	19.8	47.3	13.5	16.4	25.1
Thoughts of self-harm	15.6	29.8	4.5	10.1	15.2

Figure 4.13: Psychological morbidity (depression and self-harm) per country and per total



4.8 Social morbidity

Domestic violence

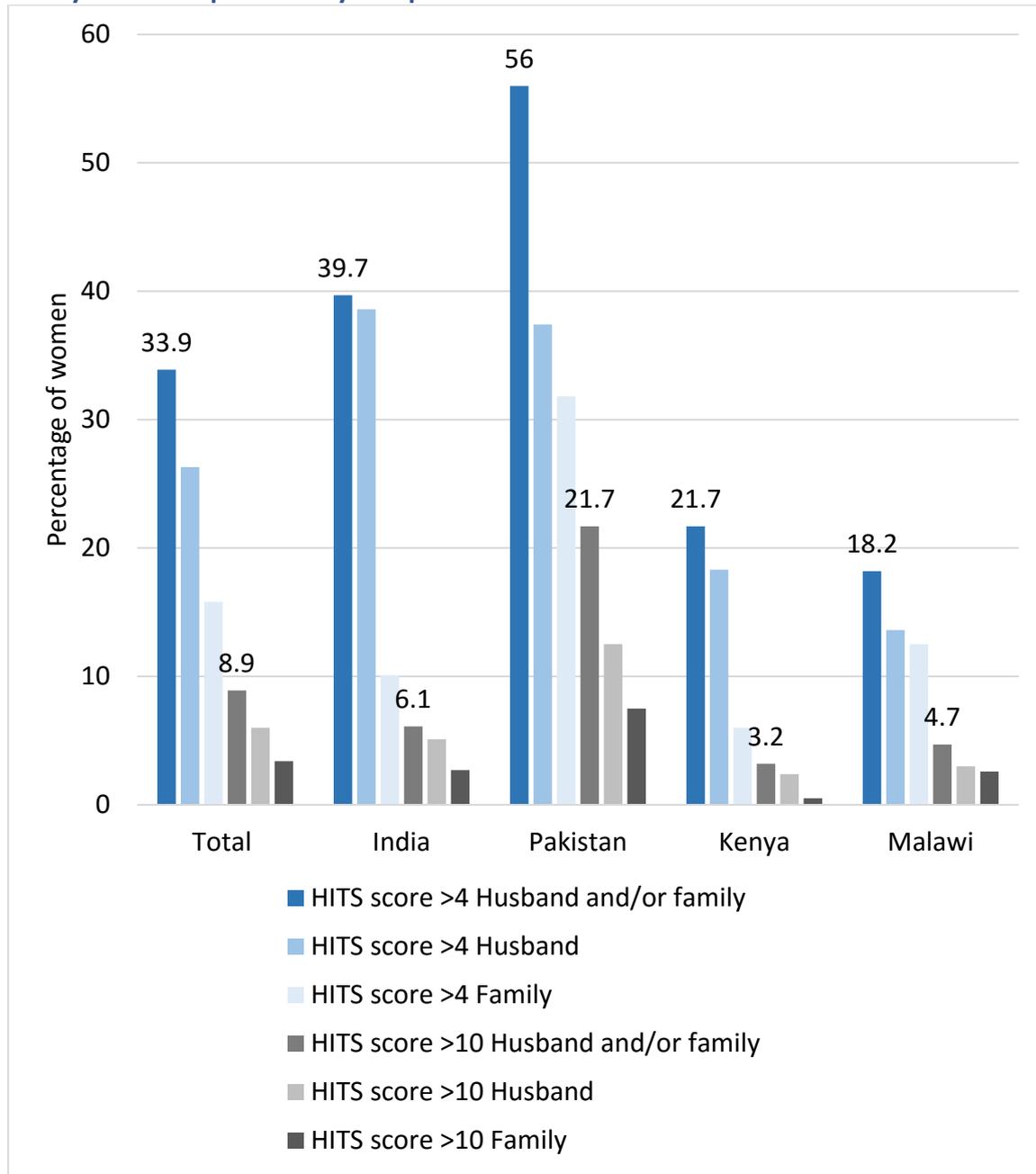
Overall 3,887 women (33.9%) reported domestic violence (HITS >4). More women reported domestic violence in Pakistan (56.0%), India (39.7%), compared to Kenya (21.7%) and Malawi (18.2%). Overall, domestic violence was commonly reported from the husband (26.3%) than from another family member (15.8%). Domestic violence was commonly reported perpetrated by the husband in India (38.6%), Pakistan (37.4%), compared to Kenya (18.3%) and Malawi (13.6%). More women reported domestic violence perpetrated by family members in Pakistan (31.8%) compared to Malawi (12.5%), India (10.1%), and Kenya (6.0%) (Table 4.18 and Figure 4.14).

Overall 8.9% of women reported higher levels domestic violence (HITS score >10). More women reported higher levels of domestic violence in Pakistan (21.7%), compared to India (6.1%), Malawi (4.7%) and Kenya (3.2%). Overall, higher levels of domestic violence were commonly reported from husbands (6.0%) than from another family members (3.4%).

Table 4.18: Severity of domestic violence from husband/partner, and/or family, per country and per total.

Category		India	Pakistan	Kenya	Malawi	Total
Number of women		2099	3287	3145	2923	11454
		%	%	%	%	%
Domestic violence						
Any domestic violence -	Husband and/or family	39.7	56.0	21.7	18.2	33.9
	HITS score >4					
	Husband	38.6	37.4	18.3	13.6	26.3
	Family	10.1	31.8	6.0	12.5	15.8
More significant domestic violence -	Husband and/or family	6.1	21.7	3.2	4.7	8.9
	HITS score >10					
	Husband	5.1	12.5	2.4	3.0	6.0
	Family	2.7	7.5	0.5	2.6	3.4

Figure 4.14: Severity of domestic violence perpetrated by husband/partner, or family members per country and per total



Substance use

Use of alcohol, sedatives or inhalants was not common, with an overall 6.5% of women reporting using any of these substances over the three months prior to the time of assessment. More women reported using alcohol, sedatives, inhalants or tobacco over the past three months in India (2.7%) and Kenya (2.0%) compared to Malawi (1.7%) and Pakistan (0.2%). Overall, 1.7% of women had an ASSIST score of >4 indicating that they would benefit from an intervention for substance use. More women scored an ASSIST score of >4 in Malawi (2.8%), Pakistan (1.5%), Kenya (1.4%) compared to India (0.8%) (Table 4.20).

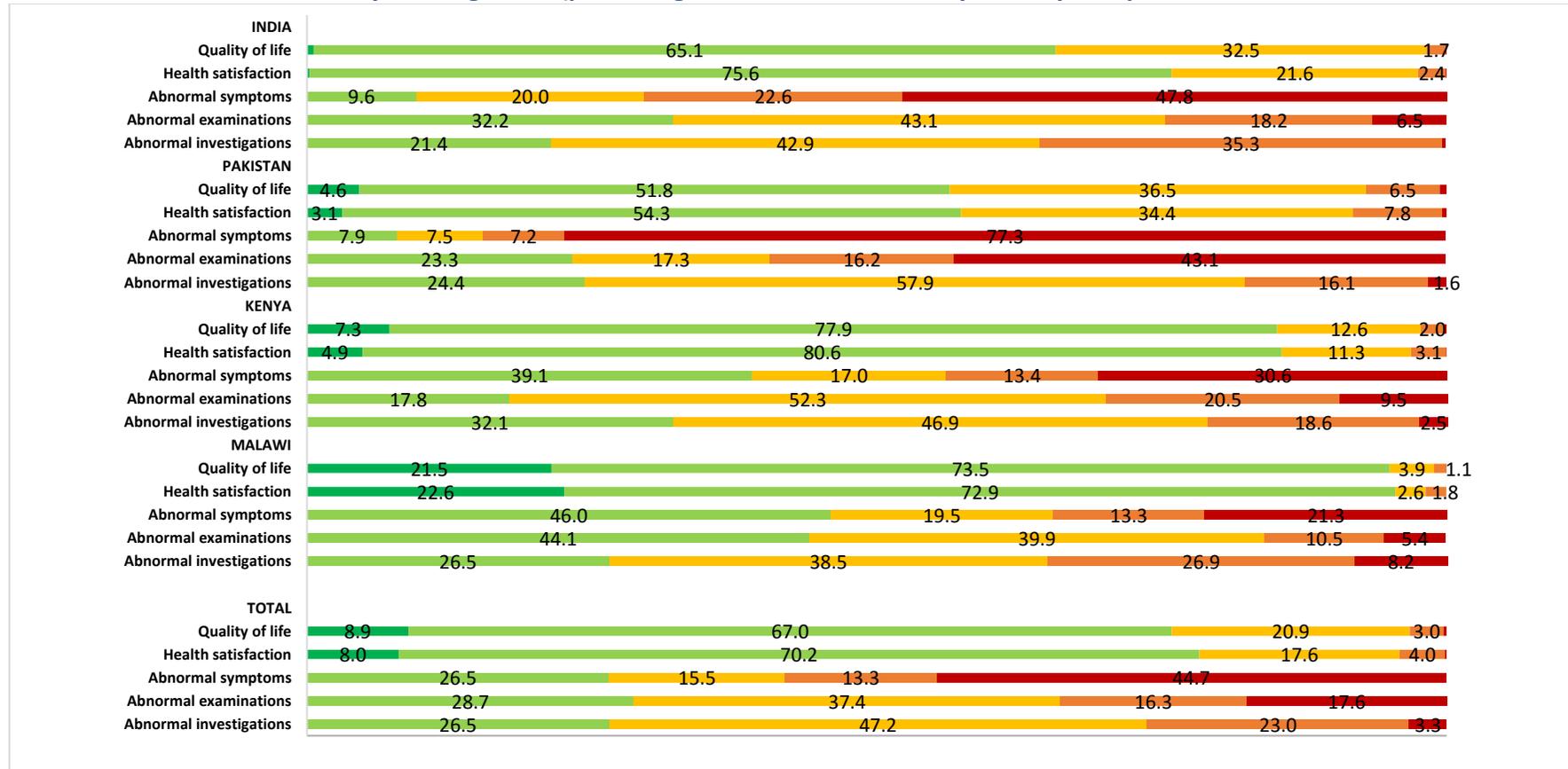
Table 4.19 Substance use per country and per total

Category	India	Pakistan	Kenya	Malawi	Total
Number of women	2099	3287	3145	2923	11454
	%	%	%	%	%
Substance misuse					
Use of alcohol sedatives, inhalants, tobacco in last three months	2.7	0.2	2.0	1.7	6.5
Intervention recommended (ASSIST score >4)	0.8	1.5	1.4	2.8	1.7

Summary

The following histogram (**Figure 4.1**) displays the visual trend of quality of life, satisfaction with health, number of symptoms, number of abnormal clinical examinations, and number of abnormal laboratory investigations as percentage of women assessed by country and per total.

Figure 4.15: Histogram of quality of life, satisfaction with health, number of symptoms, number of abnormal clinical examinations, and number of abnormal laboratory investigations (percentage of women assessed by country and per total)

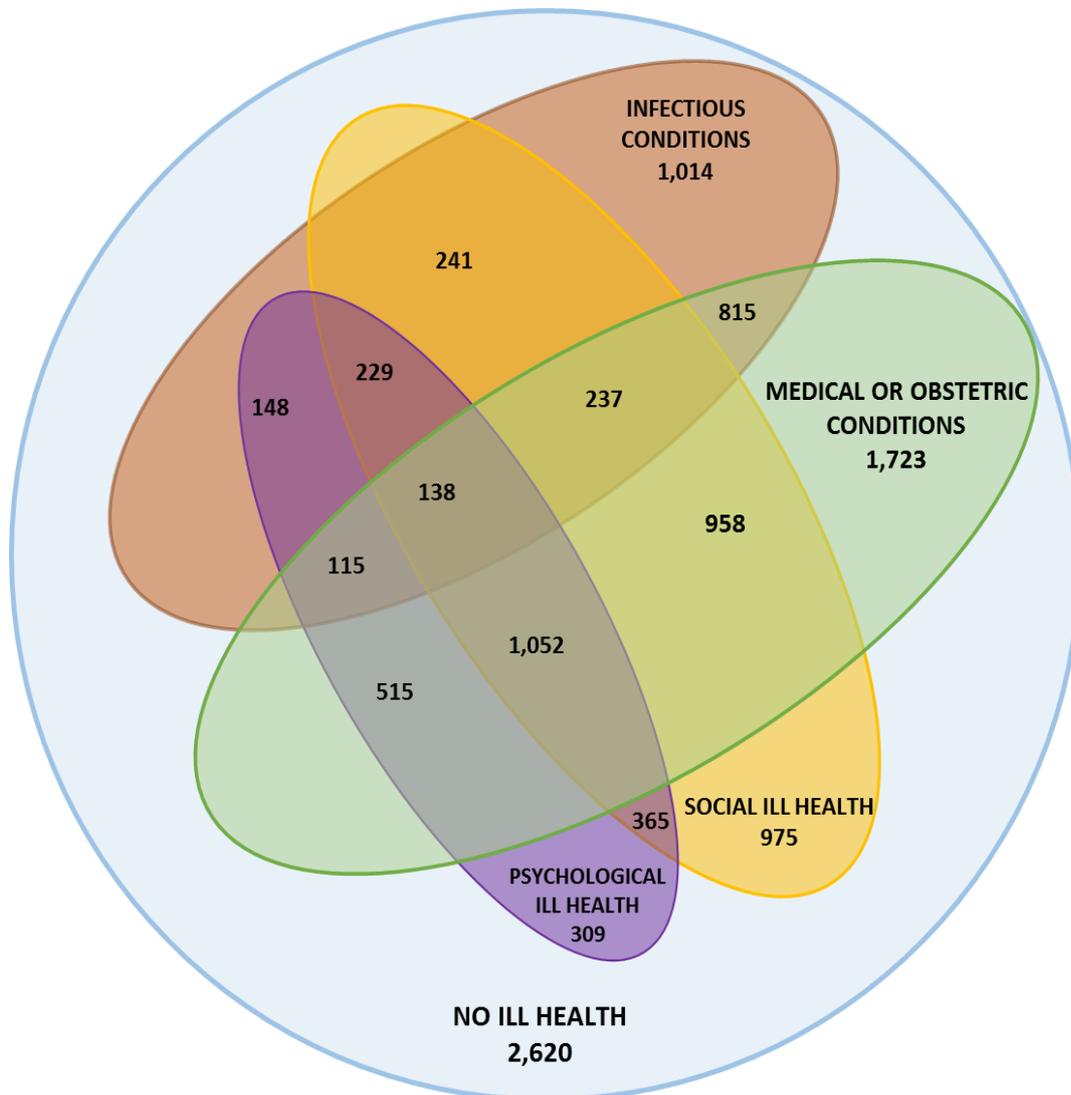


	Satisfaction with health	Quality of life	Number of symptoms	Number of abnormal examinations	Number of abnormal investigations
	Very satisfied	Very good	-	-	-
	Satisfied	Good	0	0	0
	Neither satisfied nor dissatisfied	Neither good nor poor	1	1	1
	Dissatisfied	Poor	2	2	2
	Very dissatisfied	Very poor	≥3	≥3	≥3

Overall, despite most women reporting a good quality of life (75.9%) and satisfaction with health (78.2%), almost three out of four women reported at least one symptom (73.5%), had at least one abnormal finding on clinical examination (71.3%) or had at least one abnormal finding on simple laboratory investigation (73.5%).

Figure 4.16 displays the overlap of maternal morbidity for the whole combined cohort.

Figure 4.16: Venn diagram for number of women with no morbidity; or infectious, medical/obstetric, psychological and/or social morbidity (n=11454)



Overall, most women (8,834; 77.1%) had at least one type of morbidity and a very small number of women (138; 1.2%) had all four types of morbidity (**Figure 4.13**). Overall, more women had a medical or obstetric morbidity (48.5%), social morbidity (35.9%), infectious morbidity (25.6%) or psychological morbidity (25.1%) compared to no morbidity (22.4%).

4.9 Chapter summary

Overall, despite most women reporting a good quality of life (75.9%) and satisfaction with health (78.2%), almost three out of four women reported at least one symptom (73.5%), had at least one abnormal finding on clinical examination (71.3%) or had at least one abnormal finding on simple point-of-care investigation (73.5%).

Overall, 1 in 4 women (25.1%) reported psychological morbidity on screening and more than 1 in 3 women (36.6%) reported social morbidity (domestic violence and/or substance misuse) with 15.6% of women reporting both psychological and social morbidity.

Women in Pakistan tended to report more physical, psychological, and social ill-health. Of all women tested, 47.4% of women were anaemic with the highest prevalence among women from India and Pakistan.

Using an amended SIRS score, 23.1% of women had possible early signs of infection; in 43% of cases, a source could be identified which (based on symptoms and clinical examination) was most frequently gastroenteritis followed by lower respiratory tract, sexually transmitted or urinary tract infection or mastitis. The prevalence of HIV, malaria, and syphilis was below 5% in all settings except Malawi. Overall, one or more infectious condition was identified in 25.6% of women, one or more medical or obstetric condition in 45.5%.

4.10 Chapter summary in relation to literature

Summative morbidity

As this is the first study to assess the prevalence of physical, psychological and social components of ill-health comprehensively at five different assessment stages in four LMIC, there is little data in the literature against which to compare the overall summative burden of maternal morbidity. There are early reports of population surveys or health camps which tried to identify maternal ill-health in Uganda and Egypt (Ugandan Ministry of Health 1994, Osman-Hassan 1995). The community based-survey in Egypt reported up to 82.8% of women having morbidity before, during or after pregnancy respectively (Osman-Hassan 1995). One prospective study followed up 280 women in rural India for 5 years and reported pregnancy related morbidity in 30% of women (Bhatia 1995). In Kenya, 53% of women assessed for postnatal morbidity reported feeling “unwell” and 37% had experienced a “health problem” since childbirth (Chersich 2009). In a more recent study, 44% of women reported at least one self-reported physical complaint (Assarag 2013). In another study, 50.0% of 1,732 women in Malawi and 53.0% of 1,727 women in Pakistan had a least one medical/obstetric morbidity (infective or non-infective) but this relied only on solicited symptoms and limited clinical examination (Zafar 2015). Only one of the previous studies included social and psychological aspects of ill-health, along with physical measures of ill-health (Chersich 2009). In this PhD study, across the four countries, 77.1% of women had at least one type of morbidity. This may be because the assessment of ill-health was very comprehensive including self-reported symptoms, in combination with detailed clinical examinations and investigations. Furthermore, in this study all aspects of ill-health were assessed (infectious, medical/obstetric, psychological and social ill-health), in line with the current definition of maternal morbidity. Other studies have largely measured only one or two types of morbidity and this may explain the lower reported prevalence of morbidity in many of these studies.

With regards to self-reported perception of health, few women reported a poor or very poor quality of life (24.1%) and were dissatisfied or very dissatisfied with their

health (21.8%), despite having morbidity on further questioning and examination. However, this prevalence of poor perceived health is more than the prevalence of what other studies have reported. For example, as part of the overall assessment of ill-health in Ethiopia, 3.8% of 1065 pregnant women reported “poor/bad global health” (Hanlon 2009). The findings in this PhD study suggests that self-perceived ill-health is not simply a result of physical change during and after pregnancy but is influenced by a woman’s understanding of health, her social support and/or social desirability bias in responding to such questions (Graham 2016). The understanding of women’s perception of health and how this is reported warrants further research.

Infectious morbidity

With regards to infectious morbidities, the overall prevalence of HIV was 4.8%, and this is much higher than the global HIV prevalence of 0.8% among adults and the global estimate of new HIV infections among adults 15-49 years old as 0.5 per 1000 uninfected population (WHO 2017i, WHO 2016c). This finding may be higher than the global prevalence of HIV, as settings with known high prevalence of HIV (for example Malawi) were included in this overall estimated. Similarly, overall 2.7% of women were positive for malaria and 0.9% for syphilis. The prevalence of HIV, malaria, and syphilis are context specific. The findings from this PhD study for the prevalence in each country were comparable (**Table 3.4**).

Possible chest infection/tuberculosis was much lower than estimated global and national prevalence (**Table 3.4**) and this may be due to the lack of sensitivity of the screening question that was used to detect possible chest infection/tuberculosis. In this PhD study, 23.1% of women scored ≥ 2 using our amended SIRS score (CRP instead of WCC). This amended score has not been used in any other study and there is lack of data of the prevalence and significance of women with a SIRS score ≥ 2 in LMIC settings. However, the finding is very similar to a clinical audit in a HIC setting where 23.1% of 225 pregnant women with confirmed infection had a SIRS score ≥ 2 (Richardson 2017). It is noted however, that the definitions of a “raised CRP” in this

PhD study used low cut-offs levels (>5mg/L and >10mg/L within 24 hours of childbirth); and this may have resulted in an over-estimation of women with possible infection. Caution in interpretation of the sensitivity and specificity of these results are required.

Medical/obstetric morbidity

In this study the overall prevalence of anaemia was 47.9%, a higher prevalence compared to the global estimated prevalence of anaemia during pregnancy (38.2%) (WHO 2015d). Country specific prevalence of anaemia and the severity are similar to national prevalence (WHO 2015d). In this study, hypertension was diagnosed in 2.4% of women; a smaller prevalence compared to the estimated prevalence of 3.6 to 9.1 % in HIC (Roberts 2011); and pre-eclampsia was diagnosed in 0.6% of women; a smaller prevalence compared to the estimated global prevalence of 4.6% (Abalos 2013). This may be because the study population in each setting were women attending for antenatal or postnatal care, and they may have received anti-hypertensive medication to treat their hypertension or pre-eclampsia. In this study, urinary incontinence was diagnosed in 3.6% of women; a similar finding to other studies that reported urinary incontinence as part of an overall assessment of maternal morbidity, with estimates ranging from 1.0 to 4.7% in LMIC settings (Assarag 2013, Chersich 2009, Surkan 2017). The understanding of the type, severity and impact on a woman's well-being regarding incontinence requires further research. Antepartum haemorrhage was reported by 4.9% of women, a comparable finding to other studies in LMIC, that reported prevalence of antepartum haemorrhage as 1.2 to 5.5% (Chufamo 2015, Zafar 2015, Takai 2017).

Psychological morbidity

In this PhD study, 25.1% of women reported a EPDS ≥ 10 . This finding is similar to studies from LMIC that report the prevalence of pregnant or postpartum women with an EPDS ≥ 10 as 13.5 to 39.5% (Brittain 2017, Nasreen 2011, Rees 2016, Tsai 2016). In this PhD study 15.2% of women reported thoughts of self-harm; and this finding is

similar to prevalence ranges (5.0-18.0%) reported in a systematic review of 17 studies from HIC and LMIC (Lindahl 2005). These findings are also corroborated by more recent studies from other LMICs, with reported suicidal ideation and thoughts of self-harm prevalence rates ranging from 6.3 to 14% (Gausia 2009; Huang 2012; Zhong 2015). The reasons why women report such burden of psychological morbidity, and interventions to address these health needs across different country settings, requires further research.

Social morbidity, domestic violence

In this PhD study, overall 33.9% of women reported at least one form of domestic violence, and this could have been physical or verbal abuse. This finding is comparable to that of one study that assessed maternal morbidity after childbirth in women in Kenya that reported 39.4% of women had been coerced into sex, and 19% had been pushed or physical hit by an intimate partner (Chersich 2009). This prevalence of domestic finding from this PhD is higher than overall findings reported in the WHO multi-country study on domestic violence against women, that found in most settings, the prevalence of physical intimate partner violence in pregnancy ranged between 4% and 12% (WHO 2013c). Other clinical studies found higher prevalence of physical domestic violence in Egypt (32%), followed by India (28%), Saudi Arabia (21%) and Mexico (11%) (WHO 2013c); and clinical studies from Africa reported prevalence rates of 23–40% for physical, 3–27% for sexual and 25–49% for emotional intimate partner violence during pregnancy (WHO 2013c). The findings of a high prevalence of domestic violence in this PhD study, may be due to women being asked questions regarding physical and verbal forms of domestic violence, not just from the partner/husband but from other family members also.

Social morbidity, substance misuse

In this PhD study, 6.5% of women reported any substance misuse during and after pregnancy. This summative finding includes the misuse of tobacco, alcohol, illicit drugs and stimulants and suggests that overall, as a summative measure, substance

misuse is not a common problem in women in these settings. There is little information available on the extent of substance use among pregnant women in LMIC settings. The global prevalence of women using alcohol during pregnancy has been reported as 9.8% (Popova 2017). Similarly, one study that assessed maternal morbidity after childbirth in 500 women, reported that overall 8% of women had drunk alcohol during pregnancy or whilst breastfeeding (Chersich 2009). The overall prevalence of tobacco use in women during pregnancy in LMIC settings has been estimated as 2.6% (Caleyachetty 2014); and the limited data available indicate that between 3.6 to 8.8% of pregnant women use illicit substances in South Africa (Petersen 2014).

Further reflections of the main findings from this chapter in relation to other literature are given in the discussion chapter of this thesis.

CHAPTER 5: RESULTS TWO

5.1 Introduction

This is the second of four chapters that report on the results of this research project. The four chapters that present the main results of the research study, are structured in sequence to address each main research question. For the purposes of this thesis, results for the study settings are presented per country in the following sequence: India, Pakistan, Kenya and Malawi. Where appropriate, results are presented as a combined study population. In this chapter, the prevalence of maternal morbidity per assessment stage of pregnancy per country and as a combined study population is presented. Results are presented in a narrative text accompanied by tables and figures. Where supplementary information is necessary, this is presented in the appendices.

Background

In this research study, there were four research questions.

Table 5.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

In this chapter, results are presented to address the following research question: “What is the prevalence of maternal morbidity at different stages of pregnancy?” In this research study for standardisation the following abbreviations and stages of pregnancy are presented in **Table 5.2**.

Table 5.2: Definitions of assessment stages

Number	Stage	Abbreviation	Time frame
1.	Early antenatal	EAN	≤20 weeks’ gestation of pregnancy*
2.	Late antenatal	LAN	>20 weeks gestation of pregnancy*
3.	Delivery	DEL	≤24 hours from time of childbirth
4.	Early postnatal	EPN	from day 1–7 (>24 hours up ≤day 7) from time of childbirth
5.	Late postnatal	LPN	from week 2–12 (>day 7 and ≤week 12) from time of childbirth

*For the antenatal assessments, gestation was calculated based on the women’s last menstrual period or the results of a dating scan if available.

5.2 Study population per assessment stage

In this chapter, results are presented using the combined dataset, which includes all four countries. If there are significant differences between the countries, these are highlighted in the narrative text.

Table 5.3: Number of women in the study per assessment stage, per country and per total

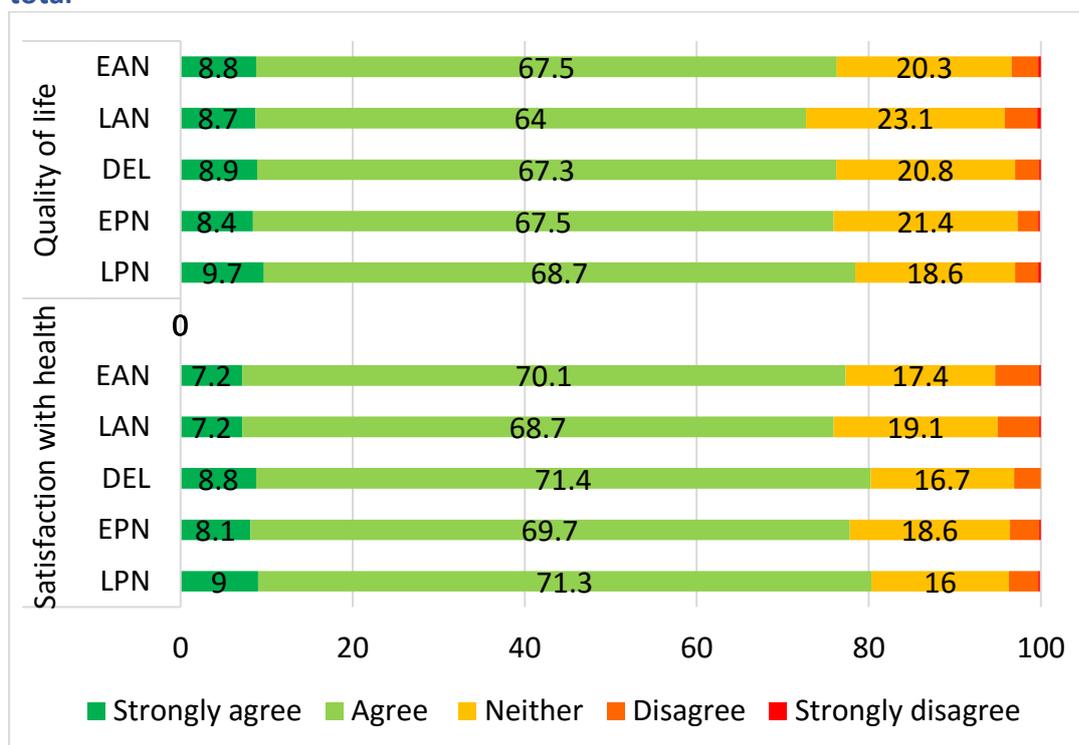
Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n=11454)	
	n	%	n	%	n	%	n	%	n	%
Stage of pregnancy										
Early antenatal	416	19.8	607	18.5	592	18.8	589	20.2	2204	19.2
Late antenatal	397	18.9	768	23.4	684	21.7	576	19.7	2425	21.2
Delivery	423	20.2	654	19.9	592	18.8	581	19.9	2250	19.6
Early postnatal	432	20.6	618	18.8	620	19.7	594	20.3	2264	19.8
Late postnatal	431	20.5	640	19.5	657	20.9	583	19.9	2311	20.2

This study was designed as a cross sectional study. The target size for each assessment stage was the sample size divided by the five assessment stages. Some of the research assistants across the four LMIC collected more data from women at various assessment stages. Instead of discarding this data, all data was included in the final analysis. Similar proportions of women were recruited for each assessment stage from each country setting with more women recruited from the late antenatal and late postnatal stages due to over-recruitment (**Table 5.3**).

5.3 Self-reported health

Overall, the responses of women to questions regarding their quality of life and their satisfaction with health were similar across all five assessment stages (**Figure 5.1**). Overall, most women across all assessment stages agreed that they had a good quality of life and were satisfied with their health. Between 18.6% and 23.1% of all women, responded that they neither agreed or disagreed that they had a good quality of life. This was highest (23.1%) in the late antenatal stage (**Figure 5.1**). Between 19.0% and 23.5% of all women, responded that they neither agreed or disagreed that they were satisfied with their health. This was highest (23.5%) in the late antenatal stage. The trend for satisfaction was in line with how women reported their quality of life, with similar percentage across the five assessment stages (**Figure 5.1**).

Figure 5.1 Quality of life and satisfaction with health per assessment stage, per total

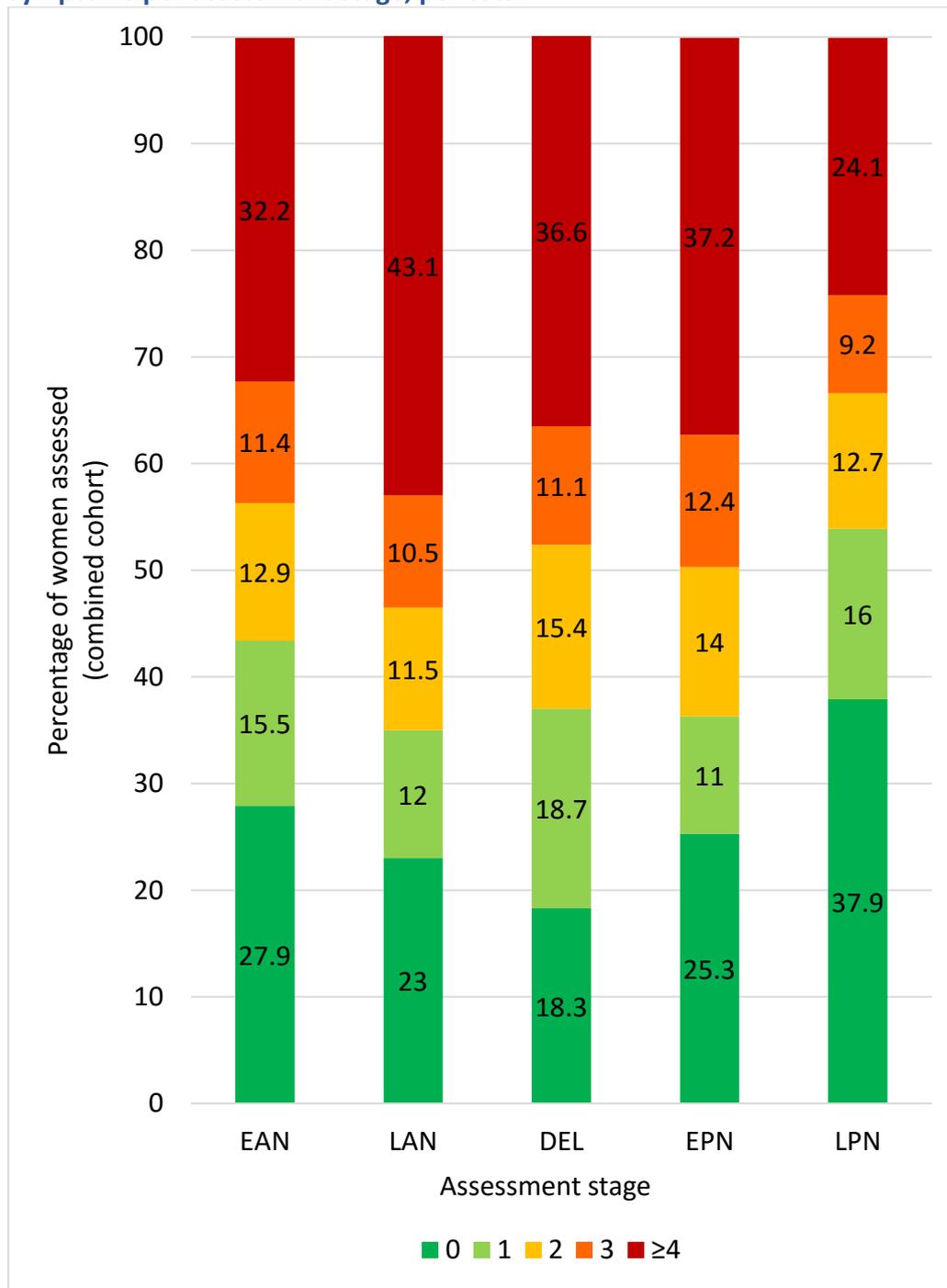


*Percentages reported are derived from the number of women per assessment stage.

Self-reported number of symptoms per assessment stage per total

Figure 5.2 shows as a combined cohort, the responses of women when screened for different types of symptoms covering six organ systems using 76 screening questions. More women did not report any symptoms in the late postnatal stage (37.9%), compared to the early antenatal (27.9%), early postnatal (25.3%), late antenatal stages (23.0%) and within 24 hours of delivery (18.3%). Similar percentages of women reported the same numbers of symptoms across all five assessment stages, with small variations only. For example, the percentage of women reporting three symptoms was 11.4%, 10.5%, 11.1%, 12.4% and 9.2% throughout the continuum of pregnancy from early antenatal to late postnatal stage (**Figure 5.2**). 43.1% of women reported at least four symptoms at the late antenatal stage. 81.7% of women reported at least one symptom within 24 hours of childbirth. Overall, 24.1% of women reported at least four symptoms in the late postnatal assessment stage. The mean number of symptoms were similar across all five assessment stages (EAN 3.4, DEL 3.8, EPN 3.8, LPN 3.2) with a slight increase in the late antenatal stage (4.8).

Figure 5.2: Percentage of all women with no symptoms and one or more symptoms per assessment stage, per total



Severity of symptoms per assessment stages per total

Figure 5.3: Severity of symptoms reported for all women who reported symptoms per assessment stage, per total.

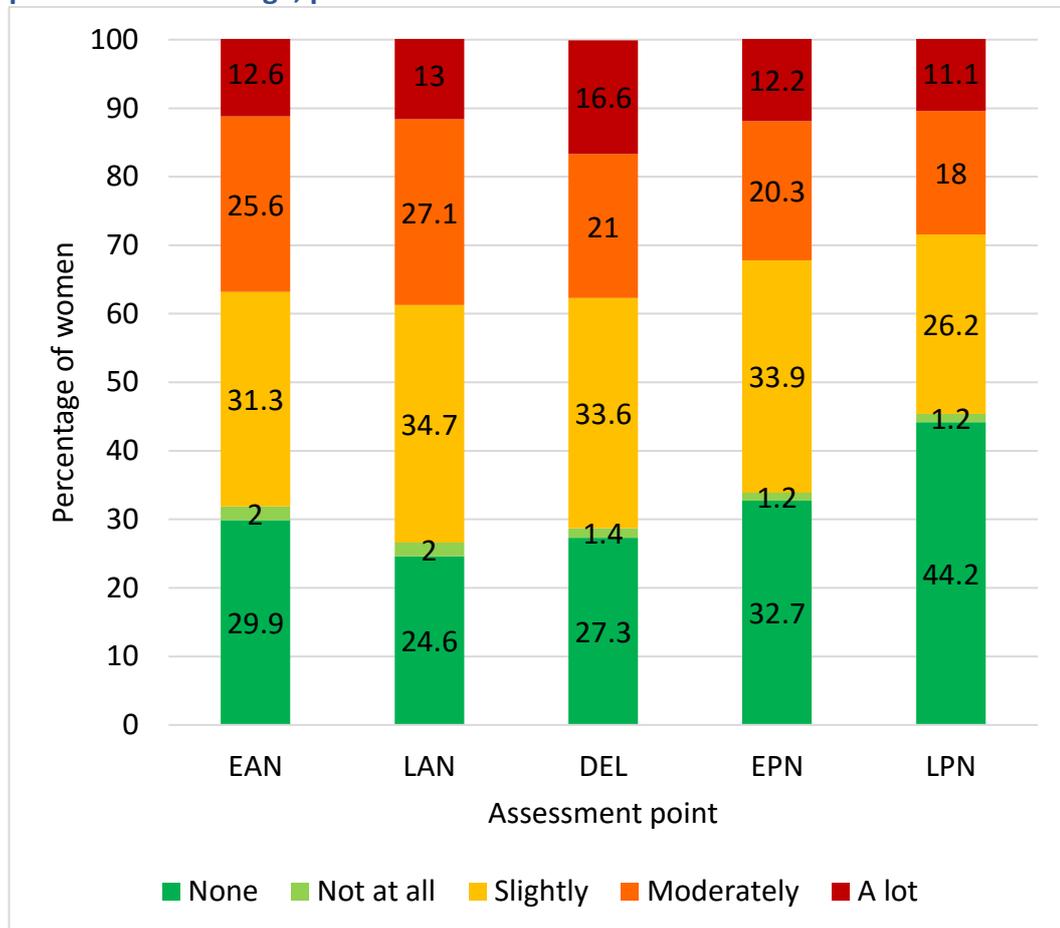


Figure 5.3 shows as a combined cohort and the percentage of all women assessed, whether they report symptoms and if so, the severity of symptoms reported per assessment stage. Overall, 11454 women reported 43,706 symptoms in total. Of all the symptoms reported, similar proportions of women reported the same scale of severity of symptoms across the five assessment stages. For example, the percentage of women reporting that their symptoms were bothering them a lot was similar (12.6%, 13.0%, 12.2%, 11.1%) throughout the continuum of pregnancy from early antenatal to late postnatal stage with a slightly higher proportion within 24 hours of delivery (16.6%). Similar proportions of women also reported the same scale of severity of symptoms (slightly) across four assessment stages (31.3%, 34.7%, 33.6%,

33.9%) throughout the continuum of pregnancy from the early antenatal to late postnatal stage with a slightly lower proportion in late postnatal (26.2%) (**Figure 5.3**).

Severity of symptoms per assessment stage per country

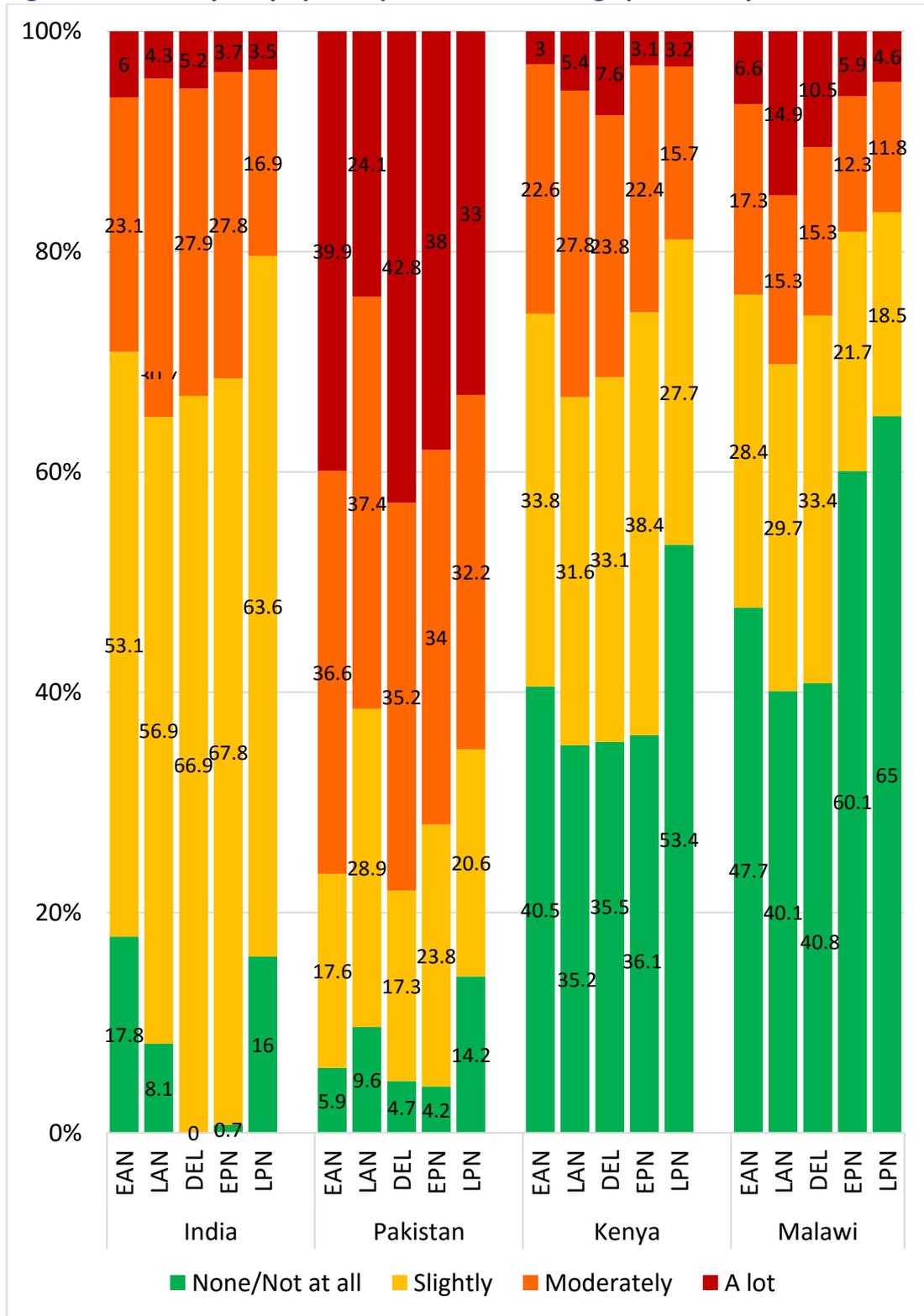
In India, a large proportion of women reported that their symptoms bothered them only “slightly” across all five assessment stages, with the highest percentage of women reporting this within 24 hours of childbirth (66.9%). (**Figure 5.4**).

In Pakistan, a large proportion of women reported that their symptoms bothered them “a lot” over the five assessment stages with 42.8% of women reported that their symptoms bothered them “a lot” within 24 hours of childbirth; 39.9% in the early antenatal, 38.0% in the early postnatal and 33.0% in the late postnatal stages (**Figure 5.4**).

In Kenya, a larger proportion of women denied any symptoms/or if they reported a symptom, it “did not bother them at all” across the five assessment stages, with the highest percentage of women reporting this in the late postnatal stage (65.0%).

Similar to Kenya, in Malawi, a large proportion of women denied any symptoms; or if they reported a symptom, it did not bother them “at all”, with the highest percentage of women reporting this in the late postnatal stage (53.4%) (**Figure 5.4**).

Figure 5.4: Severity of symptoms per assessment stage per country



Categorises of morbidity

For the purposes of this research project, maternal morbidity was defined as:

- (1) physical
- (2) psychological
- (3) social

Summative physical morbidity was defined as (1) infectious or (2) medical and obstetric.

5.4 Infectious morbidity

In this study, infectious physical morbidity that could be measured included: HIV, malaria, syphilis, possible chest infection/TB, and a SIRS score of ≥ 2 . **Table 5.4** presents infectious morbidity identified per assessment stage for all countries combined and percentages are derived using the number of women who responded per assessment stage.

Table 5.4: Infectious morbidity per assessment stage per total

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women*	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
INFECTIOUS MORBIDITY						
Condition ^a						
HIV	99 (4.5%)	107 (4.4%)	107 (4.8%)	123 (5.4%)	116 (5.0%)	551 (4.8%)
Malaria	85 (3.9%)	73 (3.0%)	59 (2.6%)	43 (1.9%)	49 (2.1%)	309 (2.7%)
Syphilis	36 (1.6%)	24 (1.0%)	19 (0.8%)	16 (0.7%)	12 (0.5%)	107 (0.9%)
Positive screening for chest infection/ possible TB	18 (0.8%)	24 (1.0%)	10 (0.4%)	12 (0.5%)	10 (0.4%)	74 (0.6%)
Number of women with CRP measured ^b	1,409 (63.9%)	1,368 (56.4%)	1,502 (66.8%)	1,518 (67.1%)	1,396 (60.4%)	7,193 (62.8%)

Median CRP (IQR)	7 (5-13)	6 (5-12)	15 (7-30)	19 (8-44)	10 (5-22)	10 (5-23)
Septic Inflammatory Response Syndrome (SIRS) ^b	480 (21.8%)	609 (25.1%)	472 (21.0%)	590 (26.1%)	492 (21.3%)	2,643 (23.1%)
At least 1 infectious condition	601 (27.3%)	730 (30.1%)	582 (25.9%)	691 (30.5%)	597 (25.8%)	3,201 (28.0%)

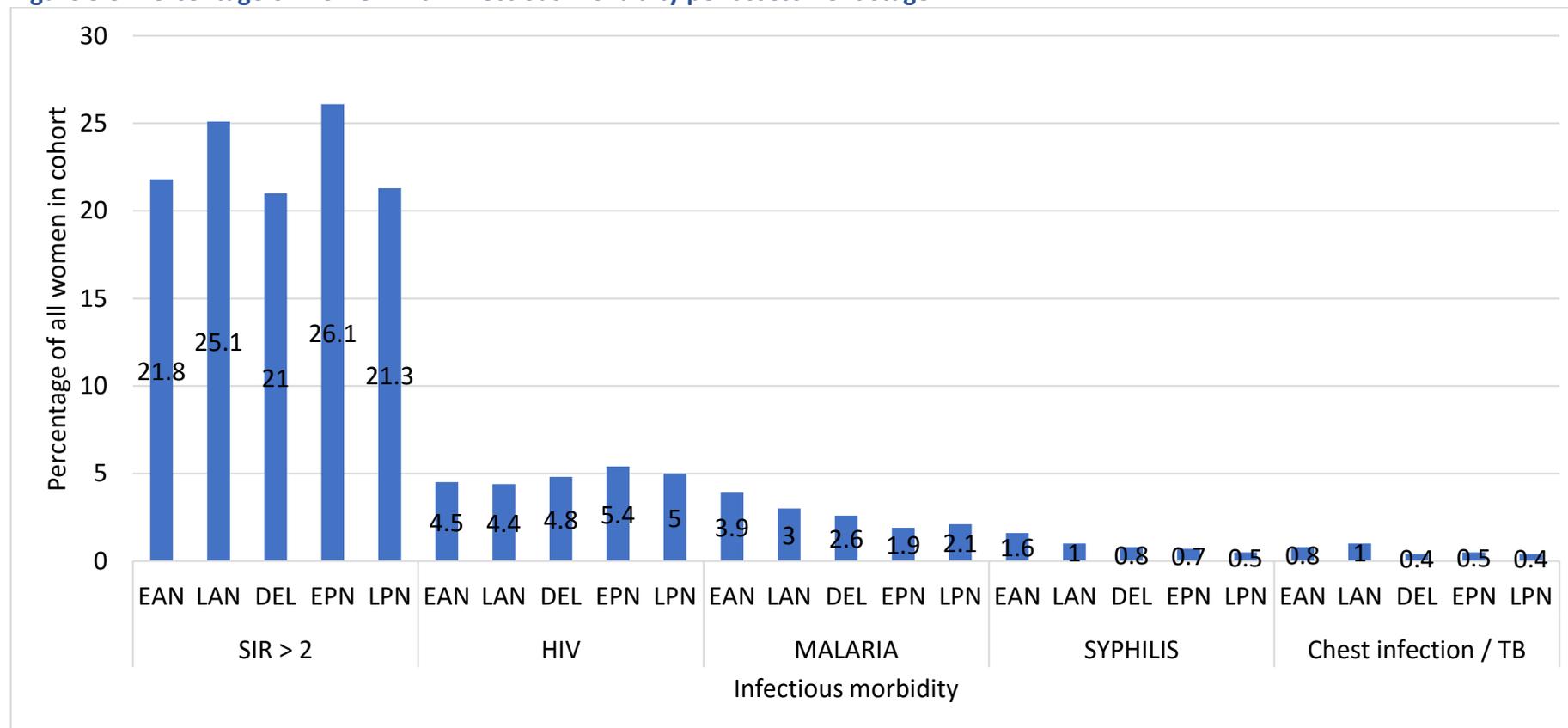
^a Where data were missing for a condition, the condition was regarded as being absent for purposes of deriving morbidities % missing was: HIV 9.7%, malaria 5.3%, syphilis 8.9%, screening for chest infection/TB 2.0%.

^b CRP was not measured at some primary level facilities in Malawi and Pakistan. Only participants for whom a CRP result was obtained are included in these statistics.

The CRP levels were highest in the early postnatal stage (19), then within 24 hours of delivery (15), in the late postnatal (10), early antenatal (7), and late antenatal stages (6). This trend was similar across all four countries (**Table 5.5**). The percentage of women with possible early signs of infection (using the score of SIRS ≥ 2) were highest in the early postnatal (26.1%) and in the late antenatal (25.1%) stages. There were similar percentages of women with possible early signs of infection in the early antenatal (21.0%), within 24 hours of delivery (21.0%) and late postnatal (21.3%) stages.

Figure 5.5 further displays the percentage of women as a combined total cohort with infectious morbidity per assessment stage, and percentages are derived using the number of women who responded per assessment stage.

Figure 5.5: Percentage of women with infectious morbidity per assessment stage



Similar proportions of women were HIV positive across all five assessment stages with the highest percentage of women in the early postnatal stage (5.4%) (**Table 5.4 and Figure 5.5**). Overall, the highest percentage of women who women tested positive for malaria in the early antenatal stage (3.9%), and this percentage generally decreased as the pregnancy continued (**Table 5.4 and Figure 5.5**).

Overall, the highest percentage of women tested positive for syphilis in the early antenatal stage (1.6%) and this percentage decreased as the pregnancy continued and after delivery with the lowest percentage at the late postnatal (0.5%) stage. Compared to the other assessment stages, more women reported a productive cough of more than two weeks suggestive of a possible chest infection/TB at the late antenatal stage (1.0%).

The percentages of women with malaria and syphilis were highest in the early antenatal stage, and decreased across the continuum of pregnancy (**Figure 5.5**).

Overall, and as a combined measure, 30.5% of women were diagnosed with at least one infectious morbidity in the early postnatal stage, 30.1% in the late antenatal, 27.3% in the early antenatal, and 25.8% in the early postnatal stage. Within 24 hours of childbirth 25.8% of women were diagnosed with at least one infectious morbidity. Country specific tables for infectious morbidity per assessment stage are displayed in **Table 5.5**. The percentages and trends of each infectious morbidity were generally similar across all four countries, although differences are highlighted in the text below the table. Percentages are derived using the number of women who responded per assessment stage.

Table 5.5: Infectious morbidity per assessment stage per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Infectious morbidity						
INDIA						
Number of women*	416	397	423	432	431	2099
HIV	2 (0.5%)	2 (0.5%)	1 (0.2%)	1 (0.2%)	0	6 (0.3%)
Malaria	0	0	0	0	2 (0.5%)	2 (0.1%)
Syphilis	0	0	0	0	0	0
Chest infection/ possible TB	2 (0.5%)	1 (0.2%)	1 (0.2%)	2 (0.5%)	2 (0.5%)	8 (0.4%)
Number of women with CRP measured ^b	373 (89.7%)	372 (93.7%)	380 (89.8%)	375 (86.8%)	373 (86.5%)	1873 (89.2%)
Median CRP (IQR)	5 (5-6)	5 (5-12)	16 (6-34)	20 (8-40)	9 (5-18)	9 (5-21)
SIRS ≥ 2 ^b	43 (10.3%)	66 (16.6%)	47 (11.1%)	63 (14.6%)	70 (16.2%)	289 (13.8%)
At least 1 infectious condition	47 (11.3%)	68 (17.1%)	49 (11.6%)	65 (15.0%)	73 (16.9%)	302 (14.4%)
PAKISTAN						
Number of women*	607	768	654	618	640	3287
HIV	0	1 (0.1%)	7 (1.1%)	2 (0.3%)	1 (0.2%)	11 (0.3%)
Malaria	0	0	0	1 (0.2%)	0	1 (0.03%)
Syphilis	0	0	0	0	0	0
Chest infection/ possible TB	7 (1.1%)	11 (1.4%)	2 (0.3%)	2 (0.3%)	3 (0.5%)	25 (0.8%)
Number of women with CRP measured ^b	222 (36.6%)	91 (11.8%)	194 (29.7%)	169 (27.3%)	116 (18.1%)	792 (24.1%)
Median CRP (IQR)	9 (6-15)	7 (5-12)	10.5(6-19)	15 (9-28)	9 (6-15)	10 (6-17)

SIRS ≥ 2 ^b	67 (11.0%)	122 (15.9%)	54 (8.3%)	70 (11.3%)	55 (8.6%)	368 (11.2%)
At least 1 infectious condition	73 (12.0%)	134 (17.4%)	63 (9.6%)	73 (11.8%)	59 (9.2%)	402 (12.2%)
KENYA						
Number of women*	592	684	592	620	657	3145
HIV	24 (4.0%)	19 (2.8%)	24 (4.0%)	25 (4.0%)	25 (3.8%)	117 (3.7%)
Malaria	2 (0.3%)	2 (0.3%)	1 (0.2%)	2 (0.3%)	0	7 (0.2%)
Syphilis	2 (0.3%)	2 (0.3%)	1 (0.2%)	0	3 (0.5%)	8 (0.2%)
Chest infection/ possible TB	3 (0.5%)	6 (0.9%)	5 (0.8%)	3 (0.5%)	5 (0.8%)	22 (0.7%)
Number of women with CRP measured ^b	532 (89.9%)	673 (98.4%)	573 (96.8%)	605 (97.6%)	601 (91.5%)	2984 (94.9%)
Median CRP (IQR)	7 (5-11)	6 (5-9)	12 (6-22)	19 (7-49)	7 (5-19)	8 (5-19)
SIRS ≥ 2 ^b	206 (34.8%)	267 (39.0%)	197 (33.3%)	278 (44.8%)	199 (30.3%)	1147 (36.5%)
At least 1 infectious condition	216 (36.5%)	280 (40.9%)	218 (36.8%)	289 (46.6%)	216 (32.9%)	1219 (38.8%)
MALAWI						
Number of women*	589	576	581	594	583	2923
HIV	73 (12.4%)	85 (14.8%)	75 (12.9%)	95 (16.0%)	90 (15.4%)	418 (14.3%)
Malaria	83 (14.1%)	71 (12.3%)	58 (10.0%)	40 (6.7%)	47 (8.1%)	299 (10.2%)
Syphilis	34 (5.8%)	22 (3.8%)	18 (3.1%)	16 (2.7%)	9 (1.5%)	99 (3.4%)
Chest infection/ possible TB	6 (1.0%)	6 (1.0%)	2 (0.3%)	5 (0.8%)	0	19 (0.7%)
Number of women with CRP measured ^b	282 (47.9%)	232 (40.3%)	355 (61.1%)	369 (62.1%)	306 (52.5%)	1544 (52.8%)
Median CRP (IQR)	15 (7-25)	10 (7-20.5)	25 (14-49)	23 (12-46)	18 (10-27)	18.5 (9-35)

SIRS ≥ 2 ^b	164 (27.8%)	154 26.7(%)	174 (30.0%)	179 (30.1%)	168 (28.8%)	839 (28.7%)
At least 1 infectious condition	265 (45.0%)	248 (43.1%)	252 (43.4%)	264 (44.4%)	249 (42.7%)	1278 (43.7%)

^a Where data were missing for a condition the condition was regarded as being absent for purposes of deriving the percentage.

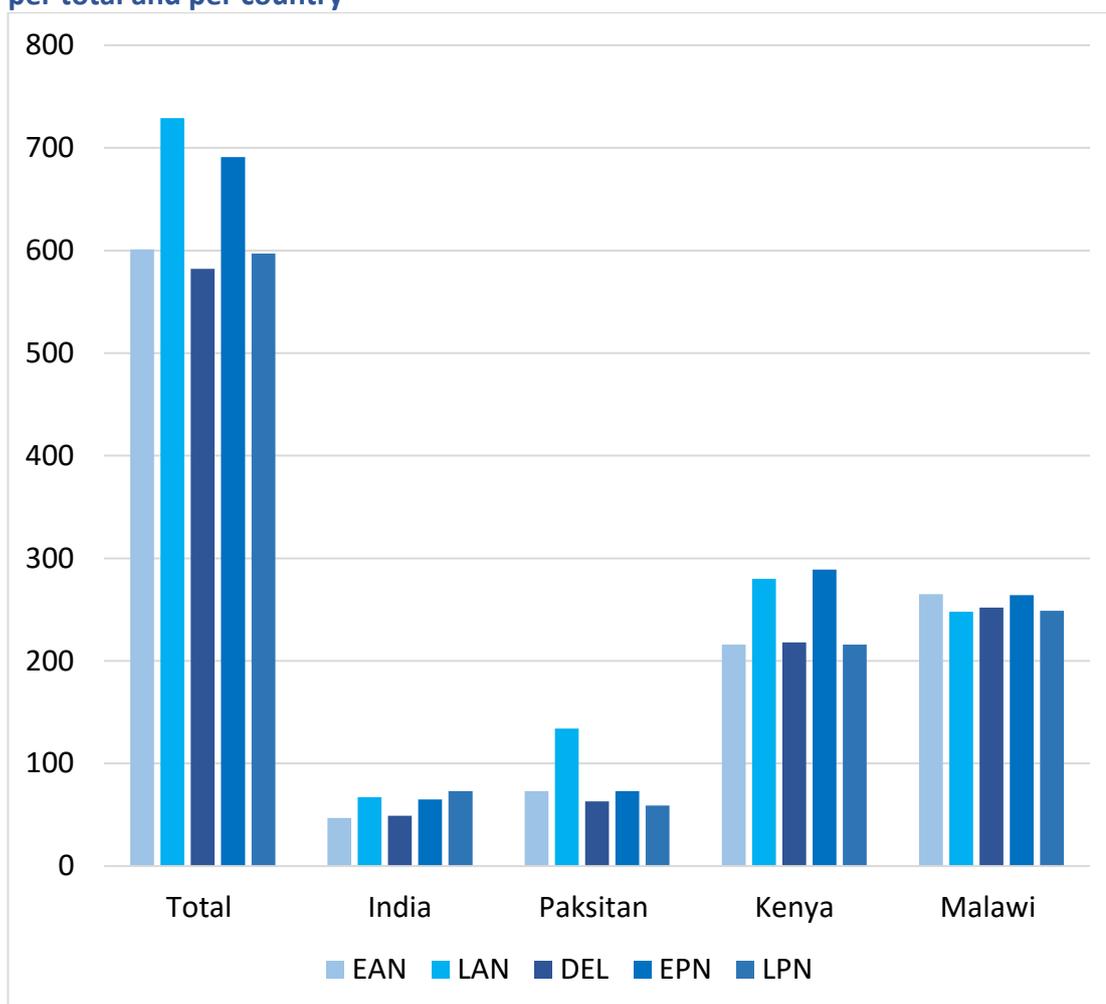
^b CRP was not measured at some primary level facilities in Malawi and Pakistan. Only participants for whom a CRP result was obtained are included in these statistics.

As a combined cohort, the median CRP level was 10 with an interquartile range (IQR) of 5-23. Across the four countries, the highest median levels of CRP were highest in Malawi (18.5; IQR 9-35) and then Pakistan (10; IQR 6-17), Kenya (8; IQR 5-19) and India (9; IQR 5-21). Across all four countries, CRP levels tended to be highest in the early postnatal stage, then within 24 hours of delivery, and then in the late postnatal, early antenatal, and late antenatal stages (Table 5.5). As a combined cohort, the highest percentage of women with SIRS ≥ 2 was in the early postnatal stage. This trend was similar for women in Kenya and Malawi. In India, of those who did have SIRS ≥ 2 , the largest percentage was in the late antenatal compared to the early postnatal in the overall cohort. This was similar to the trend of women with SIRS ≥ 2 in Pakistan also (Table 5.5).

As a combined measure, the highest percentage of women were diagnosed with at least one infectious morbidity in the early postnatal stage. This trend was similar in Kenya. In India and Pakistan, the highest percentage of women were diagnosed with at least one infectious morbidity in the late antenatal stage. In Malawi, the highest percentage of women were diagnosed with at least one infectious morbidity in the early antenatal stage.

Figure 5.6 displays these trends visually, displaying the number of women with any infection morbidity per assessment stage, per total and per country.

Figure 5.6: Number of women with any infection morbidity per assessment stage, per total and per country



there was a much higher burden of infectious morbidity in the Kenya and Malawi, compared to India and Paksitan. **Figure 5.6** demonstrates that this burden of infectious morbidity is identified across all five assessments stages with the highest percentage of women overall with infectious morbidity in the late antenatal stage.

5.5 Medical/obstetric morbidity

In this study medical/obstetric morbidity that could be measured included: anaemia, hypertension, pre-eclampsia, antenatal haemorrhage and urinary incontinence. **Table 5.7** presents medical/obstetric morbidity per assessment stage per total and **Table 5.8** presents further information on the severity of anaemia per assessment

stage per total. Percentages are derived using the number of women who responded per assessment stage.

Table 5.6: Medical/obstetric morbidity per assessment stage per total

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
MEDICAL/OBSTETRIC MORBIDITY						
Condition						
Anaemia	900 (40.8%)	1226 (50.6%)	1096 (48.7%)	1213 (53.6%)	985 (42.6%)	5420 (47.3%)
Hypertension	33 (1.5%)	111 (4.6%)	82 (3.6%)	66 (2.9%)	48 (2.1%)	340 (3.0%)
Pre-eclampsia	n/a	51 (2.1%)	18 (0.8%)	17 (0.7%)	n/a	86 (1.2%)
Urinary incontinence	67 (3.0%)	161 (6.6%)	69 (3.1%)	44 (1.9%)	76 (3.3%)	417 (3.6%)
Antenatal haemorrhage	139 (6.3%)	74 (3.0%)	n/a	n/a	n/a	213 (4.6%)
At least 1 medical or obstetric condition	998 (45.3%)	1328 (54.8%)	1135 (50.4%)	1245 (55.0%)	1017 (44.0%)	5723 (50.0%)

Table 5.7: Severity of anaemia per assessment stage for all countries combined

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Anaemia* (Hb <11.0 g/l)	900 (40.8%)	1226 (50.6%)	1096 (48.7%)	1213 (53.6%)	985 (42.6%)	5420 (47.3%)
Severity of anaemia						
Mild anaemia (Hb 10-10.9 g/l)	440 (20.0%)	495 (20.4%)	476 (21.2%)	499 (22.0%)	490 (21.2%)	2400 (20.9%)
Moderate anaemia (Hb 70-99 g/l)	432 (19.6%)	684 (28.2%)	579 (25.7%)	651 (28.7%)	472 (20.4%)	2818 (24.6%)
Severe anaemia (Hb <70 g/l)	28 (1.3%)	47 (1.9%)	41 (1.8%)	63 (2.8%)	23 (1.0%)	202 (1.8%)

*It is noted that haemoglobin levels decrease as pregnancy continues due to haemodilution. The WHO definitions of anaemia have been used here to display the severity of anaemia across the assessment stages of pregnancy.

Overall, as a combined cohort, the percentage of women with anaemia was highest in the early postnatal (53.6%) and late antenatal (50.6%) stages. There were similar percentages of women with anaemia in the early antenatal (40.8%) and late postnatal (42.6%) stages. Within 24 hours of delivery the percentage of women with anaemia was 48.7%. **Table 5.7** displays that most of the anaemia was either mild (Hb 10-10.9g/l) or moderate (Hb 70-99 g/l) at each assessment stage. The percentage of women with severe anaemia (Hb <70 g/l) was highest in the early postnatal (2.8%) and the late antenatal stage (1.9%). There were similar percentages of women with severe anaemia in the late antenatal stage (1.9%) and within 24 hours of delivery (1.8%). There were similar percentage of women with severe anaemia in the early antenatal (1.2%) stage and within 24 hours of delivery (1.0%). More women were diagnosed with anaemia and with severe anaemia in India and Pakistan compared to Kenya and Malawi.

Overall, 4.6% of women were diagnosed with hypertension in the late antenatal stage and 1.5% of women were diagnosed in early antenatal stage. This could represent women with pre-existing hypertension. The percentage of women diagnosed with hypertension decreased along the continuum of pregnancy to 3.6% within 24 hours of childbirth, 2.9% in the early postnatal and 2.1% in the late postnatal stage. This trend may indicate that women with hypertension are identified during antenatal care and receive appropriate treatment, resulting in a decrease in women with hypertension along the continuum of pregnancy.

In the late antenatal stage, 2.1% of women were diagnosed with pre-eclampsia. The percentage of women were diagnosed with pre-eclampsia decreased to 0.8% within 24 hours of childbirth and 0.7% in the early postnatal stage (**Table 5.6** and **Figure 5.7**).

This trend may indicate that women with pre-eclampsia were identified during antenatal care and/or during childbirth, and received appropriate treatment.

However, this trend may also simply reflect the physiological resolving of pre-eclampsia after childbirth (Magowan 2014).

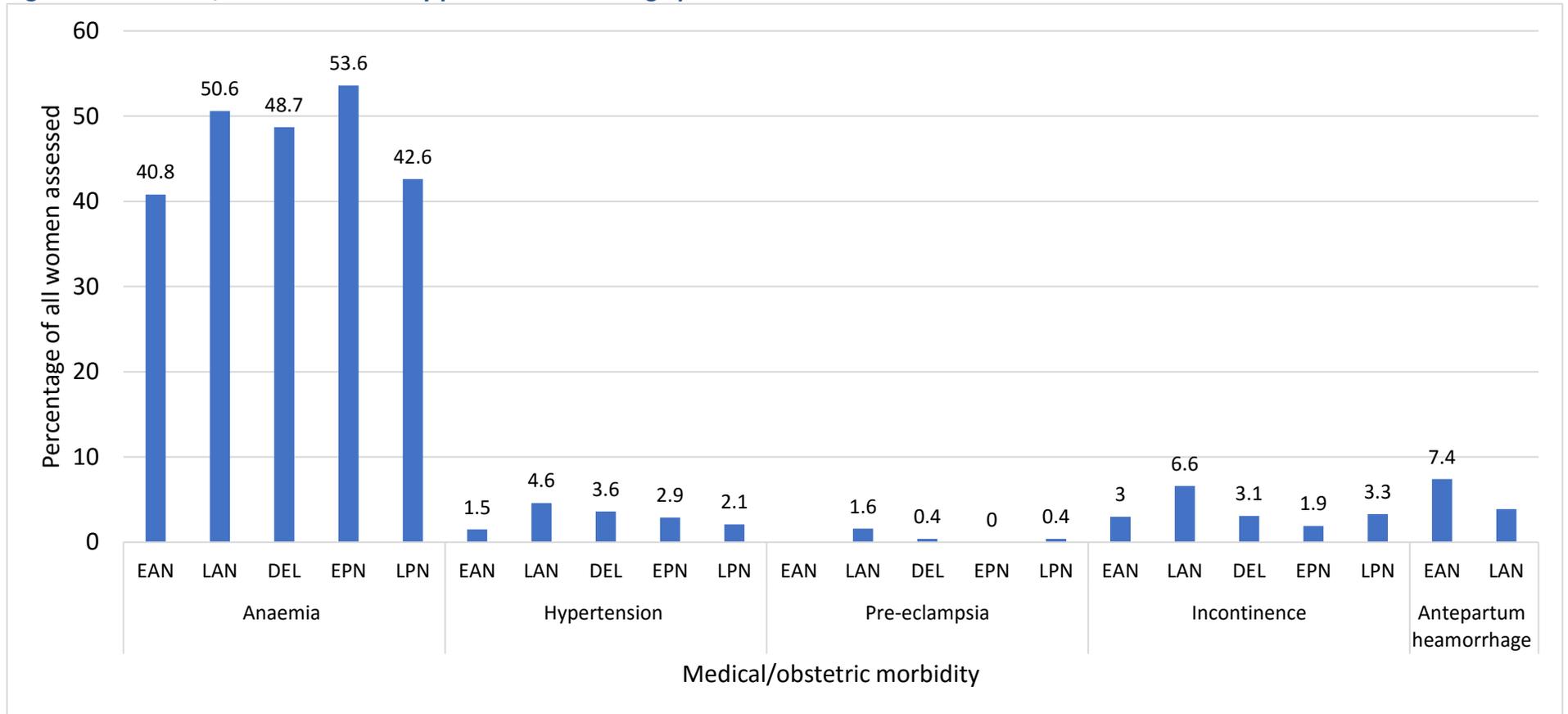
Overall, the highest percentage of women who were diagnosed with urinary incontinence was in the late antenatal stage (6.6%) (**Table 5.6** and **Figure 5.7**). Similar proportions of women were diagnosed with urinary incontinence in the early antenatal (3.0%) and the late postnatal (3.3%) stages, and within 24 hours of childbirth (3.1%). Overall, 1.9% of women were diagnosed with urinary incontinence in the early postnatal stage.

Overall, 6.3% of women were diagnosed with antenatal haemorrhage in the early antenatal and 3.0% in the late antenatal stage.

Overall, as a combined cohort 50.0% of women had at least one medical/obstetric morbidity. The highest percentage of women who had at least one medical/obstetric morbidity was in the early postnatal stage (55.0%), followed by the late antenatal (54.8%), within 24 hours of childbirth (50.4%), early antenatal (45.3%) and then late postnatal stage (44.0%) (**Table 5.5**).

Figure 5.7 displays visually the percentage of women as a combined total cohort with each medical/ obstetric morbidity per assessment stage.

Figure 5.7: Medical/obstetric morbidity per assessment stage per total



Country specific tables for medical/obstetric morbidity per assessment stage are displayed in **Table 5.8**. **Table 5.9** presents further information on the severity of anaemia per assessment stage per country. Percentages are derived using the number of women who responded per assessment stage.

The percentages and trends of each medical/obstetric morbidity were similar across all four countries, although differences are highlighted in the text below the table.

Table 5.8: Medical/obstetric morbidity per assessment point per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Condition						
INDIA						
Number of women	416	397	423	432	431	2099
Anaemia	184 (44.2%)	228 (57.4%)	282 (66.7%)	309 (71.5%)	265 (61.5%)	1268 (60.4%)
Hypertension	2 (0.5%)	16 (4.0%)	7 (1.6%)	7 (1.6%)	1 (0.2%)	33 (1.6%)
Pre-eclampsia	n/a	0	0	1 (0.2%)	n/a	1 (0.1%)
Urine incontinence	13 (3.1%)	21 (5.3%)	0	2 (0.5%)	0	36 (1.7%)
Antenatal haemorrhage	0	0	n/a	n/a	n/a	0
At least 1 medical or obstetric condition	202 (48.6%)	254 (64.0%)	285 (67.4%)	311 (72.0%)	266 (61.7%)	1318 (62.8%)
PAKISTAN						
Number of women	607	768	654	618	640	3287
Anaemia	389 (64.1%)	590 (76.8%)	435 (66.5%)	437 (70.7%)	375 (58.6%)	2226 (67.7%)
Hypertension	18 (3.0%)	67 (8.7%)	54 (8.3%)	40 (6.5%)	27 (4.2%)	206 (6.3%)
Pre-eclampsia	n/a	26 (3.4%)	8 (1.2%)	6 (1.0%)	n/a	40 (2.0%)
Urine incontinence	40 (6.6%)	106 (13.8%)	64 (9.8%)	39 (6.3%)	65 (10.2%)	314 (9.5%)

Antenatal haemorrhage	80 (13.2%)	60 (7.8%)	n/a	n/a	n/a	140 (10.2%)
At least 1 medical or obstetric condition	422 (69.5%)	619 (80.6%)	455 (69.6%)	455 (73.6%)	388 (60.6%)	2339 (71.2%)
KENYA						
Number of women	592	684	592	620	657	3145
Anaemia	102 (17.2%)	163 (23.8%)	146 (24.7%)	204 (32.9%)	130 (19.8%)	745 (23.7%)
Hypertension	6 (1.0%)	9 (1.6%)	8 (1.4%)	3 (0.5%)	5 (0.9%)	31 (1.1%)
Pre-eclampsia	n/a	17 (2.9%)	10 (1.7%)	6 (1.0%)	n/a	49 (2.8%)
Urine incontinence	2 (0.3%)	11 (1.9%)	3 (0.5%)	0	2 (0.3%)	18 (0.6%)
Antenatal haemorrhage	5 (0.9%)	2 (0.4%)	n/a	n/a	n/a	7 (0.6%)
At least 1 medical or obstetric condition	232 (39.4%)	258 (44.8%)	239 (41.1%)	265 (44.6%)	220 (37.7%)	1214 (41.5%)
MALAWI						
Number of women	589	576	581	594	583	2923
Anaemia	225 (38.2%)	245 (42.5%)	233 (40.1%)	263 (44.3%)	215 (36.9%)	1181 (40.4%)
Hypertension	6 (1.0%)	9 (1.6%)	8 (1.4%)	3 (0.5%)	5 (0.9%)	31 (1.1%)
Pre-eclampsia	n/a	17 (2.9%)	10 (1.7%)	6 (1.0%)	n/a	49 (2.8%)
Urine incontinence	2 (0.3%)	11 (1.9%)	3 (0.5%)	0	2 (0.3%)	18 (0.6%)
Antenatal haemorrhage	5 (0.9%)	2 (0.4%)	n/a	n/a	n/a	7 (0.6%)
At least 1 medical or obstetric condition	232 (39.4%)	258 (44.8%)	239 (41.1%)	265 (44.6%)	220 (37.7%)	1214 (41.5%)

Table 5.9: Severity of anaemia per assessment stage per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Condition						
INDIA						
Anaemia	184 (44.2%)	228 (57.4%)	282 (66.7%)	309 (71.5%)	265 (61.5%)	1268 (60.4%)
Mild anaemia	94 (22.6%)	75 (18.9%)	117 (27.7%)	119 (27.6%)	122 (28.3%)	527 (25.1%)
Moderate anaemia	86 (20.7%)	140 (35.3%)	153 (36.2%)	173 (40.1%)	138 (32.0%)	690 (32.9%)
Severe anaemia	4 (1.0%)	13 (3.3%)	12 (2.8%)	17 (3.9%)	5 (1.2%)	51 (2.4%)
PAKISTAN						
Anaemia	389 (64.1%)	590 (76.8%)	435 (66.5%)	437 (70.7%)	375 (58.6%)	2226 (67.7%)
Mild anaemia	181 (29.8%)	216 (28.1%)	165 (25.2%)	155 (25.1%)	174 (27.2%)	891 (27.1%)
Moderate anaemia	199 (32.8%)	347 (45.2%)	252 (38.5%)	260 (42.1%)	196 (30.6%)	1254 (38.1%)
Severe anaemia	9 (1.5%)	27 (3.5%)	18 (2.7%)	22 (3.6%)	5 (0.8%)	81 (2.5%)
KENYA						
Anaemia	102 (17.2%)	163 (23.8%)	146 (24.7%)	204 (32.9%)	130 (19.8%)	745 (23.7%)
Mild anaemia	45 (7.6%)	87 (12.7%)	70 (11.8%)	90 (14.5%)	68 (10.3%)	360 (11.4%)
Moderate anaemia	50 (8.4%)	72 (10.5%)	69 (11.7%)	102 (16.4%)	55 (8.4%)	348 (11.1%)
Severe anaemia	7 (1.2%)	4 (0.6%)	7 (1.2%)	12 (1.9%)	7 (1.1%)	37 (1.2%)
MALAWI						
Anaemia	225 (38.2%)	245 (42.5%)	233 (40.1%)	263 (44.3%)	215 (36.9%)	1181 (40.4%)
Mild anaemia	120 (20.4%)	117 (20.3%)	124 (21.3%)	135 (22.7%)	126 (21.6%)	622 (21.3%)
Moderate anaemia	97 (16.5%)	125 (21.7%)	105 (18.1%)	116 (19.5%)	83 (14.2%)	526 (18.0%)
Severe anaemia	8 (1.4%)	3 (0.5%)	4 (0.7%)	12 (2.0%)	6 (1.0%)	33 (1.1%)

Overall, the highest percentage of women with anaemia was in the early postnatal stage, and this trend was similar in India, Kenya and Malawi. In Pakistan, the highest percentage of women with anaemia was in the late antenatal stage (76.8%).

Overall, the highest percentage of women with hypertension was in the late antenatal stage and this was the same trend across all four countries. Overall, the highest percentage of women with pre-eclampsia was in the late postnatal stage, and this trend was similar for Pakistan, Kenya and Malawi. In India, the highest percentage of women with pre-eclampsia was in the early postnatal stage (0.2%). Overall, the highest percentage of women with urinary incontinence was in the late antenatal stage and this trend was similar across all four countries. Overall, the highest percentage of women with antenatal haemorrhage was in the early antenatal stage, and this was the same trend across all four countries.

Overall, the highest percentage of women who had at least one medical/obstetric morbidity was in the early postnatal stage, and this was similar for women in India and Kenya. The highest percentage of women who had at least one medical/obstetric morbidity was in the late antenatal stage in Pakistan and Malawi.

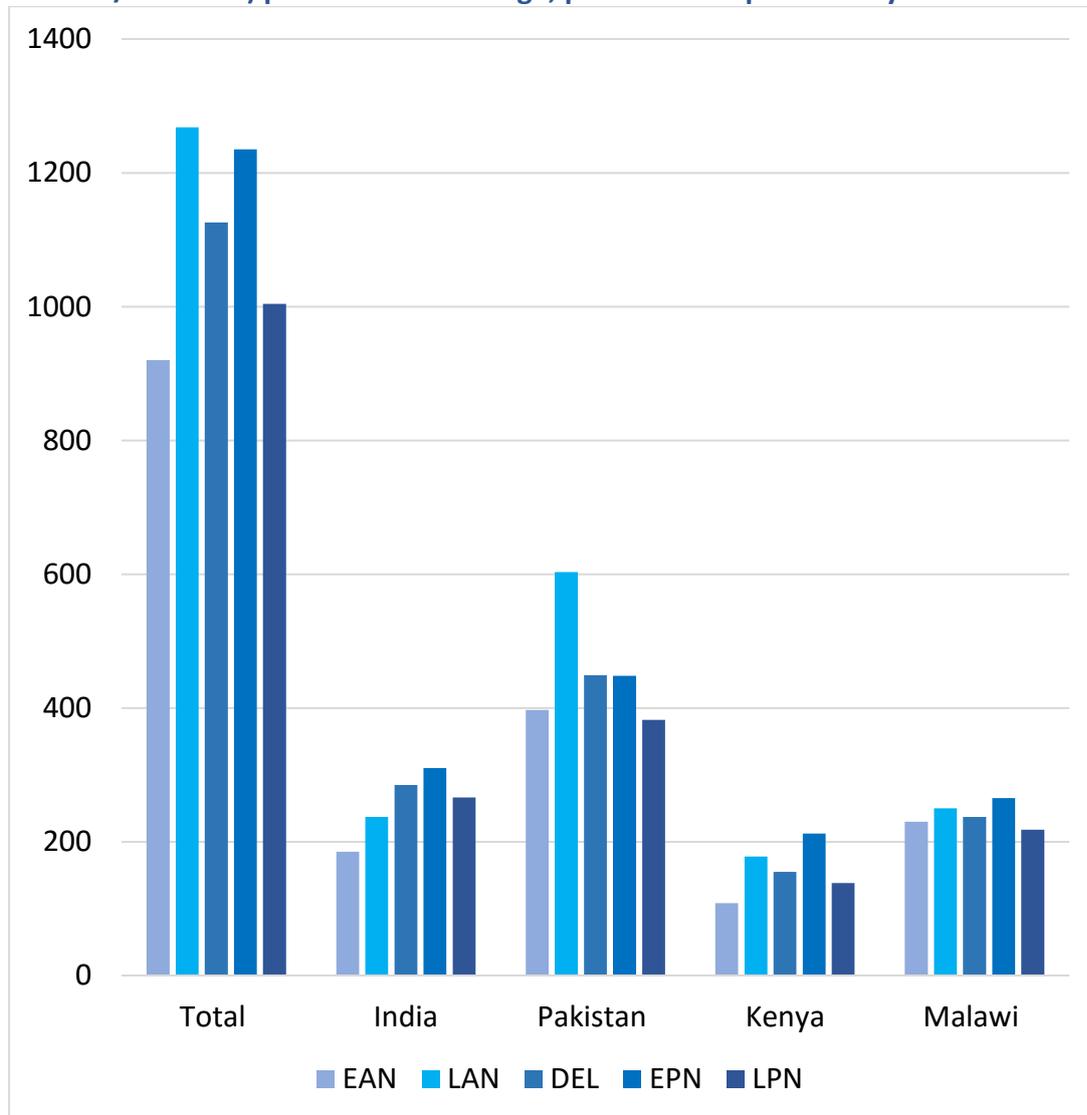
Summative physical morbidity

Furthermore, as a summative measure, **Figure 5.8** displays the number of women with any physical morbidity (infectious and medical/obstetric combined) per assessment stage, per total and per country.

Overall, more women were diagnosed with physical morbidity in the late antenatal and early postnatal stage, compared to within 24 hours of delivery and in the late postnatal and early antenatal stages

In India, Kenya and Malawi, more women had a physical morbidity in the early postnatal stage, compared to Pakistan, where women had more physical morbidity in the late antenatal stage.

Figure 5.8: Number of women with any physical morbidity (infectious and medical/obstetric) per assessment stage, per total and per country



5.6 Psychological morbidity

Psychological morbidity was defined as an EPDS score of ≥ 10 and or thoughts of self-harm. Overall 25.1% of women scored positive for depression (EPDS score of ≥ 10) and 15.2% of women self-reported thought of self-harm (**Table 5.10**). More women reported psychological morbidity in Pakistan and India, compared to Kenya and Malawi. Depression was the commonest form of psychological morbidity along each assessment stage, with the highest percentage of women reporting depression in the early antenatal stage. However, across the five assessment stages, the highest percentage of women who self-reported thoughts of self-harm was in the early antenatal stage (17.6%) (**Table 5.10**).

Table 5.10: Psychological morbidity of women per assessment stage and per total

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women*	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
PSYCHOLOGICAL MORBIDITY						
EDPS ≥ 10	494 (22.4%)	641 (26.4%)	511 (22.7%)	503 (22.2%)	469 (20.3%)	2618 (22.9%)
Thoughts of self-harm	246 (11.2%)	426 (17.6%)	359 (16.0%)	351 (15.5%)	362 (15.7%)	1744 (15.2%)
EDPS ≥ 10 and/or thoughts of self-harm	542 (24.6%)	721 (29.7%)	630 (28.0%)	591 (26.1%)	575 (24.9%)	3059 (26.7%)

Individual psychological morbidities per assessment stage are presented in **Table 5.11** for each country. Percentages are derived using the number of women who responded per assessment stage.

Table 5.11: Psychological morbidity of women per assessment stage per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Country	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
INDIA						
Number of women*	416	397	423	432	431	2099
EDPS ≥ 10	45 (10.8%)	103 (25.9%)	86 (20.3%)	86 (19.9%)	84 (19.5%)	404 (19.2%)
Thoughts of self-harm	40 (9.6%)	79 (19.9%)	72 (17.0%)	71 (16.4%)	66 (15.3%)	328 (15.6%)
EDPS ≥ 10 and/or thoughts of self-harm	60 (14.4%)	116 (29.2%)	102 (24.1%)	99 (22.9%)	95 (22.0%)	472 (22.5%)
PAKISTAN						
Number of women*	607	768	654	618	640	3287
EDPS ≥ 10	277 (45.6%)	349 (45.4%)	243 (37.2%)	256 (41.4%)	243 (38.0%)	1368 (41.6%)
Thoughts of self-harm	130 (21.4%)	242 (31.5%)	194 (29.7%)	200 (32.4%)	212 (33.1%)	978 (29.7%)
EDPS ≥ 10 and/or thoughts of self-harm	297 (48.9%)	379 (49.3%)	323 (49.4%)	308 (49.8%)	315 (49.2%)	1622 (49.3%)
KENYA						
Number of women*	592	684	592	620	657	3145
EDPS ≥ 10	86 (14.5%)	101 (14.8%)	81 (13.7%)	72 (11.6%)	49 (7.5%)	389 (12.4%)
Thoughts of self-harm	28 (4.7%)	47 (6.9%)	29 (4.9%)	20 (3.2%)	19 (2.9%)	143 (4.5%)
EDPS ≥ 10 and/or thoughts of self-harm	94 (15.9%)	126 (18.4%)	95 (16.0%)	84 (13.5%)	60 (9.1%)	459 (14.6%)
MALAWI						
Number of women*	589	576	581	594	583	2923
EDPS ≥ 10	86 (14.6%)	88 (15.3%)	101 (17.4%)	89 (15.0%)	93 (15.9%)	457 (15.6%)
Thoughts of self-harm	48 (8.2%)	58 (10.1%)	64 (11.0%)	60 (10.1%)	65 (11.1%)	295 (10.1%)
EDPS ≥ 10 and/or thoughts of self-harm	91 (15.4%)	100 (17.4%)	110 (18.9%)	100 (16.8%)	105 (18.0%)	506 (17.3%)

Overall, 25.1% of women scored positive for psychological morbidity using the EPDS. The proportion of women with psychological morbidity was much higher in Pakistan (49.3% compared to India (22.5%), Malawi (17.3%) and Kenya (14.6%). There were similar proportions of women who reported any psychological morbidity across the continuum of pregnancy. Overall, women reported psychological morbidity in the following stages: late antenatal (29.7%), within 24 hours of delivery (28.0%), early postnatal (26.1%), late postnatal (24.9%) and least in the early antenatal stage (24.6%). The overall trend in psychological morbidity was similar in India and Pakistan also (**Table 5.11**).

In India, women reported psychological morbidity in the following stages: late antenatal (29.2%), within 24 hours of delivery (24.1%), early postnatal (22.9%), late postnatal (22.0%), and least in the early antenatal stage (14.4%) (**Table 5.11**).

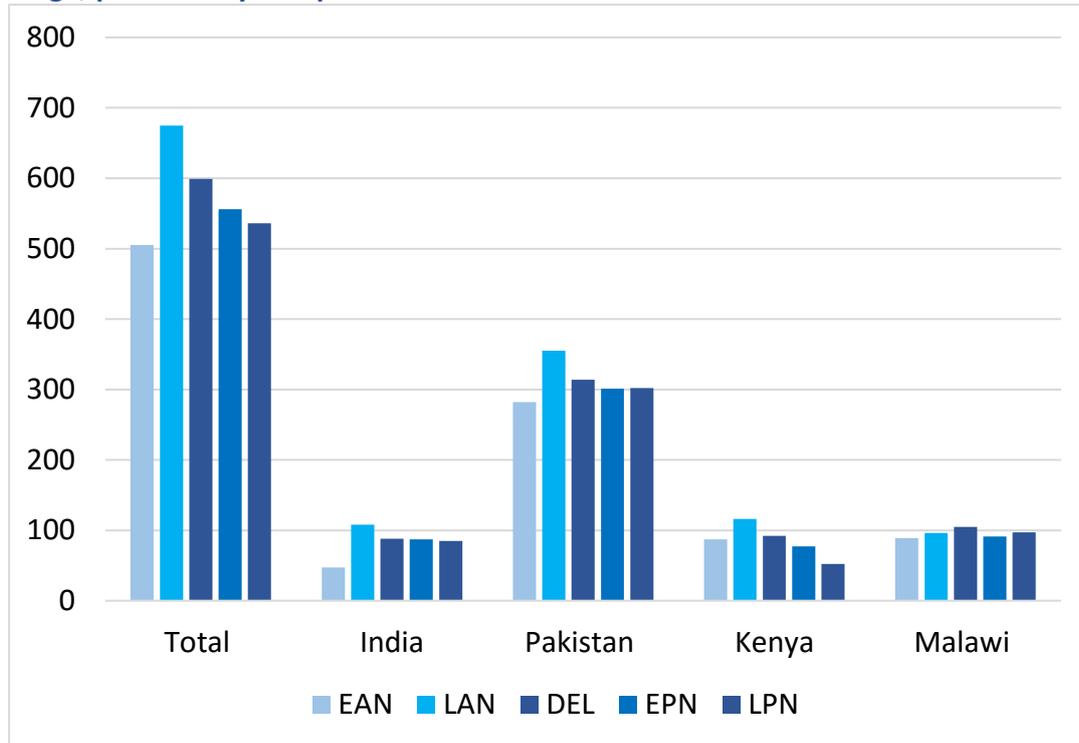
In Pakistan, similar percentages of women reported psychological morbidity across all five assessment stages, along the continuum of pregnancy: early antenatal stage (48.9%), late antenatal (49.3%), within 24 hours of delivery (49.4%), early postnatal (49.8%) and late postnatal (49.2%).

This trend was like Kenya, where more women reported psychological morbidity in the following stages: late antenatal (18.4%), within 24 hours of delivery (16.0%), early antenatal (15.9%), early postnatal (13.2%) and least in the late postnatal stage (9.1%) (**Table 5.11**).

This trend was different in Malawi, where the proportions of women who reported psychological morbidity were similar across all five assessment stages: within 24 hours of delivery (18.9%), late postnatal (18.0%), late antenatal (17.4%), early postnatal (16.8%) and least in the early antenatal stage (15.4%).

These differences in the numbers of women who reported any psychological morbidity per assessment stage, per country and per total are displayed visually in (Figure 5.9).

Figure 5.9: Number of women with any psychological morbidity per assessment stage, per country and per total



5.7 Social morbidity

Social morbidity was defined as women reporting any domestic violence (HITS score >4) and or any substance misuse. **Table 5.12** displays domestic violence (from husband and/or family) per assessment stage for the combined cohort of women. Percentages are derived using the number of women who responded per assessment stage.

Table 5.12: Social morbidity (domestic violence) in women per assessment stage and per total

Assessment stage		Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women*		2204	2425	2250	2264	2311	11,454
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
SOCIAL MORBIDITY							
Domestic violence							
Any domestic violence - HITS score >4	Husband and/or family	657 (29.8%)	978 (40.3%)	756 (33.6%)	770 (34.0%)	722 (31.2%)	3883 (33.9%)
	Husband	475 (21.5%)	776 (32.0%)	597 (26.5%)	602 (26.6%)	560 (24.2%)	3010 (26.3%)
	Family	328 (14.9%)	444 (18.3%)	358 (15.9%)	341 (15.1%)	334 (14.4%)	1805 (15.8%)
Significant Domestic violence - HITS score >10	Husband and/or family	161 (7.3%)	276 (11.4%)	172 (7.6%)	187 (8.3%)	170 (7.4%)	966 (8.4%)
	Husband	101 (4.6%)	223 (9.2%)	109 (4.8%)	127 (5.6%)	121 (5.2%)	681 (6.0%)
	Family	74 (3.4%)	80 (3.3%)	85 (3.8%)	79 (3.5%)	73 (3.2%)	391 (3.4%)

Overall 3883 (33.9%) women reported domestic violence (HITS >4) from their partner/husband and or family members; and the highest percentage of women who reported any domestic violence was in the late antenatal stage (40.3%), then the early postnatal stage (34.0%), within 24 hours of delivery (33.6%), the late postnatal (31.2%) and the early antenatal stages (29.8%).

Overall 969 women reported domestic violence (HITS>10) from their husband/partner and/or family members. Women reported higher levels of domestic violence in the following stages: late antenatal (28.6%), early postnatal (19.3%), within 24 hours of delivery (18.0%), late postnatal (17.5%) and least in the early antenatal stage (16.6%). Overall, the proportion of women who reported higher levels of domestic violence peaked in the late antenatal stage (Table 5.8).

The trend for any domestic violence was in line with that of severity of domestic violence from the husband/partner and/or domestic violence from family across all five assessment stages.

There was not a wide variation in the percentage of women who reported higher levels of domestic violence (HITS >10) across the continuum of pregnancy. More women reported higher levels of domestic violence in the late antenatal stage in India, Pakistan and Kenya, compared to Malawi where more women reported higher levels of domestic violence in the late postnatal stage (**Table 5.12**)

Table 5.13 presents social morbidity (domestic violence) per assessment stage per country. Percentages are derived using the number of women who responded per assessment stage.

The trend for any domestic violence was in line with that of the severity of domestic violence from the husband/partner and domestic violence from family across all five assessment stages and the trend was similar across all four countries. Where there are differences, these are highlighted in the text below.

Table 5:13: Social morbidity (domestic violence) of women in per assessment stage, per country

Assessment stage		Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Total number of women*		2204	2425	2250	2264	2311	11,454
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Domestic violence							
INDIA							
Any domestic violence - HITS score >4	Husband and/or family	159 (38.2%)	173 (43.6%)	153 (36.2%)	189 (43.7%)	159 (36.9%)	833 (39.7%)
	Husband	154 (37.0%)	164 (41.3%)	152 (35.9%)	185 (42.8%)	155 (36.0%)	810 (38.6%)
	Family	35 (8.4%)	67 (16.9%)	28 (6.6%)	52 (12.0%)	29 (6.7%)	211 (10.0%)
Significant Domestic violence - HITS score >10	Husband and/or family	23 (5.5%)	36 (9.1%)	18 (4.3%)	33 (7.6%)	17 (3.9%)	127 (6.0%)
	Husband	19 (4.6%)	27 (6.8%)	16 (3.8%)	30 (6.9%)	15 (3.5%)	107 (5.1%)
	Family	8 (1.9%)	22 (5.5%)	3 (0.7%)	15 (3.5%)	8 (1.9%)	56 (2.7%)
PAKISTAN							
Any domestic violence - HITS score >4	Husband and/or family	308 (50.7%)	464 (60.4%)	371 (56.7%)	382 (61.8%)	314 (49.1%)	1839 (55.9%)
	Husband	183 (30.1%)	340 (44.3%)	255 (39.0%)	255 (41.3%)	195 (30.5%)	1228 (37.4%)
	Family	197 (32.4%)	246 (32.0%)	217 (33.2%)	199 (32.2%)	184 (28.7%)	1043 (31.7%)
Significant Domestic violence - HITS score >10	Husband and/or family	109 (18.0%)	185 (24.1%)	103 (15.7%)	115 (18.6%)	104 (16.2%)	616 (18.7%)
	Husband	64 (10.5%)	150 (19.5%)	59 (9.0%)	70 (11.3%)	68 (10.6%)	411 (12.5%)
	Family	50 (8.2%)	47 (6.1%)	55 (8.4%)	47 (7.6%)	47 (7.3%)	246 (7.5%)
KENYA							
Any domestic violence - HITS score >4	Husband and/or family	99 (16.7%)	201 (29.4%)	130 (22.0%)	105 (17.0%)	144 (21.9%)	679 (21.6%)
	Husband	78 (13.2%)	176 (25.7%)	108 (18.2%)	88 (14.2%)	125 (19.0%)	575 (18.3%)
	Family	29 (4.9%)	51 (7.5%)	35 (5.9%)	24 (3.9%)	47 (7.1%)	186 (5.9%)

Significant Domestic violence - HITS score >10	Husband and/or family	9 (1.5%)	26 (3.8%)	22 (3.7%)	12 (1.9%)	17 (2.6%)	86 (2.7%)
	Husband	8 (1.3%)	24 (3.5%)	18 (3.0%)	10 (1.6%)	15 (2.3%)	75 (2.4%)
	Family	2 (0.3%)	2 (0.3%)	6 (1.0%)	2 (0.3%)	2 (0.3%)	14 (0.4%)
MALAWI							
Any domestic violence - HITS score >4	Husband and/or family	91 (15.4%)	140 (24.3%)	102 (17.6%)	94 (15.8%)	105 (18.0%)	532 (18.2%)
	Husband	60 (10.2%)	96 (16.7%)	82 (14.1%)	74 (12.5%)	85 (14.6%)	397 (13.6%)
	Family	67 (11.4%)	80 (13.9%)	78 (13.4%)	66 (11.1%)	74 (12.7%)	365 (12.5%)
Significant Domestic violence - HITS score >10	Husband and/or family	20 (3.4%)	29 (5.0%)	29 (5.0%)	27 (4.5%)	32 (5.5%)	137 (4.7%)
	Husband	10 (1.7%)	22 (3.8%)	16 (2.7%)	17 (2.9%)	23 (3.9%)	88 (3.0%)
	Family	14 (2.4%)	9 (1.6%)	21 (3.6%)	15 (2.5%)	16 (2.7%)	75 (2.6%)

The proportion of women reporting domestic violence was much higher in Pakistan (55.9%) compared to India (37.9%), Kenya (21.6%), and Malawi (18.2%) (**Table 5.13**).

There was not a huge variation in the percentage of women who reported any domestic violence (HITS >4) or severe (HITS >10) across the continuum of pregnancy. More women reported domestic violence in the late antenatal stage in Pakistan, Kenya and Malawi, compared to India, where more women reported domestic violence in the early postnatal stage.

The proportion of women reporting domestic violence was much higher in Pakistan (617; 63.7%) compared to Malawi (137; 14.1%), India (127; 13.1%), Kenya (88; 9.1%).

The trend for any domestic violence was in line with that of severity of domestic violence from the husband/partner and/or domestic violence from family across all five assessment stages.

There was not a wide variation in the percentage of women who reported higher levels of domestic violence (HITS >10) across the continuum of pregnancy. More women reported higher levels of domestic violence in the late antenatal stage in India, Pakistan and Kenya, compared to Malawi where more women reported higher levels of domestic violence in the late postnatal stage (**Table 5.13**).

The main difference noted was that the highest percentage of women reporting more severe domestic violence from family members was within 24 hours of childbirth and this trend was similar across all four countries.

Substance misuse per assessment stage

Table 5.14 presents social morbidity as substance misuse, per assessment stage per total. Percentages are derived using the number of women who responded per assessment stage.

Overall, 672 (5.9%) women reported substance misuse, of which 202 (1.8%) required intervention. The highest percentage of women who reported substance misuse and who required intervention was in the late postnatal stage (6.8% and 2.2% respectively) (**Table 5.14**).

Table 5.14: Social morbidity (substance misuse) per assessment stage, per total

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Number of women*	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
SOCIAL MORBIDITY						
Substance misuse						
Use of alcohol, sedatives, inhalants, tobacco in last 3 months	135 (6.1%)	112 (4.6%)	122 (5.4%)	146 (6.5%)	157 (6.8%)	672 (5.9%)
Intervention required (ASSIST score > 4)	38 (1.7%)	38 (1.6%)	34 (1.5%)	42 (1.9%)	20 (2.2%)	202 (1.8%)

Table 5.15 presents social morbidity as substance misuse, per assessment stage per country. Percentages are derived using the number of women who responded per assessment stage.

Table 5:15: Social morbidity (substance misuse) of women per assessment stage per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Total number of women*	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
SUBSTANCE MISUSE						
INDIA						
Use of alcohol, sedatives, inhalants, tobacco in last 3 months	6 (1.4%)	9 (2.3%)	4 (0.9%)	12 (2.8%)	5 (1.2%)	36 (1.7%)
Intervention required (ASSIST score > 4)	4 (1.0%)	7 (1.8%)	0	5 (1.2%)	1 (0.2%)	17 (0.8%)
PAKISTAN						
Use of alcohol, sedatives, inhalants, tobacco in last 3 months	61 (10.0%)	53 (6.9%)	45 (6.9%)	74 (12.0%)	60 (9.4%)	293 (8.9%)
Intervention required (ASSIST score > 4)	7 (1.1%)	13 (1.7%)	5 (0.8%)	12 (1.9%)	20 (3.1%)	57 (1.7%)
KENYA						
Use of alcohol, sedatives, inhalants, tobacco in last 3 months	40 (6.8%)	27 (3.9%)	42 (7.1%)	37 (6.0%)	63 (9.6%)	209 (6.6%)
Intervention required (ASSIST score > 4)	9 (1.5%)	6 (0.9%)	9 (1.5%)	8 (1.3%)	14 (2.1%)	46 (1.5%)
MALAWI						

Use of alcohol, sedatives, inhalants, tobacco in last 3 months	28 (4.7%)	23 (4.0%)	31 (5.3%)	23 (3.9%)	29 (5.0%)	134 (4.6%)
Intervention required (ASSIST score > 4)	18 (3.1%)	12 (2.1%)	20 (3.4%)	17 (2.9%)	15 (2.6%)	82 (2.8%)

Overall, the proportions of women reporting substance use was highest in Pakistan (8.9%) compared to Kenya (6.6%) Malawi (4.6%) and India (1.7%) (**Table 5.9**).

Overall women reported substance misuse in the following stages:) late postnatal (6.8%), early postnatal (6.5%), early antenatal (6.1%), within 24 hours of childbirth (5.4%) and late antenatal (4.6%). The highest percentage of women who reported substance use in India and Pakistan was in the early postnatal stage (2.8% and 12.0% respectively). The highest percentage of women who reported substance use in Kenya was in the late postnatal stage (9.6%) and in Malawi was within 24 hours of childbirth (5.3%).

Summative social morbidity

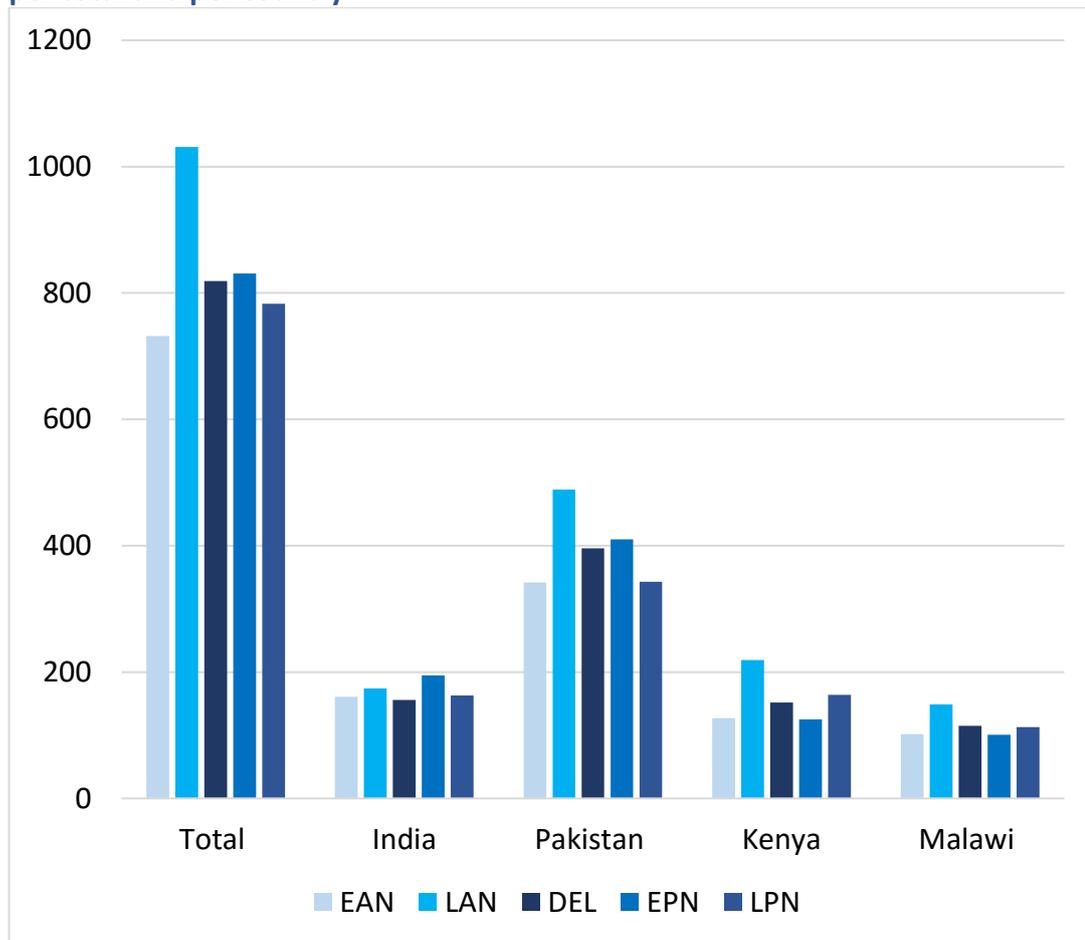
Overall and as a combined measure, social morbidity was defined as women reporting any domestic violence and/or substance misuse. **Table 5.16** displays women with any social morbidity per assessment stage per total. Overall, 4193 (36.6%) women reported social morbidity, and the highest percentage of women who reported any social morbidity was in the late antenatal stage (42.5%) (**Table 5.16**). This trend was similar to that in Pakistan, Kenya and Malawi; but different to India where the highest percentage of women who reported any social morbidity was in the early postnatal stage (45.1%) (**Table 5.16**).

Table 5.16: Social morbidity (any domestic violence and/or substance misuse) per assessment stage and per country

Assessment stage	Early antenatal	Late antenatal	Within 24 hours of delivery	Early postnatal	Late postnatal	Total
Total number of women*	2204	2425	2250	2264	2311	11,454
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Any social morbidity						
Domestic violence and/or substance misuse						
India	161 (38.7%)	174 (43.8%)	156 (36.9%)	195 (45.1%)	163 (37.8%)	849 (40.4%)
Pakistan	341 (56.2%)	489 (63.7%)	395 (60.4%)	410 (66.3%)	343 (53.6%)	1978 (60.2%)
Kenya	127 (21.4%)	219 (32.0%)	151 (25.5%)	125 (20.2%)	164 (25.0%)	786 (25.0%)
Malawi	102 (17.3%)	149 (25.9%)	115 (19.8%)	101 (17.0%)	113 (19.4%)	580 (19.8%)
Total	731 (33.2%)	1031 (42.5%)	817 (36.3%)	831 (36.7%)	783 (33.9%)	4193 (36.6%)

The trends of social morbidity (any domestic violence and/or substance misuse) per assessment stage and per total are displayed in **Figure 5:10**.

Figure 5.10 Number of women with any social morbidity per assessment stage, per total and per country



5.9 Summative morbidity

Table 5.17 presents women with any morbidity per assessment stage, per country and per total. Percentages are derived using the number of women who responded per assessment stage.

Overall, 8889 (77.6%) women reported any morbidity. The proportion of women reporting any morbidity was much higher in Pakistan (89.5%) compared to India (83.5%), Malawi (71.8%), and Kenya (66.5%).

Of all women assessed, the highest percentage of women who had any morbidity (infectious, medical/obstetric, psychological, social) was in the late antenatal stage (81.1%); then early postnatal stage (80.3%), within 24 hours of childbirth (78.9%). Similar percentage of women had any morbidity in the early antenatal (73.5%) and the late postnatal stage (73.8%).

Similar to the overall cohort, the highest percentage of more women who had any morbidity was in the late antenatal stage in Pakistan (91.9%) and Kenya (73.2%). In India and Malawi, the highest percentage of women who had any morbidity was just similar more in the early postnatal stage (87.5% and 73.6% respectively) compared to the late antenatal stage in each country (**Table 5.17**).

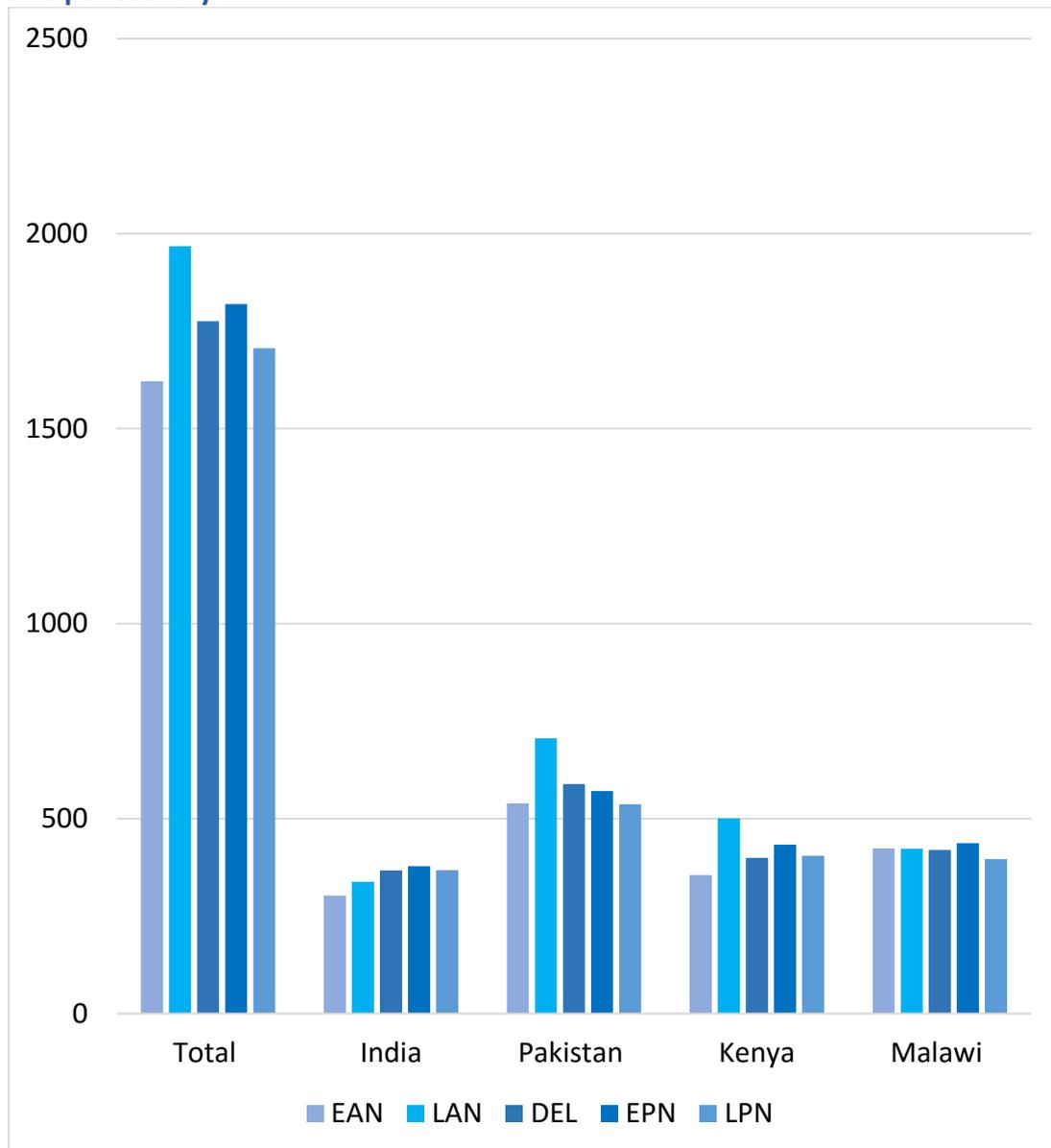
These trends are displayed visually in **Figure 5:11**.

Table 5.17: Women with any morbidity per assessment stage, per total and per country

Variable and category	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		Total (n=11454)	
	n	%*	n	%*	n	%*	n	%*	n	%*
Any morbidity										
Early antenatal	303	72.8	539	88.8	355	60.0	424	72.0	1621	73.5
Late antenatal	338	85.1	706	91.9	501	73.2	423	73.5	1968	81.1
Delivery	367	86.8	589	90.1	399	67.4	420	72.3	1775	78.9
Early postnatal	378	87.5	571	92.4	433	69.8	437	73.6	1819	80.3
Late postnatal	368	85.4	537	83.9	405	61.6	396	67.9	1706	73.8
TOTAL**	1754	83.5	2942	89.5	2093	66.5	2100	71.8	8889	77.6

*Percentages are derived using the number of women who responded per assessment stage. ** The percentages in the total row are derived using the number of women who responded per country sample size.

Figure 5.11: Number of women with any morbidity per assessment stage, per total and per country



5.10 Chapter summary in relation to literature

Summative morbidity

There is a lack of studies that have assessed two or more types of morbidity in women at different stages of pregnancy in LMIC settings. Three. In Kenya, Chersich et al collected data from the women at three postnatal stages: early (4-12 weeks), middle (12-24 weeks) and late (24-26 weeks) after childbirth in Kenya (Chersich 2009) and measured infectious, medical/obstetric, psychological and social morbidity. In Malawi and Pakistan, Zafar et al used a cross sectional survey to assess women at three different assessment stages, both during (early and late antenatal) and after pregnancy and measured infectious, medical/obstetric and psychological morbidity (Zafar 2015). In India, Prost et al assessed women in the postnatal stage and asked women to recall medical/obstetric morbidity or complications experienced during pregnancy, at delivery and after childbirth (Prost 2012).

In this PhD study, women's perception of health with regards to quality of life and satisfaction with health was similar along all five assessment stages. No other study that has assessed maternal morbidity has assessed women's perception of health at five different stages of pregnancy. In Ethiopia, Hanlon et al also used a variety of measures to assess physical morbidity in 1065 pregnant women, and reported 3.8% of women reported "poor/bad global health" at one stage during pregnancy (Hanlon 2009). This finding is similar to this PhD study, in that 4.0 % of women were dissatisfied with their health and this percentage varied slightly across the stages of pregnancy (5.1% in the early antenatal and 4.8% in the late antenatal stage). This finding would suggest that there is a small sub-group of women who are dissatisfied with their health at different stages of the pregnancy, and that there is no specific "at risk" time, when higher percentages of women report dissatisfaction with their health.

In this PhD study, 45.3% of women reported at least one morbidity in the early antenatal, late antenatal stage (54.8%); at delivery (50.4%); and in the early (44.0%) and late postnatal stage (50.0%). This finding would suggest that women have ill-health along the continuum of pregnancy, and not at one specific time. In a study that sought to assess maternal morbidity in India, Prost et al assessed women in the postnatal stage and asked women to recall complications; 46.3% of women recalled “problems” during pregnancy; 35.1% at delivery; and 30.5% in the postpartum stage (Prost 2012). The higher prevalence of morbidity reported in this PhD study may be because the data collection tool used was very comprehensive and included variables to assess four types of morbidity, along with self-reporting symptoms and clinical examinations and investigations.

Infectious morbidity

Infective morbidity is traditionally considered to be more of a concern after pregnancy, where it is labelled “puerperal sepsis” (RCOG 2012). However, one of the main findings of this PhD study is that overall, using an amended SIRS score, similar proportions of women were diagnosed with possible early signs of infection from the early stage of pregnancy (21.0%), along the continuum of pregnancy and childbirth (25.1 to 21.3%) and up to 12 weeks postnatal (23.1%).

In the Zafar et al study, the highest percentage of women with “fever of unknown origin” was in the late antenatal stage in Malawi (3.5%) and in the early antenatal stage in Pakistan (3.6%) (Zafar 2015). In the Chersich et al study, women were not assessed during pregnancy and 6% of women reported febrile symptoms at 4-12 weeks; 11% at 12-24 weeks and 13% at 24-26 weeks after childbirth in Kenya (Chersich 2009). As previously highlighted in Chapter 4, section 4.10, the higher prevalence of infectious morbidity in this PhD study may be due to a more comprehensive measurement of infectious in combination to the use of a low cut-off level for “raised CRP”, may have resulted in an overestimated of women with a SIRS score of ≥ 2 , suggestive of early infection.

Other studies have used CRP as a marker for possible infection in women during pregnancy. It is well recognised that CRP levels vary depending on whether a woman is pregnant or not, and the stage of pregnancy (Trochez-Martinez 2007). Overall, CRP is useful as an indicator of possible infection but is not sensitive to indicate what type of infection could be present. With a higher cut-off level of CRP, specificity would be increased but sensitivity would be lower. In a non-pregnant woman, a normal CRP is 0.2–3.0 mg/L (Abbassi-Ghanavati 2009). There are no standardised ranges for a normal CRP level in a pregnant woman in the first trimester. In this PhD study, the median CRP was 7 with an interquartile range of 5 to 13 in the early antenatal stage; the median CRP was 6 (IQR 5-12) in the late antenatal stage; and the median CRP was highest in the late postnatal stage, 19 (IQR 8-44). The reported normal CRP range is wide in a pregnant female population (0.4–20.3 mg/L) in the second trimester; and the third trimester is 0.4–8.1 mg/L (Abbassi-Ghanavati 2009). However, it is difficult to fully compare the levels of CRP as there is currently lack of agreed reference standards on what is a normal and what is an abnormal CRP level in women at different stages of pregnancy and after childbirth; and what levels of CRP are sensitive and specific to indicate infection (Trochez-Martinez 2007). It is noted that although CRP may be useful to indicate infection, a one-off reading should not be interpreted in isolation. The interpretation of a CRP level is more useful when used in compliment to other clinical parameters (RCOG 2012). Most of the research to date, that has explored CRP levels during and after pregnancy are related to the use of CRP to diagnose chorioamnionitis in pregnant women with premature prelabour rupture of membranes. In one recent study, women in the late antenatal stage of pregnancy (31 to 34 weeks gestation) with PPRM with no clinical signs of infection had a median CRP of 4.9 with a range of 0.1 to 59.1 (Musilova 2017a). The median CRP of women with PPRM along with signs of infection was 6.9 with a range of 0.4 to 113 (Musilova 2017a).

With regards to the prevalence of malaria and syphilis, the prevalence of these conditions was highest in the early antenatal stage, suggesting that with screening these conditions are detected and treated and therefore the trend decreases along

the continuum of pregnancy. This is a similar finding to Zafar et al where the highest percentage of women with malaria was in the early pregnancy stage in Malawi (8.8%) and Pakistan (2.1%); and a similar finding to a study in Kenya, 2% of women were diagnosed with malaria at each assessment stage after childbirth; and 2% of women were diagnosed with syphilis 24-26 weeks and 1% were diagnosed with syphilis at 12-24 weeks after childbirth (Chersich 2009). In this PhD study, detection of HIV was highest in the early postnatal stage (5.4%) This is a similar finding to that of the Zafar et al study where the highest percentage of women diagnosed with HIV was in the postnatal stage in Malawi (16.5%) and Pakistan (7.0%). These findings would suggest perhaps that these women did not attend for and/or receive screening during antenatal care but attended for delivery at the healthcare facility and were screened for HIV prior to discharge.

Medical/obstetric morbidity

In this PhD study, the severity of anaemia increased as the pregnancy continued and the highest percentage of women with moderate and severe anaemia was in the early postnatal stage; and this trend was similar in the four LMIC settings. This finding is in line with the clinical fact that haemoglobin levels decrease during pregnancy due to haemodilution, and then most women lose some blood during childbirth. In other studies, the highest percentage of women with anaemia was in the late antenatal stage in Malawi (41.1%) and Pakistan (39.3%). In Kenya, the highest percentage of women with anaemia (61.0%) was at 12-24 weeks after childbirth (Chersich 2009). However, this study did not assess women during pregnancy. This highest percentage of women diagnosed with antepartum haemorrhage was in the early antenatal stage (6.3%), and this bleeding tended to have resolved later in pregnancy. This finding is comparable to that of the Zafar et al study, where the highest percentages of women with antepartum haemorrhage was in the late antenatal stage in Malawi (1.5%) but highest in the early antenatal stage in Pakistan (4.6%). The reasons of why some more women have bleeding at different assessment stages in different settings requires further research.

In this PhD study, the highest percentage of women with hypertension, pre-eclampsia, urinary incontinence was in the late antenatal stage. This is in keeping with clinical evidence of higher prevalence of these conditions later in pregnancy.

Pre-eclampsia was detected more in the late antenatal stage in this PhD study and this is similar to the findings in Malawi (0.2%) and Pakistan (1.3%) (Zafar 2015). In this PhD study, the highest percentage of women urinary incontinence was in the late antenatal stage, and this may be due to stress incontinence due to the increased abdominal pressure of the baby. However, in the Zafar et al study, the highest percentage of women reporting incontinence (urine or faeces) was in the postnatal stage in Malawi (0.9%) and Pakistan (4.7%) (Zafar 2015); the reason for this may be due to transient incontinence related to perineal trauma that occurred during childbirth.

Psychological morbidity

Psychological morbidity is traditionally considered to be more of a concern after pregnancy, where it is labelled “postnatal depression”. However, one of the main findings of this study is that overall, similar proportions of women are reporting psychological morbidity (including symptoms of depression and self-harm) from the early stage of pregnancy (24.6%), along the continuum of pregnancy and childbirth (29.7 to 24.9%) and up to 12 weeks postnatal (26.7%). In another study, in Malawi and Pakistan, more women reported psychological morbidity in the postnatal stage (Zafar 2015). In Malawi, the proportion of women with psychological morbidity increased across the stages of pregnancy in Malawi (1.2%, 3.2% and 3.6%) and in Pakistan (25.8%, 26.9% and 28.1%).

The findings of the prevalence of psychological morbidity from this PhD study are higher prevalence compared to the global estimates of 10% of women during pregnancy and 13% of women after childbirth being affected by psychological ill-health (WHO 2017, maternal mental health). The findings from the PhD study are

more compared to a systematic review of studies from LMIC settings where psychological morbidity affected 15.6% of women during pregnancy and 19.8% after pregnancy (Fisher 2012). Another review reported higher prevalence of 1 in 4 women in LMIC settings reported depression during pregnancy and 1 in 5 reported depression after pregnancy (Gelaye 2013). The authors of the review suggest that the figures in LMIC settings are twice the rate of women in high income countries, and it is suggested that psychological ill-health in general is not reported, infrequently recognised and under-treated in many LMIC (Fisher 2012). The reasons why women in LMIC settings are reporting psychological morbidity at different stages of pregnancy, requires further research to understand how to address these health needs, both during pregnancy and after childbirth.

Social morbidity

In this PhD study, more women reported substance misuse in the early stage of pregnancy or after childbirth, compared to the late antenatal stage, suggesting that women understood the harmful effects of substance misuse to the developing baby with more women tending to stop misusing substances as the pregnancy progressed. However, high proportions of women reported domestic violence from the early stage of pregnancy (29.8%), along the continuum of pregnancy and childbirth (40.3 to 34.0%) and up to 12 weeks after childbirth (33.9%). This urgently requires interventions to prevent and stop this practice in these settings. The finding that domestic violence occurs after childbirth is similar to the study by Chersich et al in which women reported domestic violence (physical (23.3%), sexual (56.9%) and substance misuse (11%) at 12-24 weeks after childbirth in Kenya (Chersich 2009).

Summary

The overall findings from this chapter would suggest that overall the burden of disease is not simply at one “high risk” stage of pregnancy, but that women report and/or are diagnosed with significant morbidity at different stages during and after

pregnancy. Further reflections of the main findings from this chapter in relation to other literature are given in the discussion chapter of this thesis.

CHAPTER 6: RESULTS THREE

6.1 Introduction

This is the third of four chapters that report on the results of this research project. The four chapters are structured in sequence to address each main research question. In this chapter age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy are assessed to determine any association with maternal morbidity. Results are described per country in univariate and multivariate analysis.

Factors examined include:

- Age
- Socioeconomic status
- Educational level
- Number of previous pregnancies
- Adverse maternal outcome in the most recent pregnancy
- Adverse neonatal outcome in the most recent pregnancy

These factors were chosen by the lead researcher as they are recognised to influence a woman's health risk index from a clinical point of view, and are factors recognised to be associated with maternal mortality in LMIC (Alvarez 2009).

For the purposes of this thesis, results for the study settings are presented per country in the following sequence: India, Pakistan, Kenya and Malawi. Results are presented in a narrative text accompanied by tables and figures. Where supplementary information is necessary, this is presented in the appendices.

Research questions

In this research study, there were four research questions.

Table 6.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

In this chapter, results are presented to address the research question: “Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?”.

The different types of morbidity include the following:

- Physical (infectious)
- Physical (medical/obstetric)
- Psychological
- Social

Definitions of types of morbidities

As set out in the chapter three, that described the methodology, summative physical morbidity is defined as (1) infectious or (2) medical/obstetric. Infectious morbidity can include: HIV, malaria, syphilis, possible chest infection, and a SIRS score of ≥ 2 . Medical/obstetric morbidity can include: anaemia, hypertension, pre-eclampsia, antenatal haemorrhage and incontinence. Psychological morbidity is defined as an EPDS score of ≥ 10 and/or thoughts of self-harm. Social morbidity is defined as a woman reporting any domestic violence (HITS score >4) and or any substance use.

Table 6.2: Definitions of maternal morbidity

PHYSICAL MORBIDITY		NON-PHYSICAL MORBIDITY	
Medical/obstetric	Infectious	Psychological	Social
<ul style="list-style-type: none"> • Anaemia • Hypertension • Pre-eclampsia • Antenatal haemorrhage • Urinary incontinence 	<ul style="list-style-type: none"> • HIV • Malaria • Syphilis • Possible chest infection/TB • SIRS score of ≥ 2 	<ul style="list-style-type: none"> • EDPS ≥ 10 • Thoughts of self-harm 	<ul style="list-style-type: none"> • Any domestic violence (HITS score >4) • Any substance misuse

For this study, all women were asked questions regarding adverse maternal outcomes in the most recent pregnancy and/or adverse neonatal outcomes in the most recent pregnancy. **Table 6.3** and **Table 6.4** lists the ranges of maternal and adverse neonatal outcomes explored. These outcomes are not definitive and this is highlighted as a limitation in the discussion chapter of this thesis.

For the tabulations of the univariate and multivariate analysis, the reference category are women who did not report maternal or newborn adverse outcomes in the most recent pregnancy.

Table 6.3: Adverse maternal outcomes in most recent pregnancy

Adverse maternal outcome		Definition/explanation of question
1.	Caesarean section wound infection	Any concerns with the Caesarean section scar, for which a woman has visited a healthcare provider and received antibiotics.
2.	Complications of episiotomy	Dehiscence/breakdown of the episiotomy wound; any concerns with the episiotomy for which the women has visited a healthcare provider and received antibiotics.
3.	Complications of instrumental delivery	Third or fourth degree tears, internal spiral vaginal lacerations, failed instrumental delivery.
4.	General/spinal/epidural anaesthetic complications	Aspiration pneumonia, dural headache, total spinal, spinal cord infection.
5.	Vesico-vaginal fistula	Connection between the bladder and the vagina resulting in leakage of urine.
6.	Recto-vaginal fistula	Connection between the rectum and the vagina resulting in leakage of faecal matter.
7.	Uterine inversion	An acute obstetric emergency occurring when the placenta fails to detach from the uterus and traction on the placenta pulls on the inside surface, and inverts the uterus.
8.	Postpartum haemorrhage	Bleeding from the genital tract >500mls
9.	Antepartum haemorrhage	Any bleeding from the genital tract during pregnancy from the stage of viability
10.	Blood transfusion	Transfusion of red blood cells due to low haemoglobin

Table 6.4: Adverse neonatal outcomes in most recent pregnancy

Adverse neonatal outcome		Definition / explanation of question
1.	Stillbirth	Baby is born dead from the stage of viability (>28 weeks in LMIC).
2.	Neonatal death	Death of baby from birth to 28 days.
3.	Low birth weight baby	<2.5kg at birth.
4.	Preterm delivery	<37 weeks' gestation at birth.
5.	Macrosomia	>4.0kg at birth.
6.	Microcephaly	An abnormally small head due to failure of brain growth caused by intrauterine infections (such as rubella, cytomegalovirus, and toxoplasmosis), intrauterine chemical exposure (such as in fetal alcohol syndrome), chromosome abnormalities and genetic syndromes.
7.	Newborn eye infection	Any eye infection in the newborn.
8.	Newborn blindness	Any detected blindness in the newborn.

In the analysis presented in chapter four, there were significant differences between the countries with regards to prevalence of age, parity, SES, HIV, and malaria. For this reason, the results in this chapter are reported per country as the associations were not appropriate to analyse with regards to the combined countries total cohort. Nearly all women (93.2%) were married and therefore marital status was not used as a factor.

The associated factors results are reported per type of morbidity (infectious, medical/obstetric, psychological and social) per country (India, Pakistan, Kenya and Malawi) for univariate analysis. Key socio-economic and obstetric variables were included in the univariate analysis as these factors are clinically recognised to be relevant for a women's health during and after pregnancy.

Table 6.5: Factors examined for association with maternal morbidity

Factors examined included:
<ul style="list-style-type: none">• Age• Socioeconomic status• Educational level• Number of previous pregnancies• Adverse maternal outcomes in the most recent pregnancy• Adverse neonatal outcomes in the most recent pregnancy

There were no elimination criteria, and therefore, all factors were also included in the multivariate analysis. The associated factors are reported per type of morbidity per country in multivariate analysis. For all results, statistically significant differences are highlighted and odd ratios, 95% confidence intervals and p-values are presented. The results reported are tabulations, univariate and multivariate associations between the type of morbidity and each associated factor.

1. Cross tabulations of the associated factors with the morbidity class were conducted.
2. Univariate analysis was conducted for each associated factor with the type of morbidity for each country.

For the results reported in this chapter, colour is used to highlight significant findings.

Table 6.6: Explanation of colour coding for results tables

Colour	Code
Blue	Reference category
Green	Women are less likely to report this type of morbidity
Light orange	Women are more likely to report this type of morbidity

For associations related to the age factor, all women were compared to women in the age range 20-<25 as this was considered the most representative. The age range 15-<20 years was not considered as the reference category as this would suggest that adolescents were the most typical group to compare the other age groups against.

6.2 India: Univariate analysis

All results for univariate analysis for the study population are displayed in **Table 6.7**.

Age

There were similar percentage of women across the different age categories for all four types of morbidity in India. There are no statistically significant differences between the age groups for medical/obstetric or psychological morbidity. When compared to women in the age range 20-<25 years of age, women in the age range ≥ 35 years of age were more likely to report infectious morbidity OR 2.63 (1.17-5.90) p-value 0.02. Compared to women in the age range 20-<25 years of age, women in the age range 25-<30 and 30-<35 years of age were more likely to report social morbidity OR 1.61 (1.33-1.96) p-value 0.00 and 1.85 (1.37-2.50) p-value 0.00 respectively.

Socioeconomic status

When compared to women in the lower SES category, women in the upper middle and upper SES categories were more likely to report social morbidity: OR 0.17 (0.04-0.72) p-value 0.02 and OR 0.19 (0.04-0.87) p-value 0.03 respectively.

Educational level completed

When compared to women with no education level, women who had completed primary level education were less likely to report social morbidity OR 0.56 (0.38-0.84) p-value 0.00. Compared to women with no education level, women who had completed secondary level education were less likely to report medical/obstetric morbidity OR 0.61 (0.39-0.94) p-value 0.03. Compared to women with no education level, women who had completed tertiary level education were less likely to report medical/obstetric morbidity OR 0.55 (0.35-0.85) p-value 0.01, and social morbidity OR 0.46 (0.31-0.70) p-value 0.00; and more likely to report psychological morbidity OR 1.77 (1.03-3.04) p-value 0.04.

Number of previous pregnancies

Overall, there are no statistically significant differences between the number of previous pregnancies and infectious or psychological morbidity. However, compared to women with no previous pregnancy (primigravida), women with one previous pregnancy were more likely to report medical/obstetric OR 2.27 (1.72-2.99) p-value 0.00 and less likely to report social morbidity OR 0.74 (0.56-0.97). Compared to women with no previous pregnancies (primigravida), there are no statistically significant differences between women with two-four (P2-4) or five or more previous pregnancies (P≥5) and medical/obstetric, infectious, psychological or social morbidity.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome in the most recent pregnancy, were more likely to report medical/obstetric (OR 1.96 (1.36-2.80) p-value 0.00), psychosocial (OR 1.45 (1.02-2.07) p-value 0.04), and social morbidity (OR 1.60 (1.17-2.17) p-value 0.00) in the index pregnancy.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no adverse neonatal outcome in the most recent pregnancy, women with an adverse neonatal outcome in the most recent pregnancy, were more likely to report medical/obstetric (OR 1.40 (1.07-1.83) p-value 0.02) and psychosocial morbidity (OR 3.90 (2.97-5.12) p-value 0.00), but were less likely to report infectious morbidity (OR 0.48 (0.31-0.73) p-value 0.00).

Table 6.7: India: Univariate analysis

COUNTRY	PHYSICAL MORBIDITY						NON-PHYSICAL MORBIDITY					
	MEDICAL/OBSTETRIC			INFECTIOUS			PSYCHOLOGICAL			SOCIAL		
	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)
Age												
15 - < 20	50	4	1.60 (0.93-2.77)	14	5	1.46 (0.79-2.70)	15	4	1.01 (0.55-1.82)	16	2	0.57 (0.32-1.02)
20 - < 25	510	41		122	42		178	4		284	34	
25 - < 30	539	43	0.95 (0.79-1.16)	119	4	0.89 (0.67-1.16)	157	39	0.78 (0.61-0.98)	410	49	1.61 (1.33-1.96)
30 - < 35	138	11	1.05 (0.77-1.42)	28	10	0.84 (0.51-1.30)	44	11	0.91 (0.63-1.31)	109	13	1.85 (1.37-2.50)
≥35	20	1	1.57 (0.69-3.58)	9	3	2.63 (1.17-5.90)	9	2	1.66 (0.74-3.71)	13	1	1.57 (0.75-3.32)
Socio-economic status												
Lower (V)	7	1		1	0		1	0			1	
Upper Lower (IV)	838	65	0.49 (0.10 - 2.35)	225	75	1.63 (0.20-13.09)	254	61	1.89 (0.24-15.17)	618	73	0.43 (0.11-1.74)
Lower Middle (III)	347	27	0.42 (0.09-2.06)	59	20	0.90 (0.11-7.36)	126	30	2.22 (0.27-17.88)	178	21	0.22 (0.05-0.89)
Upper Middle (II)	72	6	0.33 (0.07-1.66)	13	4	0.86 (0.10-7.42)	22	5	1.57 (0.19-13.20)	34	4	0.17 (0.04-0.72)
Upper (I)	18	1	0.20 (0.04-1.06)	4	1	0.80 (0.08-8.13)	12	3	3.00 (0.34-26.60)	12	1	0.19 (0.04-0.87)
Level of education completed												
None	79	6		21	7		18	4		7		
Primary	511	40	0.69 (0.45-1.06)	121	40	0.75 (0.45-1.25)	104	25	0.76 (0.44-1.31)	309	36	0.56 (0.38-0.84)
Secondary	392	31	0.61 (0.39-0.94)	86	28	0.65 (0.38-1.10)	160	39	1.68 (0.98-2.86)	305	36	0.80 (0.54-1.20)
Tertiary	300	23	0.55 (0.35-0.85)	74	25	0.71 (0.41-1.21)	133	32	1.77 (1.03-3.04)	176	21	0.46 (0.31-0.70)
Number of previous pregnancies												
None	133	10.9		48	16.0		64	16		128	16	
1	563	46.3	2.27 (1.72-2.99)	152	50.7	1.01 (0.71-1.45)	174	4	0.84 (0.60-1.16)	336	41	0.74 (0.56-0.97)
2-4	563	46.3	4.00 (0.82-19.59)	98	32.7	0.72 (0.49-1.05)	157	40	0.88 (0.64-1.23)	354	43	1.04 (0.79-1.37)
≥5	7	0.6	0.88 (0.69-1.10)	2	0.7	1.41 (0.28-7.00)	2	1	0.99 (0.20-4.87)	6	1	2.45 (0.60-10.00)
Adverse outcome												
Mother	141	13	1.96 (1.36-2.80)	22	9	0.75 (0.47-1.19)	47	14	1.45 (1.02-2.07)	95	14	1.60 (1.17-2.17)
Baby	213	20	1.40 (1.07-1.83)	26	10	0.48 (0.31-0.73)	124	37	3.90 (2.97-5.12)	117	17	0.87 (0.67-1.12)

India: Multivariate analysis

All results for multivariate analysis for the study population in India are displayed in **Table 6.8**.

Age

When compared to women in the age range 20-<25 years, women in the age range 15-<20 years were less likely to report social morbidity OR 0.51 (0.28-0.93) p-value 0.03. When compared to women in the age range 20-<25 years, women in the age range 25-<30 years and 30-<35 years were more likely to report social morbidity, and the risk increased as age increased: OR 1.48 (1.19-1.85) p-value 0.00, OR 1.69 (1.21-2.37) p-value 0.00 respectively. There are no statistically significant differences between age and psychological morbidity. When compared to women in the age range 20->25 years, women in the age range ≥ 35 years were more likely to report infectious morbidity 3.03 (1.24-7.39) p-value 0.01.

Socioeconomic status

There are no statistically significant differences between SES and medical/obstetric, infectious, psychological morbidity on multivariate analysis. When compared to women in the lower SES category, women in the upper middle SES category were less likely to report social morbidity OR 0.20 (0.04-0.94) p-value 0.04.

Educational level completed

There are no statistically significant differences between education level completed and infectious or psychological morbidity. When compared to women with no educational level completed, women with primary, secondary and tertiary education were more likely to report medical/obstetric morbidity OR 1.84 (1.37-2.47) p-value 0.00 and OR 2.60 (1.72-3.92) p-value 0.00 respectively.

When compared to women with no educational level completed, women with primary and secondary education were less likely to report social morbidity and this decreased with level of education: OR 0.66 (0.49-0.89) p-value 0.01; OR 0.60 (0.39-0.91) p-value 0.02 respectively.

Number of previous pregnancies

There are no statistically significant differences between number of previous pregnancies and medical/obstetric, infectious, or social morbidity on multivariate analysis. When compared to women with no previous pregnancies, women with two to four pregnancies, and women with five or more pregnancies were more likely to report psychological morbidity and this likelihood increased with the number of pregnancies: OR 2.23 (1.20-4.14) p-value 0.01 and OR 2.53 (1.33-4.81) p-value 0.00.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report medical/obstetric and social morbidity: OR 1.87 (1.17-2.99) p-value 0.00 and OR 1.89 (1.25-2.87) p-value 0.00.

Mothers with an adverse neonatal outcome in the most recent pregnancy

There are no statistically significant differences between women with adverse neonatal outcomes for the newborn in the most recent pregnancy and medical/obstetric or social morbidity on multivariate analysis. When compared to women with no neonatal adverse outcomes in the most recent pregnancy, women with an adverse neonatal outcome were less likely to report infectious morbidity OR 0.48 (0.27-0.87) p-value 0.01. When compared to women with no newborn adverse outcomes in the most recent pregnancy, women with a newborn adverse outcome were more likely to report psychological morbidity OR 4.12 (2.83-6.00) p-value 0.00.

Summary box: India	
Factor	Associations with morbidity
Age	When compared to women in the age range 20-<25 years, women in the age range 15-<20 years were less likely to report social morbidity; women in the age range 25-<30 years and 30-<35 years were more likely to report social morbidity; and women in the age range ≥35 years were more likely to report infectious morbidity.
Socioeconomic status	When compared to women in the lower SES category, women in the upper middle SES category were less likely to report social morbidity.
Educational level	Women with primary and secondary education were more likely to report medical/obstetric morbidity and less likely to report social morbidity.
Number of previous pregnancies	When compared to women with no previous pregnancies, women with two to four pregnancies, and women with five or more pregnancies were more likely to report psychological morbidity and this likelihood increased with the number of pregnancies.
Adverse maternal outcome in the most recent pregnancy	Women with an adverse maternal outcome were more likely to report medical/obstetric and social morbidity.
Adverse neonatal outcome in the most recent pregnancy	Women with an adverse neonatal outcome were less likely to report infectious morbidity. Women with an adverse neonatal outcome were more likely to report psychological morbidity.

Table 6.8: India: Multivariate analysis

COUNTRY	INDIA									
Variable	PHYSICAL MORBIDITY				NON-PHYSICAL MORBIDITY				ANY MORBIDITY	
	MEDICAL/OBSTETRIC		INFECTIOUS		PSYCHOLOGICAL		SOCIAL			
	OR (95% CI)	P-value								
Age										
15- <20	1.84 (1.01-3.32)	0.05	1.33 (0.71-2.50)	0.38	0.98 (0.53-1.82)	0.95	0.51 (0.28-0.93)	0.03	1.09 (0.50-2.40)	0.82
20 - <25	Reference									
25 - <30	0.84 (0.67-1.05)	0.13	0.88 (0.66-1.19)	0.41	0.72 (0.55-0.94)	0.02	1.48 (1.19-1.85)	0.00	0.85 (0.62-1.15)	0.28
30- <35	0.84 (0.60-1.18)	0.32	0.87 (0.54-1.40)	0.56	0.87(0.57-1.32)	0.50	1.69 (1.21-2.37)	0.00	0.87 (0.54-1.40)	0.58
≥35	1.21 (0.51-2.89)	0.67	3.03 (1.24-7.39)	0.01	1.50 (0.61-3.65)	0.38	1.64 (0.73-3.68)	0.23	1.42 (0.40-5.09)	0.59
SES										
Lower (V)	Reference									
Upper Lower	0.69 (0.14-3.55)	0.66	1.75(0.20-14.9)	0.61	1.91 (0.21-17.52)	0.57	0.52 (0.12-2.24)	0.38	1.04 (0.12-9.02)	0.97
Lower Middle	0.67 (0.13-3.45)	0.63	0.97 (0.11-8.50)	0.98	1.99 (0.21-18.47)	0.55	0.23 (0.05-1.00)	0.05	0.43 (0.05-3.82)	0.45
Upper Middle	0.54 (0.10-2.93)	0.48	0.89 (0.10-8.38)	0.92	1.42 (0.15-13.86)	0.76	0.20 (0.04-0.94)	0.04	0.36 (0.04-3.30)	0.36
Upper (I)	0.31 (0.05-1.83)	0.20	0.51 (0.04-6.08)	0.60	1.68 (0.16-17.53)	0.66	0.20 (0.04-1.03)	0.05	0.23 (0.02-2.23)	0.20
Level of education completed										
None	Reference									
Primary	1.84 (1.37-2.47)	0.00	0.99 (0.67-1.46)	0.95	0.98 (0.68-1.39)	0.90	0.66 (0.49-0.89)	0.01	1.40 (0.94-2.09)	0.10
Secondary	2.60 (1.72-3.92)	0.00	0.62 (0.36-1.06)	0.08	1.11(0.67-1.86)	0.68	0.60 (0.39-0.91)	0.02	1.98 (1.14-3.46)	0.02
Tertiary	3.60 (0.68-19.0)	0.13	0.81 (0.13-5.02)	0.82	1.09 (0.18-6.45)	0.93	1.28 (0.28-5.92)	0.75	2.08 (0.23-19.0)	0.52
Number of previous pregnancies										
None	Reference									
1	0.75 (0.46-1.21)	0.23	0.74 (0.42-1.29)	0.29	1.03 (0.55-1.92)	0.93	0.87 (0.56-1.36)	0.54	0.76 (0.38-1.52)	0.44
2-4	0.72 (0.44-1.17)	0.18	0.67 (0.37-1.19)	0.17	2.23 (1.20-4.14)	0.01	1.45 (0.92-2.28)	0.11	1.48 (0.72-3.02)	0.29
≥5	0.73 (0.43-1.22)	0.23	0.88 (0.48-1.62)	0.69	2.53(1.33-4.81)	0.00	1.07 (0.66-1.73)	0.79	1.37 (0.65-2.87)	0.41
Adverse outcome										
Mother	1.87 (1.17-2.99)	0.01	0.91 (0.49-1.70)	0.77	1.49 (0.92-2.42)	0.10	1.89 (1.25-2.87)	0.00	9.06 (2.20-37.3)	0.00
Baby	1.01 (0.71-1.44)	0.96	0.48 (0.27-0.87)	0.01	4.12 (2.83-6.00)	0.00	0.89 (0.63-1.27)	0.53	1.27 (0.74-2.18)	0.39

6.3 Pakistan: Univariate analysis

All results for univariate analysis for the study population are displayed in **Table 6.9**.

Age

There were no statistically significant differences between the age groups and the likelihood of medical/obstetric or social morbidity. When compared to women in the age range 20-<25 years of age, women were more likely to report infectious morbidity in the age range ≥ 35 years of age OR 1.49 (1.03-2.17) p-value 0.04. When compared to women in the age range 20-<25 years of age, women were more likely to report psychological morbidity across three age categories: in the age ranges 25-<30 years OR 1.33 (1.09-1.61) p-value 0.00; 30-<35 years OR 1.24 (1.01-1.53) p-value 0.04; and ≥ 35 years OR 1.41 (1.09-1.82) p-value 0.01.

Socioeconomic status

When compared to women in the lower SES category, women of all other SES categories were less likely to report psychological morbidity. When compared to women in the lower SES category, women in the upper middle SES category were less likely to report social morbidity OR 0.57 (0.33-0.98) p-value 0.04.

Educational level completed

There are statistically significant differences between the educational level completed and the likelihood of reporting or being diagnosed with all four types of morbidities: medical/obstetric; infectious; psychological and social morbidity. When compared to women with no education level, women were less likely to report medical/obstetric morbidity across all other educational levels: primary OR 0.77 (0.61-0.98) p-value 0.03; secondary OR 0.64 (0.51-0.79) p-value 0.00, and tertiary OR 0.67 (0.54-0.84) p-value 0.00. When compared to women with no education level, women were less likely to report infectious morbidity with secondary OR 0.57 (0.42 - 0.77) p-value 0.04. When compared to women with no education level, women were

less likely to report psychological morbidity across all other educational levels: primary OR 0.73 (0.59-0.91) p-value 0.00; secondary OR 0.38 (0.31-0.47) p-value 0.00; and tertiary OR 0.33 (0.27-0.41) p-value 0.00. When compared to women with no education level, women were less likely to report social morbidity across all other educational levels: primary OR 0.73 (0.58-0.91) p-value 0.00; secondary OR 0.62 (0.50-0.76) p-value 0.00; and tertiary OR 0.43 (0.35-0.54) p-value 0.00.

Number of previous pregnancies

There are statistically significant differences between number of previous pregnancies and the likelihood of reporting or being diagnosed with medical/obstetric, infectious, psychological and social morbidity. When compared to women with no previous pregnancies (primigravida), women with one previous pregnancy were more likely to report social morbidity OR 1.45 (1.13-1.86) p-value 0.00. When compared to women with no previous pregnancy (primigravida), women with two to four pregnancies (P2-4) were more likely to have medical/obstetric OR 1.78 (1.24-2.55) p-value 0.00; infectious OR 1.49 (1.02-2.19) p-value 0.04; psychological OR 1.88 (1.48-2.39) p-value 0.00; and social morbidity OR 1.78 (1.41-2.25) p-value 0.00. When compared to women with no previous pregnancy (primigravida), women with five or more pregnancies (P≥5) were more likely to have medical/obstetric morbidity (OR 1.82 (1.46-2.26) p-value 0.00; infectious (OR 1.68 (1.03-2.75) p-value 0.04); or report psychological OR 3.11 (2.23-4.33) p-value 0.00 and social morbidity OR 1.68 (1.22-2.33) p-value 0.00.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to have medical/obstetric (OR 2.61 (2.08-3.29) p-value 0.00); infectious (OR 4.03 (3.20-5.08) p-value 0.00); and to report psychosocial OR 5.14 (4.17-6.32) p-value 0.00; and social morbidity OR 4.15 (3.30-5.21) p-value 0.00.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no neonatal adverse outcome in the most recent pregnancy, women with an adverse neonatal outcome were more likely to report medical/obstetric morbidity (OR 2.03 (1.59-2.60) p-value 0.00), infectious (OR 3.60 (2.83-4.59) p-value 0.00), psychosocial (OR 3.23 (2.60-4.02) p-value 0.00) and social morbidity OR 2.42 (1.92-3.04) p-value 0.00.

Table 6.9: Pakistan: Univariate analysis

COUNTRY	PHYSICAL MORBIDITY						NON-PHYSICAL MORBIDITY					
	MEDICAL/OBSTETRIC			INFECTIOUS			PSYCHOLOGICAL			SOCIAL		
	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)
Age												
15 -<20	113	5	0.76 (0.54-1.07)	13	3	0.63 (0.34-1.17)	79	6	0.98 (0.71-1.37)	98	5	0.78 (0.56-1.09)
20 -<25	485	23	1.00	76	20	1.00	307	21	1.00	420	23	1.0
25 -<30	698	33	1.22 (0.98-1.51)	136	36	1.35 (1.00-1.82)	490	34	1.33 (1.09-1.61)	603	34	1.12 (0.92-1.36)
30 -<35	541	26	1.19 (0.97-1.49)	95	25	1.19 (0.87-1.64)	369	26	1.24 (1.01-1.53)	456	25	1.04 (0.81-1.28)
≥35	250	12	1.24 (0.93-1.65)	54	14	1.49 (1.03-2.17)	184	12	1.41 (1.09-1.82)	213	12	1.03 (0.80-1.34)
Socio-economic status												
Lower (V)	48	2	1.00	5	1	1.00	42	3	1.00	43	2	1.00
Upper Lower (IV)	527	23	0.76 (0.43-1.36)	91	23	1.61 (0.63-4.10)	364	23	0.49 (0.29-0.83)	483	24	0.86 (0.50-1.46)
Lower Middle (III)	1205	53	0.80 (0.46-1.40)	225	56	1.78 (0.71-4.49)	860	55	0.54 (0.32-0.90)	1065	54	0.81 (0.48-1.36)
Upper Middle (II)	405	18	0.79 (0.44-1.41)	71	18	1.65 (0.64-4.25)	236	15	0.37 (0.22-0.63)	310	16	0.57 (0.33-0.98)
Upper (I)	94	4	1.07 (0.54-2.13)	10	2	1.04 (0.34-3.19)	52	3	0.39 (0.21-0.73)	79	4	0.88 (0.47-1.65)
Level of education completed												
None	721	37	1.00	153	41	1.00	589	43	1.00	663	39	1.00
Primary	381	19	0.77 (0.61-0.98)	78	21	0.88 (0.66-1.19)	293	22	0.73 (0.59-0.91)	337	20	0.73 (0.58-0.91)
Secondary	453	23	0.64 (0.51-0.79)	67	18	0.57 (0.42-0.77)	261	19	0.38 (0.31-0.47)	398	23	0.62 (0.50-0.76)
Tertiary	415	21	0.67 (0.54-0.84)	77	21	0.75 (0.56-1.01)	215	16	0.33 (0.27-0.41)	306	18	0.43 (0.35-0.54)
Number of previous pregnancies												
None	229	11.2	1.05 (0.81-1.36)	34	9	1.00	121	9	1.00	169	10	1.00
1	568	27.8	1.25 (0.98-1.59)	119	30	1.51 (1.01-2.25)	339	25	1.25 (0.96-1.61)	492	28	1.45 (1.13-1.86)
2-4	1047	51.3	1.78 (1.24-2.55)	206	52	1.49 (1.02-2.19)	743	55	1.88 (1.48-2.39)	932	53	1.78 (1.41-2.25)
≥5	197	9.7	1.82 (1.46-2.26)	39	10	1.68 (1.03-2.75)	159	12	3.11 (2.23-4.33)	156	9	1.68 (1.22-2.33)
Adverse outcome												
Mother	499	28	2.61 (2.08-3.29)	176	48	4.03 (3.20-5.08)	460	37	5.14 (4.17-6.32)	498	32	4.15 (3.30-5.21)
Baby	367	20	2.03 (1.59-2.60)	136	37	3.60 (2.83-4.59)	322	26	3.23 (2.60-4.02)	348	22	2.42 (1.92-3.04)

Pakistan: Multivariate analysis

All results for multivariate analysis for the study population are displayed in **Table 6.10**.

Age

There are no statistically significant differences between age and any type of morbidity on multivariate analysis.

Socioeconomic status

There are no statistically significant differences between SES and medical/obstetric morbidity. When compared to women in the lower SES category, women in the upper middle and upper SES were more likely to report infectious morbidity and this risk increased as the SES increased: OR 3.67 (1.19-11.3) p-value 0.02 and 4.18 (1.13-15.4) p-value 0.03 respectively. The 95% CI are wide for each odds ratio. Conversely, when compared to women in the lower SES category, women were less likely to report psychological morbidity in all other categories of SES, but the risk was not consistent in either direction. When compared to women in the lower SES category, women in the upper middle category were less likely to report social morbidity OR 0.33 (0.13-0.84) p-value 0.02.

Educational level completed

When compared to women with no educational level completed, women with secondary education were less likely to report medical/obstetric morbidity OR 0.52 (0.33-0.83) p-value 0.01. When compared to women with no educational level completed, women with primary and secondary level education were more likely to report social morbidity OR 1.40 (1.03-1.92) p-value 0.03 and OR 1.63 (1.06-2.49) 0.03. There was no consistent direction of association across the types of morbidity.

Number of previous pregnancies

There were statistically significant differences between number of previous pregnancies and medical/obstetric, infectious, psychological and social morbidity on multivariate analysis. When compared to women with no previous pregnancy, women with two to four pregnancies were less likely to have medical/obstetric morbidity OR 0.72 (0.55-0.94) 0.01. When compared to women with no previous pregnancy, women with two to four pregnancies or five or more pregnancies were less likely to report infectious morbidity OR 0.56 (0.39-0.53) 0.00 and OR 0.60 (0.41-0.87) 0.01. When compared to women with no previous pregnancy, women with one previous pregnancy, two to four pregnancies or five or more pregnancies were less likely to report psychological and social morbidity.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report all four types of morbidity: medical/obstetric, infectious, psychological and social morbidity.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no adverse neonatal outcomes in the most recent pregnancy, women with an adverse neonatal outcome were more likely to report all four types of morbidity: medical/obstetric, infectious, psychological and social morbidity.

Summary box: Pakistan	
Factor	Associations with morbidity
Age	No statistically significant difference.
Socioeconomic status	When compared to women in the lower SES category, women in the upper middle and upper SES were more likely to report infectious morbidity; women were less likely to report psychological morbidity in all other categories of SES; and women in the upper middle category were less likely to report social morbidity.
Educational level	When compared to women with no education, women with primary and secondary level education were more likely to report social morbidity.; and women with secondary education were less likely to report medical/obstetric morbidity.
Number of previous pregnancies	When compared to women with no previous pregnancy, women with two to four pregnancies were less likely to report medical/obstetric morbidity; women with two to four pregnancies or five or more pregnancies were less likely to report infectious morbidity; women with one previous pregnancy, two to four pregnancies or five or more pregnancies were less likely to report psychological and social morbidity.
Adverse maternal outcome in the most recent pregnancy	When compared to women with no adverse maternal outcome, women with an adverse maternal outcome were more likely to report medical/obstetric, infectious, psychological and social morbidity.
Adverse neonatal outcome in the most recent pregnancy	When compared to women with no adverse neonatal outcome, women with an adverse neonatal outcome were more likely to report medical/obstetric, infectious, psychological and social morbidity.

Table 6.10: Pakistan: Multivariate analysis

COUNTRY	PAKISTAN									
	PHYSICAL MORBIDITY				NON-PHYSICAL MORBIDITY				ANY MORBIDITY	
	MEDICAL/OBSTETRIC		INFECTIOUS		PSYCHOLOGICAL		SOCIAL		OR (95% CI)	P-value
OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value			
Age										
15- <20	0.81 (0.54-1.22)	0.31	0.51 (0.24-1.06)	0.07	0.85 (0.57-1.29)	0.45	0.88 (0.59-1.31)	0.53	0.96 (0.52-1.77)	0.89
20 - <25	Reference									
25 - <30	1.00 (0.78-1.29)	0.99	1.26 (0.90-1.77)	0.18	1.13 (0.88-1.45)	0.33	1.12 (0.88-1.43)	0.34	1.18 (0.80-1.73)	0.41
30- <35	0.93 (0.70-1.24)	0.62	1.10 (0.75-1.61)	0.63	0.91 (0.69-1.20)	0.50	0.92 (0.71-1.21)	0.57	0.90 (0.59-1.38)	0.64
≥35	0.91 (0.64-1.30)	0.60	1.39 (0.90-2.16)	0.14	0.97 (0.69-1.36)	0.86	0.92 (0.66-1.28)	0.63	1.45 (0.79-2.65)	0.23
SES										
Lower (V)	Reference									
Upper Lower	0.87 (0.40-1.91)	0.74	2.38 (0.79-7.14)	0.12	0.33 (0.15-0.72)	0.01	0.76 (0.36-1.61)	0.48	0.61 (0.14 2.68)	0.52
Lower Middle	0.87 (0.40-1.88)	0.72	2.77 (0.94-8.18)	0.07	0.39 (0.18-0.85)	0.02	0.74 (0.36-1.55)	0.43	0.68 (0.16-2.93)	0.61
Upper Middle	0.73 (0.33-1.62)	0.44	3.67 (1.19-11.3)	0.02	0.29 (0.13-0.64)	0.00	0.52 (0.24-1.11)	0.09	0.53 (0.12-2.30)	0.40
Upper (I)	0.68 (0.26-1.76)	0.43	4.18 (1.13-15.4)	0.03	0.19 (0.07-0.51)	0.00	0.33 (0.13-0.84)	0.02	0.40 (0.08-2.03)	0.27
Level of education completed										
None	Reference									
Primary	0.72 (0.52-1.00)	0.05	0.99 (0.60-1.63)	0.97	0.87 (0.63-1.22)	0.43	1.40 (1.03-1.92)	0.03	0.80 (0.50 1.29)	0.36
Secondary	0.52 (0.33-0.83)	0.01	0.72 (0.39-1.33)	0.29	0.99 (0.64-1.54)	0.97	1.63 (1.06-2.49)	0.03	0.56 (0.27-1.14)	0.11
Tertiary	0.89 (0.49-1.62)	0.71	0.73 (0.35 1.51)	0.39	1.70 (0.99-2.93)	0.05	1.31 (0.78-2.20)	0.32	0.92 (0.34-2.47)	0.87
Number of previous pregnancies										
None	Reference									
1	0.87 (0.65-1.15)	0.33	0.85 (0.61-1.19)	0.34	0.66 (0.51-0.85)	0.00	0.70 (0.54-0.91)	0.01	0.56 (0.35-0.88)	0.01
2-4	0.72 (0.55-0.94)	0.01	0.56 (0.39-0.80)	0.00	0.42 (0.32-0.53)	0.00	0.71 (0.55-0.91)	0.01	0.50 (0.32-0.76)	0.00
≥5	0.79 (0.60-1.05)	0.10	0.60 (0.41-0.87)	0.01	0.39 (0.30-0.51)	0.00	0.58 (0.45-0.76)	0.00	0.53 (0.34-0.84)	0.01
Adverse outcome										
Mother	2.21 (1.59-3.07)	0.00	3.04 (2.26 4.10)	0.00	4.48 (3.35-6.01)	0.00	4.41 (3.21-6.07)	0.00	4.84 (2.30-10.2)	0.001
Baby	1.46 (1.04-2.05)	0.03	2.13 (1.56-2.92)	0.00	1.76 (1.31-2.37)	0.00	1.36 (1.01-1.84)	0.01	1.27 (0.72-2.22)	0.41

6.4 Kenya: Univariate analysis

All results for univariate analysis for the study population are displayed in **Table 6.11**.

Age

When compared to women in the age range 20-<25 years of age, women were more likely to report psychological morbidity in the age ranges 15-<20 years and 30-35 years OR 1.67 (1.22-2.28) p-value 0.00 and OR 1.54 (1.14-2.08) p-value 0.00.

Socioeconomic status

There are statistically significant differences between SES and the likelihood of medical/obstetric, infectious, psychological and social morbidity. When compared to women in the lower SES category, women in the upper lower and the middle categories were less likely to have medical/obstetric morbidity OR 0.60 (0.45 - 0.79) p-value 0.00 and OR 0.73 (0.56-0.95) p-value 0.02 respectively. When compared to women in the lower SES category, women in the upper middle and the upper categories were more likely to have infectious morbidity OR 1.40 (1.10-1.78) p-value 0.01 and OR 1.39 (1.09-1.76) p-value 0.01 respectively. When compared to women in the lower SES category, women in the all SES categories were less likely to report psychological morbidity. When compared to women in the lower SES category, women in the upper lower and upper SES categories were less likely to report social morbidity but women in the middle SES category were more likely to report social morbidity.

Educational level completed

When compared to women with no education level, women were more likely to have infectious morbidity with secondary OR 2.08 (1.22-3.55) p-value 0.01, and tertiary OR 2.04 (1.17-3.55) p-value 0.01 education levels. When compared to women with no education level, women were less likely to report psychological morbidity with primary OR 0.34 (0.21-0.57) p-value 0.00; secondary (OR 0.30 (0.18-0.50) p-value 0.00; and tertiary OR 0.26 (0.15-0.47) p-value 0.00 education levels.

Number of previous pregnancies

When compared to women with no previous pregnancy (primigravida), women with one previous pregnancy were more likely to have infectious morbidity OR 1.38 (1.11-1.73) p-value 0.00

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to have infectious morbidity 3.31 (2.14-5.10) p-value 0.00 and social morbidity OR 2.08 (1.24-3.48) p-value 0.01.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no adverse neonatal outcomes in the most recent pregnancy, women with an adverse neonatal outcome were more likely to have medical/obstetric OR 1.98 (1.46-2.68) p-value 0.00 and infectious OR 1.45 (1.08-1.95) p-value 0.01 and to report psychosocial morbidity OR 1.78 (1.22-2.58) p-value 0.00.

Table 6.11: Kenya: Univariate analysis

COUNTRY	PHYSICAL MORBIDITY						NON-PHYSICAL MORBIDITY					
	MEDICAL/OBSTETRIC			INFECTIOUS			PSYCHOLOGICAL			SOCIAL		
	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)
Age												
15 <-20	113	14	0.98 (0.76-1.26)	162	13	0.94 (0.75-1.18)	76	18	1.67 (1.22-2.28)	115	15	1.12 (0.87-1.45)
20 <-25	270	34	1.00	395	33	1.00	115	27	1.00	247	32	1.00
25 <-30	201	26	0.98 (0.80-1.20)	310	26	1.00 (0.83-1.21)	99	24	1.11 (0.83-1.48)	204	26	1.06 (0.86-1.32)
30 <-35	126	16	0.88 (0.70-1.12)	216	18	1.08 (0.88-1.34)	87	21	1.54 (1.14-2.08)	131	17	1.03 (0.81-1.31)
≥35	75	9	1.10 (0.83-1.48)	124	9	1.29 (0.99-1.68)	42	10	1.41 (0.96-2.07)	78	10	1.23 (0.91-1.65)
Socio-economic status												
Lower (V)	164	22	1.00	206	19	1.00	109	27	1.00	149	21	1.00
Upper Lower (IV)	108	15	0.60 (0.45-0.79)	180	16	0.85 (0.66 - 1.09)	76	19	0.67 (0.49-0.93)	113	16	0.72 (0.55-0.96)
Lower Middle (III)	133	18	0.73 (0.56-0.95)	215	19	1.03 (0.81-1.31)	71	18	0.58 (0.42-0.81)	200	28	1.47 (1.14-1.90)
Upper Middle (II)	157	21	0.93 (0.72-1.21)	253	23	1.40 (1.10-1.78)	71	18	0.60 (0.43-0.83)	138	19	0.90 (0.68-1.17)
Upper (I)	170	23	1.06 (0.82-1.37)	249	23	1.39 (1.09-1.76)	78	19	0.67 (0.49-0.92)	119	17	0.75 (0.57-0.99)
Level of education completed												
None	19	2	1.00	19	2	1.00	24	6	1.00	21	3	1.00
Primary	322	41	0.90 (0.52-1.53)	491	40	1.63 (0.96-2.78)	192	45	0.34 (0.21-0.57)	372	48	0.95 (0.56-1.59)
Secondary	336	43	1.06 (0.62-1.81)	524	43	2.08 (1.22-3.55)	156	37	0.30 (0.18-0.50)	299	38	0.79 (0.47-1.33)
Tertiary	113	14	0.99 (0.56-1.73)	184	15	2.04 (1.17-3.55)	50	12	0.26 (0.15-0.47)	90	12	0.64 (0.37-1.12)
Number of previous pregnancies												
None	114	14.7	1.00	164	14	1.00	71	18	1.00	112	15	1.00
1	289	37.3	1.06 (0.83-1.36)	486	41	1.38 (1.11-1.73)	138	34	0.78 (0.57-1.06)	269	35	0.99 (0.77-1.27)
2-4	352	45.4	1.18 (0.93-1.50)	507	43	1.22 (0.98-1.51)	183	45	0.94 (0.70-1.26)	363	48	1.26 (0.99-1.61)
≥5	20	2.6	1.81 (1.01-3.26)	23	2	1.37 (0.78-2.41)	13	3	1.77 (0.90-3.45)	15	2	1.22 (0.65-2.29)
Adverse outcome												
Mother	45	7	3.31 (2.14-5.10)	40	4	1.33 (0.87-2.05)	20	6	2.08 (1.24-3.48)	19	3	0.83(0.50-1.40)
Baby	76	11	1.98 (1.46-2.68)	93	9	1.45 (1.08-1.95)	39	12	1.78 (1.22-2.58)	53	8	1.13 (0.81-1.57)

Kenya: Multivariate analysis

All results for multivariate analysis for the study population are displayed in **Table 6.12**.

Age

When compared to women in the age range 20-<25 years of age, women were more likely to report psychological morbidity in the age ranges 15-<20 years OR 1.66 (1.17-2.35) p-value 0.00; and 30-<35 years OR 1.48 (1.05-2.08 p-value 0.03. There were no statistically significant differences between age and medical/obstetric, infectious or social morbidity on multivariate analysis.

Socioeconomic status

When compared to women in the lower SES category, women in the upper lower and lower middle were less likely to report medical/obstetric morbidity and this risk increased as SES increased: OR 0.62 (0.46-0.79) p-value 0.00 and 0.72 (0.55-0.95) p-value 0.02 respectively. When compared to women in the lower SES category, women in the lower middle and middle SES categories were less likely to report psychological morbidity OR 0.70 (0.50-0.98) p-value 0.04 and OR 0.63(0.45-0.89) p-value 0.01.

Educational level completed

There are no statistically significant differences between level of education completed and medical/obstetric, infectious or social morbidity. When compared to women with no educational level completed, women with primary, secondary and tertiary education were less likely to report psychological morbidity and this decreased with the higher level of education.

Number of previous pregnancies

When compared to women with no previous pregnancy (primigravida), women with one previous pregnancy or two to four pregnancies were less likely to report psychological morbidity OR 0.69 (0.49-0.99) p-value 0.04 and 0.57 (0.35-0.94) p-value 0.03 respectively. There are no statistically significant differences between the number of previous pregnancies and medical/obstetric, infectious or social morbidity on multivariate analysis.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report medical/obstetric morbidity OR 2.95 (1.67-5.20) p-value 0.00.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no adverse neonatal outcomes in the most recent pregnancy, women with an adverse neonatal outcome were more likely to report medical/obstetric morbidity OR 2.00 (1.36-2.94) p-value 0.00.

Summary: Kenya	
Factor	Associations with morbidity
Age	When compared to women in the age range 20-<25 years, women were more likely to report psychological morbidity in the age ranges 15-<20 years and 30-<35 years.
Socioeconomic status	When compared to women in the lower SES category, women in the upper lower and lower middle SES category were less likely to report medical/obstetric morbidity; and women in the lower middle and middle SES category were less likely to report psychological morbidity.
Educational level	When compared to women with no education level completed, women with primary, secondary and tertiary education were less likely to report psychological morbidity.
Number of previous pregnancies	When compared to women with no previous pregnancies women with one previous pregnancy and women with two to four pregnancies were less likely to report psychological morbidity.
Adverse maternal outcome in the most recent pregnancy	When compared to women with no adverse maternal outcome, women with an adverse maternal outcome were more likely to report medical/obstetric morbidity.
Adverse neonatal outcome in the most recent pregnancy	When compared to women with no adverse neonatal outcome, women with an adverse neonatal outcome were more likely to report medical/obstetric morbidity.

Table 6.12: Kenya: Multivariate analysis

COUNTRY	KENYA									
Variable	PHYSICAL MORBIDITY				NON-PHYSICAL MORBIDITY				ANY MORBIDITY	
	MEDICAL/OBSTETRIC		INFECTIOUS		PSYCHOLOGICAL		SOCIAL			
	OR (95% CI)	P-value								
Age										
15-<20	1.15 (0.87-1.51)	0.32	1.09 (0.84-1.42)	0.50	1.66 (1.17-2.35)	0.00	1.03 (0.77-1.38)	0.83	1.27 (0.96-1.68)	0.09
20-<25	Reference									
25-<30	0.90 (0.71-1.14)	0.36	0.97 (0.78-1.20)	0.78	1.12 (0.82-1.55)	0.47	0.96 (0.76-1.23)	0.77	0.82 (0.65-1.03)	0.08
30- <35	0.78 (0.60-1.03)	0.08	1.14 (0.89-1.46)	0.29	1.48 (1.05-2.08)	0.03	0.89 (0.67-1.17)	0.41	0.82 (0.63-1.06)	0.13
≥35	0.99 (0.70-1.39)	0.94	1.38 (1.00-1.89)	0.05	1.24 (0.80-1.94)	0.33	1.02 (0.72-1.45)	0.90	1.27 (0.89-1.80)	0.19
SES										
Lower (V)	Reference									
Upper Lower	0.60 (0.45-0.79)	0.00	0.87 (0.67-1.12)	0.29	0.70 (0.50-0.98)	0.04	0.76 (0.57-1.02)	0.07	0.66 (0.51-0.86)	0.00
Lower Middle	0.72 (0.55-0.95)	0.02	1.04 (0.81-1.33)	0.79	0.63 (0.45-0.89)	0.01	1.54 (1.18-2.01)	0.00	1.10 (0.84-1.44)	0.48
Upper Middle	1.00 (0.76-1.31)	0.98	1.33 (1.03-1.72)	0.03	0.72 (0.51-1.01)	0.06	1.05 (0.79-1.40)	0.74	1.06 (0.81-1.40)	0.67
Upper (I)	1.16 (0.88-1.55)	0.30	1.35 (1.03-1.77)	0.03	0.78 (0.54-1.12)	0.18	0.86 (0.63-1.17)	0.35	1.03 (0.77-1.37)	0.86
Level of education completed										
None	Reference									
Primary	1.37 (0.76-2.47)	0.30	1.45 (0.83-2.52)	0.19	0.33 (0.19-0.56)	0.00	1.00 (0.57-1.75)	0.99	1.00 (0.58-1.73)	1.00
Secondary	1.41 (0.77-2.56)	0.26	1.75 (1.00-3.06)	0.05	0.29 (0.17-0.51)	0.00	0.84 (0.48-1.48)	0.54	1.18 (0.67-2.06)	0.57
Tertiary	1.20 (0.63-2.26)	0.58	1.49 (0.83-2.69)	0.19	0.25 (0.13-0.47)	0.00	0.70 (0.38-1.30)	0.26	1.02 (0.56-1.84)	0.95
Number of previous pregnancies										
None	Reference									
1	1.10 (0.83-1.44)	0.51	1.36 (0.83-2.52)	0.02	0.69 (0.49-0.99)	0.04	0.82 (0.61-1.10)	0.18	1.01 (0.78-1.30)	0.96
2-4	1.36 (0.92-2.02)	0.13	1.19 (1.00-3.06)	0.33	0.57 (0.35-0.94)	0.03	0.79 (0.53-1.19)	0.26	0.91 (0.62-1.33)	0.63
≥5	1.91 (0.93-3.90)	0.08	1.31 (0.83-2.69)	0.43	0.87 (0.38-2.00)	0.74	0.81 (0.39-1.71)	0.59	1.19 (0.55-2.57)	0.66
Adverse outcome										
Mother	2.95 (1.67-5.20)	0.00	1.17 (0.66-2.04)	0.59	1.63 (0.84-3.15)	0.15	0.78 (0.41-1.48)	0.44	1.33 (0.68-2.57)	0.40
Baby	2.00 (1.36-2.94)	0.00	1.21 (0.83-1.76)	0.33	1.26 (0.78-2.03)	0.35	1.16 (0.77-1.74)	0.49	1.50 (0.96-2.33)	0.07

6.5 Malawi: Univariate analysis

All results for univariate analysis for the study population are displayed in **Table 6.13**.

Age

When compared to women in the age range 20-<25years of age, women in the age category 30-<35 years and ≥ 35 years were more likely to report infectious morbidity OR 1.34 (1.04-1.73) p-value 0.02 and OR 1.85 (1.33-2.58) p-value 0.00 respectively. When compared to women in the age range 20-<25years of age, women were less likely to report psychological morbidity in the age range ≥ 35 years OR 0.54 (0.35-0.98) p-value 0.04. When compared to women in the age range 20-<25years of age, women in the age category 30-<35 years of age were more likely to report social morbidity OR 1.41 (1.04-1.91) p-value 0.03.

Socioeconomic status

When compared to women in the lower SES category, women in the upper lower SES category were more likely to report medical/obstetric morbidity OR 1.27 (1.01-1.60) p-value 0.04. When compared to women in the lower SES category, women were more likely to report psychological morbidity in the middle (III) OR 1.52 (1.05-2.21) p-value 0.03; upper middle (II) OR 2.63 (1.87-3.70) p-value 0.00; and upper (I) SES category OR 3.85 (2.76-5.36) p-value 0.00. When compared to women in the lower SES category, women were more likely to report social morbidity in the upper middle (II) OR 1.79 (1.33-2.40) p-value 0.00; and upper (I) SES category OR 2.20 (1.65-2.94) p-value 0.00.

Educational level completed

When compared to women with no education level, women were less likely to have infectious morbidity with secondary OR 0.67 (0.54-0.82) p-value 0.00; and tertiary education levels OR 0.61 (95% 0.40-0.92) p-value 0.02 education levels.

Number of previous pregnancies

There are statistically significant differences between number of previous pregnancies and the likelihood of reporting infectious, psychological and social morbidity. When compared to women with no previous pregnancy (primigravida), women with one previous pregnancy were more likely to report infectious OR 1.52 (1.20-1.93) p-value 0.00; and psychological morbidity OR 1.67 (1.11-2.50) p-value 0.01. When compared to women with no previous pregnancy (primigravida), women with two to four pregnancies (P2-4) were more likely to report medical/obstetric OR 2.09 (1.50-2.92) p-value 0.00; infectious morbidity (OR 2.76 (1.89-4.03) p-value 0.00); and psychological morbidity OR 1.68 (1.24-2.29) p-value 0.00). When compared to women with no previous pregnancy (primigravida), women with five or more pregnancies (P \geq 5) were less likely to report infectious morbidity OR 0.57 (0.46-0.70) p-value 0.00.

Mothers with an adverse outcome in the most recent pregnancy

When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report psychological OR 5.14 (4.17-6.32) p-value 0.00; and social morbidity OR 4.15 (3.30-5.21) p-value 0.00.

Mothers with an adverse neonatal outcome in the most recent pregnancy

When compared to women with no adverse neonatal outcomes in the most recent pregnancy, women with an adverse neonatal outcome were more likely to report psychosocial morbidity OR 2.18 (1.24-3.84) p-value 0.00.

Table 6.13: Malawi: Univariate analysis

COUNTRY	PHYSICAL MORBIDITY						NON-PHYSICAL MORBIDITY					
	MEDICAL/OBSTETRIC			INFECTIOUS			PSYCHOLOGICAL			SOCIAL		
	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)	n	%	OR (95% CI)
Age												
15 -<20	244	23	1.20 (0.96-1.49)	240	21	1.09 (0.88-1.36)	79	18	0.78 (0.58-1.06)	104	20	1.02 (0.78-1.35)
20 -<25	318	30	1.00	329	29	1.00	140	32		147	29	
25 -<30	278	27	0.98 (0.79-1.20)	290	26	1.00 (0.81-1.23)	126	29	1.02 (0.79-1.34)	144	28	1.14 (0.88-1.47)
30 -<35	126	12	0.95 (0.73-1.23)	163	15	1.34 (1.04-1.73)	69	16	1.22 (0.88-1.68)	81	16	1.41 (1.04-1.91)
≥35	78	8	1.27 (0.91-1.77)	97	8	1.82 (1.33-2.58)	19	4	0.59 (0.35-0.98)	38	7	1.26 (0.84-1.89)
Socio-economic status												
Lower (V)	237	20	1.00	255	20	1.00	55	12	1.00	88	15	1.00
Upper Lower (IV)	282	24	1.27 (1.01-1.60)	275	22	1.07 (1.00-1.00)	58	12	1.02 (0.69-1.50)	86	15	0.93 (0.68-1.29)
Lower Middle (III)	236	20	1.13 (0.90-1.44)	261	20	1.20 (1.17-1.17)	74	16	1.52 (1.05-2.21)	103	18	1.33 (0.97-1.81)
Upper Middle (II)	232	19	0.97 (0.77-1.23)	259	20	1.04 (1.52-1.52)	125	26	2.63 (1.87-3.70)	140	24	1.79 (1.33-2.40)
Upper (I)	213	18	0.86 (0.68-1.09)	227	18	0.84 (2.09-2.09)	165	35	3.85 (2.76-5.36)	162	28	2.20 (1.65-2.94)
Level of education completed												
None	443	37	1.00	491	39	1.00	165	35	1.00	207	36	1.00
Primary	500	42	0.98 (0.83-1.16)	543	43	0.95 (0.80-1.12)	187	39	0.99 (0.79-1.25)	223	39	0.93 (0.76-1.15)
Secondary	209	18	0.85 (0.69-1.06)	201	16	0.67 (0.54-0.82)	104	22	1.27 (0.97-1.66)	126	22	1.23 (0.95-1.57)
Tertiary	41	3	0.86 (0.57-1.29)	37	3	0.61 (0.40-0.92)	22	5	1.40 (0.85-2.30)	22	4	1.06 (0.65-1.74)
Number of previous pregnancies												
None	154	12.9	1.00	136	11	1.17 (0.91-1.50)	33	7	1.00	57	10	1.00
1	394	33.1	1.12 (0.87-1.42)	360	28	1.52 (1.20-1.93)	125	26	1.67 (1.11-2.50)	144	25	1.06 (0.76-1.48)
2-4	537	45.1	0.90 (0.71-1.13)	649	51	2.09 (1.50-2.92)	294	62	2.76 (1.89-4.03)	324	57	1.68 (1.24-2.29)
≥5	106	8.9	1.21 (0.87-1.68)	126	1	0.57 (0.46-0.70)	22	5	1.09 (0.62-1.91)	48	8	1.46 (0.95-2.23)
Adverse outcome												
Mother	33	3	1.41 (0.87-2.29)	38	3	1.63 (1.00-2.66)	34	8	5.21 (3.19-8.50)	35	7	4.51 (2.76-7.36)
Baby	20	2	0.75 (0.44-1.30)	33	3	1.64 (0.97-2.78)	18	4	2.18 (1.24-3.84)	14	3	1.25 (0.68-2.30)

Malawi: Multivariate analysis

All results for multivariate analysis for the study population are displayed in **Table 6.14**.

Age

When compared to women in the age range 20-<25 years, women in the age range 25-<30 years and ≥ 35 years of age were less likely to report psychological morbidity: OR 0.66 (0.50-0.89) p-value 0.01 and OR 0.43 (0.24-0.77) p-value 0.00. When compared to women in the age range 20-<25 years, women in the age range 15-<20 years were more likely to report social morbidity OR 1.60 (1.16-2.21) p-value 0.00.

Socioeconomic status

When compared to women in the lower SES category, women in the upper lower were more likely to have medical/obstetric morbidity OR 1.45 (1.12-1.88) p-value 0.00. When compared to women in the lower SES category, women in the upper middle and upper SES categories were more likely to report psychological morbidity and this likelihood increased as SES increased OR 3.42 (2.28-5.13) p-value 0.00 and 5.90 (3.85-9.04) p-value 0.00 respectively. When compared to women in the lower SES category, women in the upper middle and upper SES categories were more likely to report social morbidity and this likelihood increased as SES increased, OR 1.89 (1.35-2.66) p-value 0.00 and 2.59 (1.80-3.73) p-value 0.00 respectively.

Educational level completed

There are no statistically significant differences between level of education completed and medical/obstetric, infectious or social morbidity. When compared to women with no educational level completed, women with primary, secondary and tertiary education were less likely to report psychological morbidity and this generally decreased with level of education.

Number of previous pregnancies

There are no statistically significant differences between number of previous pregnancies and medical/obstetric, infectious or social morbidity on multivariate analysis.

Mothers with an adverse outcome in the most recent pregnancy

Compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report psychological morbidity OR 2.95 (1.46-5.96) p-value 0.00.

Mothers with an adverse neonatal outcome in the most recent pregnancy

There are no statistically significant differences between women with an adverse neonatal outcome in the most recent pregnancy and medical/obstetric, infectious, psychological or social morbidity on multivariate analysis.

Summary box: Malawi	
Factor	Associations with morbidity
Age	When compared to women in the age range 20-<25 years, women in the age range 15-<20 years were more likely to report social morbidity; and women in the range 25-<30 years and ≥ 35 years of age were less likely to report psychological morbidity.
Socioeconomic status	When compared to women in the lower SES category, women in the upper lower were more likely to report medical/obstetric morbidity; women in the upper middle and upper SES category were more likely to report psychological morbidity; and women in the upper middle and upper SES category were more likely to report social morbidity.
Educational level	When compared to women with no educational level completed, women with primary, secondary and tertiary education were less likely to report psychological morbidity.
Number of previous pregnancies	Not statistically significant.
Adverse maternal outcome in the most recent pregnancy	When compared to women with no adverse maternal outcomes in the most recent pregnancy, women with an adverse maternal outcome were more likely to report psychological morbidity.
Adverse neonatal outcome in the most recent pregnancy	Not statistically significance.

Table 6.14: Malawi: Multivariate analysis

COUNTRY	MALAWI									
Variable	PHYSICAL MORBIDITY				NON-PHYSICAL MORBIDITY				ANY MORBIDITY	
	MEDICAL/OBSTETRIC		INFECTIOUS		PSYCHOLOGICAL		SOCIAL			
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Age										
15- <20	1.12 (0.88-1.43)	0.35	1.30 (1.02-1.67)	0.03	1.46 (1.02-2.09)	0.04	1.60 (1.16-2.21)	0.00	1.43 (1.10-1.85)	0.01
20 - <25	1.00		1.00		1.00		1.00		1.00	
25 - <30	1.05 (0.84-1.31)	0.65	0.89 (0.71-1.11)	0.29	0.66 (0.50-0.89)	0.01	0.85 (0.65-1.12)	0.26	0.93 (0.73-1.17)	0.52
30- <35	1.00 (0.74-1.35)	1.00	1.10 (0.83-1.48)	0.50	0.73 (0.51-1.06)	0.10	0.95 (0.67-1.35)	0.78	1.09 (0.79-1.51)	0.60
≥35	1.24 (0.84-1.84)	0.28	1.41 (0.95-2.08)	0.08	0.43 (0.24-0.77)	0.00	0.94 (0.59-1.51)	0.81	1.71 (1.06-2.75)	0.03
Socioeconomic status										
Lower (V)	1.00		1.00		1.00		1.00		1.00	
Upper Lower	1.45 (1.12-1.88)	0.00	1.09 (0.84-1.41)	0.52	1.08 (0.69-1.69)	0.75	0.92 (0.64-1.32)	0.63	1.38 (1.05-1.81)	0.02
Lower Middle	1.37 (1.05-1.79)	0.02	1.09 (0.84-1.42)	0.52	1.50 (0.97-2.32)	0.07	1.21 (0.85-1.73)	0.29	1.35 (1.02-1.79)	0.04
Upper Middle	1.16 (0.89-1.52)	0.27	1.13 (0.87-1.47)	0.37	3.42 (2.28-5.13)	0.00	1.89 (1.35-2.66)	0.00	1.52 (1.14-2.02)	0.00
Upper (I)	1.03 (0.76-1.38)	0.87	0.98 (0.73-1.31)	0.90	5.90 (3.85-9.04)	0.00	2.59 (1.80-3.73)	0.00	1.39 (1.02-1.90)	0.04
Level of education completed										
None	1.00		1.00		1.00		1.00		1.00	
Primary	1.06 (0.88-1.29)	0.54	0.99 (0.82-1.20)	0.95	0.70 (0.53-0.92)	0.01	0.83 (0.65-1.06)	0.13	1.02 (0.82-1.25)	0.87
Secondary	1.00 (0.77-1.30)	0.99	0.78 (0.60-1.01)	0.06	0.57 (0.40-0.81)	0.00	0.86 (0.62-1.18)	0.34	0.93 (0.70-1.23)	0.62
Tertiary	1.23 (0.77-1.95)	0.39	0.67 (0.41-1.08)	0.10	0.42 (0.23-0.75)	0.00	0.52 (0.29-0.93)	0.03	0.90 (0.55-1.48)	0.68
Number of previous pregnancies										
None	1.00		1.00		1.00		1.00		1.00	
1	1.13 (0.86-1.49)	0.38	1.07 (0.81-1.43)	0.62	1.43 (0.53-0.92)	0.15	1.00 (0.67-1.48)	0.99	1.18 (0.89-1.57)	0.26
2-4	0.97 (0.65-1.45)	0.89	1.27 (0.84-1.90)	0.25	2.11 (0.40-0.81)	0.02	1.42 (0.83-2.42)	0.20	1.09 (0.71-1.68)	0.70
≥5	1.27 (0.75-2.16)	0.37	1.32 (0.78-2.25)	0.30	1.12 (0.23-0.75)	0.79	1.27 (0.64-2.53)	0.49	1.14 (0.63-2.06)	0.67
Adverse outcome										
Mother	1.69 (0.87-3.26)	0.12	2.34 (1.17-4.68)	0.02	2.95 (1.46-5.96)	0.00	2.77 (1.41-5.46)	0.00	4.72 (1.42-15.73)	0.01
Baby	0.54 (0.28-1.07)	0.08	1.20 (0.64-2.25)	0.58	1.76 (0.86-3.60)	0.12	0.83 (0.39-1.76)	0.62	0.68 (0.34-1.39)	0.30

6.6 Chapter summary in relation to literature

In this chapter, several factors were explored to assess any association between socio-demographic considerations and poor outcomes in a previous pregnancy and types of maternal morbidity. Commonly, in many national demographic health surveys age, educational level, rural/urban residence status, marital status, and education, employment, and household wealth are assessed as factors that are considered to have an association with health and/or ill-health. There have been many studies that have assessed factors associated with maternal mortality and SAMM. For example, women with severe obstetric complications were poorer and less educated than were women with an uncomplicated childbirth in Burkina Faso (Filipp 2007). However, there is a lack of studies that have measured two or more types of morbidity as a summative measure, and assessed any socio-demographics factors with non-severe types of maternal morbidity.

Age

From a clinical perspective, the “extremes of ages”, those that are “too young or too old” are often considered “high risk” for morbidity, especially medical/obstetric morbidity (for example hypertension and/or pre-eclampsia) but this was not the main finding in this PhD study. In this PhD study, there were associations between age and different types of morbidity across three of the four LMIC settings, but the direction and strength of association were not consistent and this was an unexpected finding. As age increased women were more likely to report social morbidity in India and Malawi; were more likely to have infectious morbidity in India; These findings may be context specific and/or may be because an increase in age represents an increased exposure time to factors that contribute to different types of morbidity (for example, domestic violence, sexually transmitted infections. It is noted that as age increased women were more likely to report psychological morbidity in Kenya; but less likely to report psychological morbidity in Malawi. The reasons for these associations may be due to a difference in women’s understanding, perception and ability to disclose

psychological morbidity due to different cultures contexts but this requires further research.

SES

In this PhD study, there were associations between SES and three types of morbidity across three of the LMIC settings, but the direction and strength of association were not consistent. This was a surprising finding. It was expected in this study that as SES increased across all four LMIC settings, maternal ill-health would decrease. This reasons for this association were thought to be that as SES increased more women access care and afford treatments. This was the case in two settings, whereas SES increased women were less likely to report social and psychological morbidity in Pakistan; and less likely to report medical/obstetric and psychological morbidity in Kenya. However, as SES increased, women were more likely to have medical/obstetric, and report psychological and social morbidity in Malawi; and were more likely to have infectious morbidity in Pakistan. The reasons for the different associations between SES and different morbidities require further research. It is further noted that SES is a challenging indicator to measure across different LMIC settings. Hence these results need to be interpreted with caution. There is also a need for an international agreed gold standard approach to the measurement of SES across LMIC settings.

Education level

It is often suggested that as educational level increases, women's health should increase (Hahn 2015). However, as women's awareness and health seeking decision making increases, and women may have less morbidity (because they access care) or more morbidity (as detection increases due to health seeking behaviour). In this PhD study, there were associations between educational level and three types of morbidity across all four LMIC settings, but the direction and strength of association were not consistent. This was an unexpected finding. As educational level increased, women were more likely to report medical/obstetric morbidity in India; and more likely to report social morbidity in Pakistan. This may be due to women having more

confidence and understanding to know and report what is “normal” health and what is “abnormal” health during and after pregnancy. Conversely, as educational level increased, women were less likely to report medical/obstetric morbidity in Pakistan; less likely to report social morbidity in India; and less likely to report psychological morbidity in Kenya and Malawi. These reasons for these associations in these contexts require further research.

Number of previous pregnancies

It is often considered that the more pregnancies a woman has, the more morbidity a woman will “accumulate”, as each pregnancy can pose “risks” to the woman. This is not necessarily the case as suggested by the findings of this study, whereas the number of previous pregnancies increased in women in Pakistan, women were less likely to be diagnosed with medical/obstetric and infectious morbidity. However, women were more likely to report psychological morbidity in India and Malawi as the number of pregnancies increased and this may be due to the pressures and responsibilities associated with caring for more children. Conversely, as the number of pregnancies increased women were less likely to report psychological morbidity in Kenya. The reasons for these associations require further research.

Previous adverse outcomes for the mother

As part of a full systematic clinical consultation, women are asked regarding their previous obstetric history, as it is clinically considered that if a woman has had a previous adverse outcome, she would be at higher risk of having an adverse outcome in this pregnancy. The findings of this PhD support the direction of this assumption. Compared to women with no previous adverse outcomes for the mother, women with previous adverse outcomes were more likely to report medical/obstetric morbidity in India, Pakistan and Kenya; more likely to report psychological morbidity in Pakistan and Malawi; more likely to report infectious morbidity in Pakistan and more likely to report social morbidity in India and Pakistan. These findings would suggest that a previous adverse maternal outcome could have a significant impact on

the morbidity a woman may experience in future pregnancies; and all women should be asked regarding their previous obstetric history to help “alert” healthcare providers to possible morbidity in any other pregnancy.

Previous adverse outcome for the newborn baby

Similar to previous adverse outcomes for the newborn baby, as part of a full systematic clinical consultation, women are asked regarding any complications with their newborn babies in their previous obstetric history, as it is clinically considered that if a woman has had a previous adverse outcome in her newborn, she would be at higher risk of having a neonatal adverse outcome in this pregnancy.

Compared to women with no previous adverse outcomes for the newborn, women with previous adverse outcomes in the newborn were more likely to report medical/obstetric morbidity in Pakistan and Kenya; and more likely to report psychological, social and infectious morbidity in Pakistan. As highlighted above, these findings would also suggest that a previous adverse neonatal outcome could have a significant impact on the morbidity a woman may experience in future pregnancies; and that all women should be asked regarding the outcomes of their most recent pregnancy to help “alert” healthcare providers to possible morbidity in any other pregnancy. The reason why this association is significant in some settings and not in other settings requires further research.

Further reflections of the main findings from this chapter in relation to other literature are given in the discussion chapter of this thesis.

CHAPTER 7: RESULTS FOUR

7.1 Introduction

This is the last chapter that report on the results of this research project. The four results chapters are structured in sequence to address each main research question. For the purposes of this thesis, results for the study settings are presented per country in the following sequence: India, Pakistan, Kenya and Malawi. Where appropriate, results are presented as a combined study population.

In this chapter, associations between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity are described per country. Results are presented in a narrative text accompanied by tables and figures. Where supplementary information is necessary, this is presented in the appendices.

7.2 Background

There were four research questions.

Table 7.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?

4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?
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In this chapter, results are presented to address the research question: “Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?”

Table 7.2: Definitions of types of morbidities

PHYSICAL MORBIDITY		NON-PHYSICAL	
Medical/obstetric	Infectious	Psychological morbidity	Social morbidity
<ul style="list-style-type: none"> • Anaemia • Hypertension • Pre-eclampsia • Antenatal haemorrhage • Urinary incontinence 	<ul style="list-style-type: none"> • HIV • Malaria • Syphilis • Possible chest infection/TB • SIRS score of ≥ 2 	<ul style="list-style-type: none"> • EDPS ≥ 10 and/or • thoughts of self-harm 	<ul style="list-style-type: none"> • Any domestic violence (HITS score >4) and/or • Any substance misuse

Summary of methodology for analysis

For each country, strength of associations of all the different types of interactions between the four different types of morbidities were explored using a loglinear model. For each country, the full model was fitted using all main effects of the four morbidities and for all the possible interactions. Terms which were not statistically significant at the 5% level were then eliminated from the model to identify the simplest sub-model which was not a significantly poorer fit. In the final set of analyses only two-way interactions were considered. Those that were not statistically significant were eliminated from the model, to identify the simplest sub-model which was not a significantly poorer fit of the model with two-way interactions only. Likelihood ratio tests were used to compare models. Statistical significance was determined using the 5% significance level. Estimated odds ratios are reported with

95% confidence interval. **Table 7.3** provides the summary of the frequency of each morbidity by country.

Table 7.3: Summary of women with maternal morbidities by country

Variable and category	India (n=2,099)		Pakistan (n=3,287)		Kenya (n=3,145)		Malawi (n=2,923)	
	n	%	n	%	n	%	n	%
Infectious	302	14.4	402	12.2	1,219	38.8	1,278	43.7
Medical/ obstetric	1,283	61.1	2,279	69.3	791	25.2	1,200	41.1
Psycho- logical	415	19.8	1,554	47.3	424	13.5	478	16.4
Social	849	40.5	1,980	60.2	787	25.0	582	19.8

There are marked differences between countries regarding prevalence of the different types of morbidity. The most notable difference is the higher prevalence of reported psychological and social morbidity in women in Pakistan; and the higher prevalence of infectious morbidity diagnosed in women in Kenya and Malawi. These results were presented in detail in Chapter 4 and 5 of this thesis.

Heterogeneity between countries

Before considering associations between maternal morbidity per country separately, the combined cohort was considered. Analysis of the data for the four countries combined, using interactions no higher than two-way, found significant evidence of heterogeneity between countries in the associations between morbidities ($X^2=5,196$, $df=30$, $p<0.001$). Therefore, no further analyses for the combined dataset were considered.

To explore the strength of associations between the different types of morbidities, all possible combinations of interactions between morbidities were assessed for each

country. **Table 7.4** tabulates the frequency distribution of each possible combination of morbidities for each country.

Table 7.4: Number of women with each combination of morbidity per country

Type of morbidity				Country			
Infectious	Medical/ obstetric	Psycho- logical	Social	India	Pakistan	Kenya	Malawi
0	0	0	0	345	345	1052	823
0	0	0	1	276	290	330	77
0	0	1	0	62	112	97	35
0	0	1	1	37	175	69	74
0	1	0	0	469	468	241	520
0	1	0	1	337	488	64	58
0	1	1	0	156	277	52	28
0	1	1	1	115	730	21	30
1	0	0	0	65	23	549	431
1	0	0	1	16	24	149	55
1	0	1	0	12	13	63	63
1	0	1	1	3	26	45	165
1	1	0	0	128	44	252	416
1	1	0	1	48	51	84	65
1	1	1	0	13	25	52	27
1	1	1	1	17	196	25	56

0 = not present

1 = present

7.3 Two-way associations between maternal morbidities per country

For each country, medical/obstetric morbidity was statistically significantly associated with psychological and infectious morbidity. These associations were all positive, with the exception that, in Malawi, the association between medical/obstetric and psychological morbidity was negative (**Table 7.5**).

India

In India, infectious morbidity was statistically significantly associated with psychological and social morbidity; these were negative associations. Women in India with infectious morbidity, were less likely to report psychological and social morbidity; OR 0.64 (0.46-0.90) p-value 0.01 and 0.52 (0.40-0.68) p-value <0.001 respectively. In India, women with medical/obstetric morbidity were more likely to report infectious and psychological morbidity; OR 1.49 (1.15-1.94) p-value 0.003 and 1.92 (1.52-2.44) p-value <0.001 respectively (**Table 7.5**).

Pakistan

In Pakistan, women with infectious morbidity more likely to have medical/obstetric OR 1.42 (1.10-1.83) p-value <0.001; and to report psychological OR 1.91 (1.52-2.39) p-value <0.001 and social morbidity OR 1.68 (1.32-2.13) p-value <0.001. In Pakistan, women with a psychological morbidity were more likely to have medical/obstetric morbidity OR 2.21 (1.88-2.59) p-value <0.001 and to report social morbidity OR 2.48 (2.13-2.88) p-value <0.001. In Pakistan, women with medical/obstetric morbidity were more likely to report social morbidity OR 1.42 (1.21-1.66) p-value <0.001 also. Overall, in Pakistan, there were significant positive associations between all pair of morbidities (**Table 7.5**).

Kenya

In Kenya, women with a medical/obstetric morbidity were more likely to report infectious OR 2.10 (1.78-2.47) p-value <0.001; and psychological morbidity OR 1.78 (1.43-2.21) p-value <0.001. In Kenya, women reporting psychological morbidity were more likely to report social morbidity also OR 2.02 (1.63-2.51) p-value <0.001 (**Table 7.5**).

Malawi

In Malawi, women with an infectious morbidity were more likely to have medical/obstetric morbidity OR 1.38 (1.18-1.61) p-value <0.001; and to report psychological OR 2.45 (1.95-3.11) <0.001 and social morbidity OR 1.43 (1.15-1.78) p-value 0.001. In Malawi, women with medical/obstetric morbidity were less likely to report psychological morbidity OR 0.50 (0.40-0.62) p-value <0.001 (**Table 7.5**).

All associations between morbidities when two-way interactions were considered are summarised in (**Table 7.5**).

Table 7.5: Estimated odds ratios and p-values for selected models using only two-way interactions, per country

Interaction between different types of morbidity	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)	
	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)	p-value
Infectious* medical/obstetric	1.49 (1.15-1.94)	0.003	1.42 (1.10-1.83)	<0.001	2.10 (1.78-2.47)	<0.001	1.38 (1.18-1.61)	<0.001
Infectious* psychological	0.64 (0.46-0.90)	0.01	1.91 (1.52-2.39)	<0.001			2.45 (1.95-3.11)	<0.001
Infectious* Social	0.52 (0.40-0.68)	<0.001	1.68 (1.32-2.13)	<0.001			1.43 (1.15-1.78)	0.001
Medical/obstetric* psychological	1.92 (1.52-2.44)	<0.001	2.21 (1.88-2.59)	<0.001	1.78 (1.43-2.21)	<0.001	0.50 (0.40-0.62)	<0.001
Medical/obstetric* Social			1.42 (1.21-1.66)	<0.001				
Psychological * Social			2.48 (2.13-2.88)	<0.001	2.02 (1.63-2.51)	<0.001	16.9 (13.4-21.4)	<0.001
<u>Comparison with full model</u>								
χ^2	0.06	0.97			2.99	0.39	0.00	0.95
df	1		0	3	1			

7.4 Three-way associations between maternal morbidities per country

India

In India, for women who report psychological morbidity, the strength of the association between infectious and medical/obstetric morbidity is less (OR 0.39 (0.18-0.80) p-value 0.01); compared to women who do not report psychological morbidity. Similarly, in women with infectious morbidity, the strength of the association between medical/obstetric and psychological morbidity is less (OR 0.39 (0.18-0.80) p-value 0.01); compared to women who do not have infectious morbidity.

In India, for women who report social morbidity, the strength of the association between infectious and medical/obstetric morbidity is more (OR 2.03 (1.09-3.77) p-value 0.03); compared to women who do not report social morbidity. Similarly, in women with infectious morbidity, the strength of the association between medical/obstetric and social morbidity is more (OR 2.03 (1.09-3.77) p-value 0.03); compared to women who do not report infectious morbidity. In India, for women who report social morbidity, the strength of the association between infectious and psychological morbidity is more (OR 2.66 (1.32-5.35) p-value 0.006); compared to women who do not report social morbidity. Similarly, in women who report infectious morbidity, the strength of the association between psychological and social morbidity is more (OR 2.66 (1.32-5.35) p-value 0.006) compared to women who do not have infectious morbidity (**Table 7.6**)

Pakistan

In Pakistan, for women who report social morbidity, the strength of the association between infectious and psychological morbidity is more (OR 2.11 (1.28-3.48) p-value 0.004); compared to women who do not report social morbidity. Similarly, in women with infectious morbidity, the strength of the association between psychological and social morbidity is more (OR 2.11 (1.28-3.48) p-value 0.004) compared to women who do not have infectious morbidity. In Pakistan, for women who report psychological

morbidity, the strength of the association between medical/obstetric and social morbidity is more (OR 1.50 (1.09-2.07) p-value 0.014); compared to women who do not report psychological morbidity. Similarly, in women with medical/obstetric morbidity, the strength of the association between psychological and social morbidity is more (OR 1.50 (1.09-2.07) p-value 0.014); compared to women who do not report medical/obstetric morbidity (**Table 7.6**)

Kenya

In Kenya, there were no associations between three-way interactions of the different types of maternal morbidities.

Malawi

In Malawi, for women who report psychological morbidity, the strength of the association between infectious and medical/obstetric morbidity is less (OR 0.46 (0.30-0.72) p-value 0.001); compared to women who do not report psychological morbidity. Similarly, in women who report medical/obstetric morbidity, the strength of the association between psychological and infectious morbidity is less (OR 0.46 (0.30-0.72) p-value 0.001); compared to women who do not report medical/obstetric morbidity. In Malawi, for women who report social morbidity, the strength of the association between medical/obstetric and psychological morbidity is less (OR 0.55 (0.33-0.89) p-value 0.02); compared to women who do not report social morbidity. Similarly, in women with medical/obstetric morbidity, the strength of the association between psychological and social morbidity is less (OR 0.55 (0.33-0.89) p-value 0.02); compared to women who do not have infectious morbidity.

When higher order interactions were considered for inclusion in models fitted, at least two of the three-way interactions were found to be statistically significant in each of India, Pakistan and Malawi (**Table 7.6**). By contrast, for Kenya, no higher order interactions statistically significantly improved the fit of the model. For India, the statistically significant three-way interactions were the three which include infectious

morbidity. For Pakistan, the two statistically significant three-way interactions involved both psychological and social morbidity. For Malawi, the two statistically significant three-way interactions involved both medical/obstetric and psychological morbidity (**Table 7.6**)

Table 7.6: Estimated odds ratios and p-values for selected models using two- and three-way interactions, per country^a

Interactions	India (n=2099)		Pakistan (n=3287)		Kenya (n=3145)		Malawi (n=2923)		All countries combined	
	OR (95% CI)	p-value								
Infectious*medical/obstetric	1.41 (1.02-1.94)	0.03	1.40 (1.08-1.81)	0.01	2.10 (1.78-2.47)	<0.001	1.53 (1.30-1.80)	<0.001	1.16 (1.05-1.27)	0.003
Infectious*psychological	0.90 (0.48-1.70)	0.74	1.14 (0.75-1.73)	0.54			3.17 (2.38-4.21)	<0.001	1.16 (0.97-1.38)	0.11
Infectious*social	0.27 (0.15-0.46)	<0.001	1.15 (0.82-1.62)	0.42			1.40 (1.12-1.74)	0.003	0.56 (0.50-0.63)	<0.001
Medical/obstetric*psychological	2.11 (1.64-2.71)	<0.001	1.73 (1.35-2.22)	<0.001	1.78 (1.43-2.21)	<0.001	1.09 (0.72-1.65)	0.69	2.57 (2.31-2.87)	<0.001
Medical/obstetric*social	0.95 (0.78-1.15)	0.58	1.23 (1.01-1.49)	0.04			1.21 (0.93-1.56)	0.16	1.45 (1.34-1.58)	<0.001
Psychological *social	0.93 (0.74-1.18)	0.57	1.73 (1.31-2.27)	<0.001	2.02 (1.63-2.51)	<0.001	21.1 (15.6-28.5)	<0.001	3.11 (2.80-3.46)	<0.001
Infectious*medical/obstetric*psychological	0.39 (0.18-0.80)	0.01					0.46 (0.30-0.72)	0.001	0.42 (0.34-0.50)	<0.001
Infectious*medical/obstetric*social	2.03 (1.09-3.77)	0.03								
Infectious*psychological *social	2.66 (1.32-5.35)	0.006	2.11 (1.28-3.48)	0.004					2.46 (2.00-3.03)	<0.001
Medical/obstetric*Psychological*social			1.50 (1.09-2.07)	0.014			0.55 (0.33-0.89)	0.02		
Comparison with full model ^b										
X ²	3.97	0.14	4.02	0.26	12.08	0.15	1.11	0.78	1.87	0.60
df	2		3		8		3		3	
Comparison with model selected using only two-way interactions										
X ²	17.28	0.004	15.45	<0.001			18.83	<0.001		
df	5		2		0		3			

7.5 Chapter summary

In this chapter associations between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity have been presented.

Summary box	
Country	Two-way associations with different types of morbidity
India	Women with an infectious morbidity, were less likely to report psychological and social morbidity. Women with a medical/obstetric morbidity, were more likely to report infectious and psychological morbidity.
Pakistan	Women with an infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity. Women with a psychological morbidity were more likely to report medical/obstetric morbidity and social morbidity. Women reporting medical/obstetric morbidity were more likely to report social morbidity also.
Kenya	Women with a medical/obstetric morbidity were more likely to report infectious morbidity and psychological morbidity. Women reporting psychological morbidity were more likely to report social morbidity also.
Malawi	Women with an infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity. Women with a medical/obstetric morbidity were less likely to report psychological morbidity.

7.6 Chapter summary in relation to literature

In this study, women with infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity in Pakistan, and Malawi; but less likely to report psychological and social morbidity in India. In other studies, that have measured two or more types of morbidity, a positive HIV status (infectious morbidity) was associated with domestic violence (social morbidity) in Zimbabwe (Shamu 2014); and other infectious morbidity was associated with psychological morbidity in Malawi and Pakistan (Zafar 2015).

Similarly, women with medical/obstetric morbidity were more likely to report infectious and psychological morbidity in India and Kenya and more likely to report social morbidity in Pakistan; but less likely to report psychological morbidity in Malawi. In other studies, that have measured two or more types of morbidity, all postpartum illnesses (infectious and medical/obstetric) were associated with an increased relative risk of psychological morbidity at 6 months postpartum in Bangladesh (Surkan 2017); and obstetric complications were independently associated with common mental disorders during pregnancy in Brazil (Faisal-Cury 2010). Complications during a previous pregnancy and/or intra or postpartum haemorrhage were associated with psychological morbidity in Malawi and Pakistan (Zafar 2015). A significant association between medical/obstetric morbidity (preterm labour, Caesarean section, antenatal hospitalization and vaginal bleeding) and social morbidity (domestic violence) was reported in pregnant women in Iran (Hassan 2014). Romero-Gutiérrez et al reported that women who had obstetric complications were more likely to have experienced domestic violence (social morbidity) in the postpartum stage of pregnancy in Mexico (Romero-Gutiérrez 2011).

In this PhD study, women with psychological morbidity were more likely to report social morbidity in Pakistan and Kenya; and more likely to report medical/obstetric morbidity in Pakistan. Several studies that have assessed two or more types of maternal morbidity report associations between psychological and social morbidity.

Partner violence (social morbidity) had strong associations with depression and anxiety (psychological morbidity) in pregnant women in Bangladesh (Nasreen 2011). Pregnant women who reported four or more traumatic events, and either physical abuse alone or in combination with severe psychological abuse, had a 10-fold increase in depressive and other mental health symptoms in Timor-Leste (Rees 2016). Intimate partner violence intensity had a strong and statistically significant association with depression symptom severity in pregnant women in South Africa (Tsai 2016).

These findings, in keeping with the PhD study results, would suggest that different components of morbidity /components of ill-health may be inter-related or inter-linked to other types of morbidity or ill-health in women during and after pregnancy. It is often suggested in a clinical setting, that co-morbidities exist together. That is, if a woman has one type of illness during and after pregnancy, she is often considered to be at higher risk for other ill-health. For example, women with diabetes tend to have more infections. It can be difficult to fully understand the relationship, if any, between different types of morbidity and whether any association is simply an overlap of ill-health or related to causality. This study has provided for the first time an exploration of associations between infectious, medical/obstetric, psychological and social morbidity. The reasons for the different directions in association, across the different LMIC settings require further research.

Further reflections of the main findings from this chapter in relation to other literature are given in the discussion chapter of this thesis.

CHAPTER 8: DISCUSSION

8.1 Introduction

In this chapter, the main results of the research project are discussed. This chapter begins with an overview of the structure of the chapter and the principal findings of the research project. Each research question is then considered for each category of type of maternal morbidity as a combined cohort (where feasible). The strengths and weaknesses of this research project are discussed; and main findings are compared to other studies and any differences in results are discussed. This chapter then describes the overall meaning of the study, and the implications for clinical practice. Recommendations are given and key future research priorities are suggested. The chapter ends with a summary conclusion.

This research project has assessed maternal morbidity using a new assessment tool to determine the prevalence of and/or associations between four different types of maternal morbidity, at five assessment stages, during and after pregnancy, in 11454 women across different settings in four LMIC: India, Pakistan, Kenya and Malawi.

There are several possible approaches to the discussion of this research project; for example, main findings could be discussed per research question, or per type of maternal morbidity, or per country, or as a combined cohort. Findings could be compared between the study countries individually or discussed as a combined study population. For ease of readability and understanding, main findings are discussed as a combined cohort (where feasible) and the discussion chapter is structured in sections in the following way recommended for scientific papers (Doherty 1998).

Statement of principal findings

This section presents the main results of the research study, structured in sequence to address each key research question.

Strengths and weaknesses of the study

This section considers the strengths and weaknesses of the research study. This section also discusses the limitations of the research project in terms of study design, study settings, study population and sampling. The data collection tool, the process of data collection, cleaning, coding and analysis is critiqued. Finally, the quality of the data and the ethical issues relevant to the research project are discussed.

Relationship of main findings to other studies

This section compares the main findings of this research project to other studies that have measured the prevalence of and/or associations between two or more different types of maternal morbidity during and after pregnancy in women in LMIC. Similarities and differences of the main findings per type of maternal morbidity are interpreted in relation to the findings of other studies.

Implications for clinicians and policymakers

This section presents the meaning of the study and implications for clinicians and policy makers are given.

Recommendations

This section describes recommendations for clinical practice and for future research are described. A conclusion is at the end of the chapter.

8.2 Background

This is the first study to assess maternal morbidity using an integrated comprehensive approach to assess self-reported physical, psychological, and social ill-health, in combination with objective clinical and laboratory measurements in women during and after pregnancy across four LMIC. This multi-country study assessed maternal morbidity in 11454 women and provides baseline measurements of maternal morbidity that have been calculated using standardised methodology, enabling comparisons between different settings and countries. Non-severe maternal morbidity is a new concept internationally and this study addressed an important topic that to date has been poorly documented. Maternal morbidity represents a significant burden of ill-health for women during and after pregnancy.

Research questions

In this study, there were four research questions.

Table 8.1: Research questions for the study

Number	Research question
1.	What is the prevalence of maternal morbidity and what types of ill-health (assessed by symptoms, signs and investigations) contribute to maternal morbidity?
2.	What is the prevalence of maternal morbidity at different stages of pregnancy?
3.	Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?
4.	Is there an association between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?

8.3 Main findings

Research question one

Research question one was “What is the prevalence of maternal morbidity and what types of ill-health (symptoms, signs and investigations) contribute to maternal morbidity?”

In this study, 11454 women across four LMICs were assessed (India (2099), Malawi (2923), Kenya (3145), and Pakistan (3287)) with similar numbers of women assessed at each of the five stages of pregnancy. Despite most women reporting good quality of life (75.9%) and satisfaction with health (78.2%), almost three out of four women reported symptoms (73.5%), had abnormal findings on clinical examination (71.3%) or on simple laboratory investigation (73.5%).

Overall, 27.9% of women were diagnosed with an infectious morbidity; and 48.5% were diagnosed with a medical/obstetric morbidity. Therefore, overall, 76.4% of women had at least one type of physical morbidity.

Overall, 25.1% of women had psychological morbidity on screening with very high prevalence of domestic violence, particularly in Pakistan (47.3% of women). Overall, more than 1 in 3 women (36.6%) reported social morbidity, with 15.6% of women reporting both psychological and social morbidity.

Overall, most women (77.1%) had at least one type of identifiable morbidity and a very small number of women (1.2%) suffered from all four types of morbidity which suggests that morbidity is not limited to a core “at risk” group of women.

Women in Pakistan reported more symptoms of higher severity and were diagnosed with more physical morbidity and reported more psychological and social morbidity. Of all women tested, 47.4% of women were anaemic with the highest prevalence among women in Pakistan and India (67.7% and 60.4% of women respectively). Overall, using the amended SIRS score of ≥ 2 , 23.1% of women had clinical signs of

possible early infection. Of these women, 43.0% had an identifiable source of infection, more commonly gastrointestinal and lower respiratory tract infection. The prevalence of HIV, malaria, and syphilis was below 5% in all settings except Malawi.

Research question two

Research question two was “What is the prevalence of maternal morbidity at different stages of pregnancy?”

In this study, overall and per country, 25% of women had at least one type of maternal morbidity across the five stages of pregnancy; and slightly more women reported or were diagnosed with more maternal morbidity in the late antenatal stage, compared to the other four assessment stages.

For each type of morbidity, there were similar prevalence across the continuum of pregnancy, with the overall highest percentage of women with different types of maternal morbidity in the late antenatal stage. There was however, a significant burden of maternal morbidity across all five stages of pregnancy, highlighting that there is not just one “at risk” stage for ill-health. This trend was similar across all the four LMIC.

Research question three

Research question three was “Is there an association between the different types of maternal morbidity and age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy?”

In this study, on multivariate analysis, age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy were not associated with the same type of maternal morbidity across all four LMIC. Different factors were associated with different types

of morbidity per country but there was no consistent direction of strength of association. Overall, more factors were associated with all four types of morbidity in Pakistan.

Research question four

Research question four was “Are there any associations between the different types of morbidity, defined as infectious, medical/obstetric, psychological and social morbidity?”

In this study, there were associations between the different types of morbidity and these associations varied between the countries. For each country, women with medical/obstetric morbidity was more likely to report psychological and infectious morbidity. These associations were all positive, with the exception that, in Malawi, the association between medical/obstetric and psychological morbidity was negative. Women with an infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity in both Pakistan and Malawi. Women with psychological morbidity were more likely to report social morbidity in Pakistan and Kenya.

These findings suggest that the different components of maternal morbidity (physical, psychological and social aspects) are inter-linked and have an influence on the other components of health. However, the strength of the association between the different types of morbidity vary across settings.

8.4 Strengths and limitations of the study

In this section of the chapter the main strengths of the study are described. The limitations of the study are discussed with regards to the study design, study settings, study population, inclusion and exclusion criteria, and sampling procedure. The data collection tool used in this study is critiqued and suggestions for how to improve the data collection tool are discussed. The limitations of the categorisations of types of maternal morbidity are discussed.

8.4.1 Strengths of the study

This is the first study to assess maternal morbidity during and after pregnancy using an integrated comprehensive tool to provide primary data of self-reported physical, psychological, and social ill-health in combination with objective clinical and laboratory measurements performed by trained healthcare providers across different types of healthcare facilities in 11454 women in four different LMIC. This study provides new estimates of the prevalence of maternal morbidity during and after pregnancy, up to 12 weeks after birth.

In this study, women's reported signs and symptoms were triangulated with clinical examination and diagnostic tests that are expected to be available in the antenatal and postnatal care clinics in LMIC. The data collection tool used in this study for the identification of maternal morbidity was found to be easy to apply and acceptable at both primary and secondary care settings across the four LMIC, enabling more robust diagnosis of maternal morbidity. This study, includes both subjective (self-reported symptoms) and objective measures (examination and investigations) performed by trained healthcare providers, thus helping document as well as "validate" which areas of ill-health are considered important by women themselves (because they report the symptoms) as well as morbidity that can be "diagnosed" by a healthcare provider.

8.4.2 Limitations of the study

Study design

This was an observational cross-sectional study and it was not possible to assess if maternal morbidity at one assessment stage of the pregnancy, was related to any adverse maternal or neonatal outcomes or ill-health during other stages of the pregnancy. It would be beneficial to conduct a prospective longitudinal cohort study, to assess the effect on pregnancy outcomes and change in health (if any) over the continuum of pregnancy.

Study settings

The study was conducted in multiple countries, which enabled comparison between settings. The selection of countries was both purposeful and opportunistic and included two countries from sub-Saharan Africa (Kenya and Malawi) and two from South East Asia (India and Pakistan). These countries were chosen to reflect the epidemiology of HIV, tuberculosis and malaria that are likely to be very different in sub-Saharan Africa compared to South East Asia. These four countries are not considered representative of LMIC in general and further research is needed to explore maternal morbidity in other settings.

In this study, overall more women were assessed in a secondary (66.7%) compared to primary level (33.3%) healthcare facility. It is noted that this could represent a selection bias and that women who attend a secondary level healthcare facility may have been aware that they had more maternal morbidity and therefore sought higher level care, compared to women who choose to attend a primary healthcare level facility.

In Pakistan, Kenya and Malawi several healthcare facilities were included across different regions, at both primary and secondary healthcare facility level. All the study population in India was recruited from one large public secondary level healthcare facility and hence there was no representation of women from a primary healthcare facility in India, and this study population is unlikely to be representative of other areas in the region.

Sampling procedure

This study used purposive sampling that represents convenience samples as opposed to population samples from a representative framework and hence is limited in terms of the sections of the population it represents. Furthermore, the sampling was not proportionated to population size. However, the aim of this study was not to conduct a study that was representative of the population of each country. This was a pragmatic study to assess the health needs of women accessing routine care, with a

large sample size and statistical power to detect common conditions including those with an expected prevalence of up to 5%.

Study population

This study population included women during or after pregnancy who sought care and attended for antenatal, intrapartum or postnatal care in public primary or secondary level healthcare facilities across the four LMIC.

With regard to healthcare coverage and uptake, globally, the proportion of women who attend for at least one ANC visit is 83%. Compared to the global estimate, a smaller proportion of women attend for at least one ANC visit in India (75%) and Pakistan (73%); and a larger proportion of women attend for at least one ANC visit in Kenya (92%) and in Malawi (96%) (WHO 2016c). For skilled attendance at birth (or institutional delivery) globally, the estimate is 78%. Compared to the global estimate, a smaller proportion of women have skilled birth attendance in Pakistan (52%) and Kenya (62%), compared to India (81%) and Malawi (90%) (WHO 2016c).

In this PhD study, overall, more women were recruited from a secondary, compared to a primary level healthcare facility and this may have resulted in a higher prevalence of morbidity in women, who may have sought care because they were unwell or had current complications due to pregnancy or childbirth. This study excludes women who did not seek care, who are based in the community setting and who may have a different perspective and burden of maternal morbidity. Thus, the prevalence of morbidity could be expected to be higher (for women who are ill but not able to access care) or lower (for women who feel well and do not see the need to access care). Most women were recruited from the outpatient clinics and the proportion of women who were inpatients at the time of assessment were less than 10% in each country setting. Of the antenatal women, most were inpatients waiting delivery by elective Caesarean section or induction of labour. Of the postnatal women, most

were interviewed as inpatients prior to routine discharge. Neither of these groups of women were severely ill and all met the inclusion criteria of the study.

Inclusion and exclusion criteria

To include women who might be attending for “routine care”, the inclusion criteria were broad and only women who had an impaired consciousness level due to a possible SAMM were excluded. Women were not specifically screened to identify SAMM and therefore there may have been some women with SAMM in this study. For example, a woman who had a massive obstetric haemorrhage at delivery may have been recruited to the study whilst on the postnatal ward a few days later, and she may have been reporting symptoms related to the previous SAMM adverse event. Women with SAMM are generally only included in the group assessed within 24 hours of delivery. However, it would have been beneficial to have had stricter exclusion criteria for this group.

8.4.3 Limitations of the data collection tool

The data collection tool used (**Appendix 6**) was a comprehensive tool with nine different sections and had been submitted to peer review including by all members of the WHO maternal morbidity working group as well as key stakeholders in each study country before use. This gave many opportunities to improve the tool to ensure that the tool was inclusive, applicable and considered feasible to administer. In this study, the full questionnaire took up to one hour to complete via a face-to-face interview, clinical examination and investigations. For further use in both a clinical and research capacity, it could be beneficial if this tool was shortened.

In the following sections, the limitations of and suggested improvements to the data collection tool are described, including the measurement of SES; the descriptions and severity scale of adverse maternal and neonatal outcomes; how to assess symptoms; measurement of psychological morbidity; time-frame over which women are asked to recall morbidity; what examinations are conducted; and what further investigations could be included.

Measurement of socioeconomic status

In this study, women's SES was assessed. However, SES is a complex factor and there is no standardised international way to measure SES across different LMIC. In this study, for Malawi and Kenya, principal component analysis was conducted to develop an amended wealth index with items from the DHS of each country. This was a relative measure of SES useful to categorise women but was not an absolute measure of wealth. It would be beneficial to have an internationally agreed comparable measure of SES across the different LMIC settings.

Adverse maternal or neonatal outcomes

In retrospect, the data collection tool included too many questions regarding previous pregnancies and outcomes including: number of all previous pregnancies, details of each pregnancy and adverse events for each pregnancy by each woman. This section could be shortened to include only the most recent pregnancy recalled and reported. In addition, the list of "adverse maternal outcomes" did not specify all possible adverse maternal outcomes that can occur during and/or after pregnancy, and did not differentiate regarding severity of adverse outcome (for example, severe uterine inversion compared to simple episiotomy wound infection). Similarly, for "previous neonatal adverse outcomes", not all possible neonatal adverse outcomes were specified, nor was there any assessment of the severity of adverse outcome (for example, stillbirth compared to newborn eye infection). To improve the data collection tool, it would be beneficial to have a comprehensive reference list for both maternal and neonatal adverse outcomes that are important to document with an accompanying severity scale. This reference list would be best placed as an appendix in a paper questionnaire or as a drop-down menu when using electronic data collection.

Measurement of symptoms

The data collection tool used in this study included a full systematic screening of physical symptoms using a total of 76 questions. The severity of each symptom was assessed on a scale of how much each symptom bothered the woman. For ease of flow of the questioning, it would be beneficial to re-categorise the sections into the groups described in the results section of this study, that is: cardiopulmonary, gastrointestinal, musculoskeletal, uro-gynaecology, obstetric and breast, and miscellaneous (dermatology, endocrine, neurological, immunology, ear-nose-throat).

Three symptoms were asked in a similar way and in the end, one question would have been sufficient. In this study, it was not possible to estimate the prevalence of women with postpartum haemorrhage accurately, as women were not able to “recall” or quantify their bleeding after birth. It is well recognised that visual estimation of bleeding is often an under-estimate, both from the women’s and the healthcare provider’s perspective (Prata 2010). Nevertheless, as postpartum haemorrhage is one of the major causes of maternal mortality and SAMM, it would be beneficial to introduce more questions that help women and healthcare providers better quantify bleeding after childbirth, in order to estimate the prevalence of maternal morbidity related to postpartum haemorrhage.

Measurement of psychological health

The data collection tool used the EPDS to measure psychological morbidity. The EPDS is easy to administer and has proven to be an effective screening tool, and has been previously been validated in 12 countries in 14 languages (Gibson 2009). However, a systematic review conducted in 2016 has indicated that current available Local Language Versions of the Edinburgh Postnatal Depression scales (LLV-EPDS) used in LMIC have some deficiencies in translation, cultural adaptation and validation processes (Shrestha 2016). This is a limitation of the EPDS, but there is an absence of a clear validated alternative questionnaire at present. In a clinical setting, it would be beneficial to use a shortened version of the EPDS; for example, using fewer questions compared to the ten questions in the current full version (Choi 2012).

Standardised timeframe required for recall of morbidity

In the data collection tool, four questions from the ASSIST questionnaire were embedded in the data collection tool to assess substance use; and the HITs questionnaire was used to assess domestic violence from the husband/partner and/or family. For both the ASSIST and HIT questions, the standard timeframe women were asked to consider was “in the past three months”. The questions from the WHO QOL SRPB questionnaire also asked women to reflect and report on their quality of life and satisfaction with health “over the past three months.” The EDPS questions asked women to report how they felt “over the past seven days.” It would be beneficial to have a more concise and standardised timeframe over which to ask women to self-report measure all types of maternal morbidity (physical, psychological and social) as a more accurate measure, for example “in the past seven days”.

Investigations

Not all possible morbidities, that could potentially have a negative impact on the woman, were included in the investigations; for example, assessment of gestational diabetes mellitus was not included in the data collection tool. Screening all women for gestational diabetes mellitus was considered, but at present there is no international consensus on how to do this as a one-point consultation for women who are pregnant. The gold standard to screen for gestational diabetes mellitus is an oral glucose tolerance test if a woman has at least one risk factor for gestational diabetes mellitus. This test requires preparation (fasting the night before the test) and takes on average three hours to perform and obtain results (NICE 2016).

Investigations for important causes of infectious morbidity for example, tuberculosis and hepatitis B were also not included in this data collection tool. A more comprehensive list of investigations could be included if affordable and rapid diagnostic tests for these conditions were available in endemic areas in LMIC settings (WHO 2013b, Khuroo 2014).

8.4.4 Data management

Quality assurance

Every effort was made to ensure all research assistants were trained, collected data and were supervised in a standardised way across all settings in all four LMIC. The competence of the research assistant as a healthcare provider may have influenced the reporting of findings detected on clinical examination; for example, doctors may be more experienced and skilled to conduct a more thorough clinical examination (including speculum examination), compared to nurse/midwives. However, all research assistants were also healthcare providers who were responsible for the delivery of routine antenatal and postnatal care.

Data collection process

In all four countries, the number of women recruited to the study were more than the minimum target sample size. Data was collected in batches by research assistants across the four LMIC. Towards the end of the data collection process, there was on occasion, a delay in communication regarding the number of women recruited per healthcare facility to the lead researcher based in Liverpool. Review and checking meant another slight delay was then encountered in relaying the information that the target size for the assessment stage for the overall country study population was achieved (or not) to the research supervisors and research assistants in each study setting. More detailed monitoring and evaluation from all in-country research supervisors would have been beneficial.

This study was the first time the research team had used electronic data collection, and there were several challenges with the implementation of this process. It was not possible to have a secure internet connection to a remote server for electronic data collection in each setting. This would have enabled instant uploading of data which would have facilitated more efficient “real time” feedback of numbers of women recruited per assessment stage. In the study, there were problems with the remote server and therefore data was sent to Liverpool using email attachments.

Once the data from both paper based and electronic data collection, was received by the research team in Liverpool, data was cleaned and coded in four separate Excel files and then merged to create one large database. It would be beneficial to have the same electronic data collection in each setting and a pre-designed large coded database set up prior to data collection, so all electronic data could be uploaded directly to this database, for a more efficient process.

Ethical considerations

There were no additional ethical concerns raised by women recruited in this study, or by research assistants or research supervisors in each study setting, compared to the ethical consideration described in the methodology chapter of this thesis.

The low refusal rate in this PhD study, indicated that women welcomed an in-depth assessment of their health including all physical, psychological and social aspects. Very few women declined examination and investigations.

No women refused to be tested for HIV. Few women received a new diagnosis of HIV this study. Many women who tested positive for HIV were aware of their status previously.

Ensuring full privacy for women during interviews and examination was a challenge in some study settings given the low resource setting and it may have been beneficial to provide screens for the research assistants in this study for further privacy for the woman.

8.5 Categorisation of maternal morbidity

Physical morbidity

To date, there is no internationally agreed categorisation system for physical morbidity. Physical morbidity can be described and measured in different ways. For example, physical morbidity can be measured by the number of symptoms reported by a woman; and/or the level of severity of the symptom as experienced by a woman; and/or a woman's perception of the negative impact of the symptom on her well-being and/or ability to function.

Physical morbidity can also be described by the number of and the severity level of abnormalities detected by a healthcare provider when performing a clinical examination and/or blood and urine testing. Or physical morbidity can be categorised only by conditions that use the findings from symptoms, signs and investigations to create a medical "diagnosis", for example pre-eclampsia.

At present, the current definition for maternal morbidity does not differentiate between ill-health from the perspective of the woman or from the perspective of the healthcare provider. It is debatable as which measurement of maternal morbidity more valid or more accurate.

In this PhD study, physical maternal morbidity was reported firstly alongside the structure of a clinical consultation taking into consideration:

- History - number and severity of symptoms
- Clinical examination- number of abnormal signs
- Investigations – number of abnormal results on blood serology and urine analysis

Secondly, reported symptoms, results of clinical examination, and laboratory investigation were combined where appropriate to determine or "diagnose" types of maternal morbidity. For the purposes of this PhD study, physical morbidity was categorised as (1) infectious or (2) medical/obstetric. Infectious physical morbidity included: HIV, malaria, syphilis, possible chest infection/suspected TB, and a SIRS score of ≥ 2 . Medical/obstetric morbidity included: anaemia, hypertension, pre-

eclampsia, antenatal haemorrhage and incontinence. Standardised international definitions for each condition were used whenever possible.

In the following section, the use of an amended SIR scale for the detection of possible early infection in this study is discussed.

Challenges in the measurement of infectious morbidity

One of the challenges to measure and describe the prevalence of infectious morbidity is the need for a standardised international definition and method to measure infection across different settings. There is often confusion regarding the definitions (and level of severity) of infection and sepsis (**Table 8.2**).

Table 8.2: Definitions of infection and sepsis

<p>Definitions</p> <p>Infection: “the invasion of an organism's body tissues by disease-causing agents, that cause pathological conditions” (Medical dictionary 2017).</p> <p>Sepsis: “infection plus systemic manifestations of infection and severe sepsis can be defined as sepsis plus sepsis-induced tissue hypo perfusion or organ dysfunction (hypotension, arterial hypoxaemia, lactic acidosis, renal failure, liver dysfunction, coagulation abnormalities, mental status changes)” (RCOG 2012).</p> <p>Septic shock: “sepsis associated with hypotension despite intravenous fluid resuscitation leading to cell dysfunction and, if prolonged, cell death” (RCOG 2012).</p> <p>Puerperal sepsis: “infection of the genital tract occurring at any time between rupture of membranes or labour and the 42nd day post-partum associated with two or more of the following: pelvic pain, fever, abnormal vaginal discharge, abnormal smell of discharge, or delay in reduction in the size of the uterus” (RCOG 2012).</p>
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The major concern with infection during and after pregnancy is that this can develop and can become very severe very quickly. If signs of possible infection are detected

and recognised early, action can be taken to prevent progression to more severe conditions. Survival rates in non-pregnant women following sepsis are related to early recognition and initiation of treatment (RCOG 2012).

Using the Systematic Inflammatory Response Syndrome

In high-income countries, for example the UK, sepsis during and after pregnancy has been of public health concern, for example, in 2015 sepsis was the main cause of maternal death in the UK (MBRRACE-UK 2016). This resulted in new public health policies and the “Surviving Sepsis” campaign to recognise “the sick woman” during and after pregnancy before undetected sepsis could progress and result in organ failure. Early warning scores included the SIRS score, alongside the Modified Obstetric Early Warning Score that have been used in a clinical setting for many years in the UK. However, there is ongoing debate regarding the parameters of SIRS for use in women during and after pregnancy. The difficult aspect of the recognition of possible early infection in pregnancy, is the differentiation of the measurements of SIRS from the normal physiological changes of pregnancy with which it overlaps.

Some researchers have argued for customized SIRS parameters for a pregnancy population. Bauer conducted a systematic review in 2014 to establish the normal maternal range in healthy pregnant women for each component of the SIRS criteria and compared these ranges with existing SIRS criteria (Bauer 2014). In this systematic review, 88 studies including 8,834 women were reviewed (Bauer 2014). Overlap with SIRS criteria occurred in healthy pregnant women during the second trimester, third trimester, and labour for each of the SIRS criteria except temperature (Bauer 2014). Bauers et al concluded that the SIRS criteria can overlap with normal physiologic parameters during pregnancy and the immediate postpartum period; thus, alternative criteria should be developed to diagnose maternal sepsis (Bauer 2014).

However, in 2016, Maguire et al examined the implications of customizing the SIRS criteria for physiologic changes of pregnancy for the diagnosis of maternal sepsis (Maguire 2016). The conclusion from this study was that in cases of confirmed maternal bacteraemia, customized SIRS criteria did not increase the rate of diagnosis

of sepsis. The recommendation is this study was that prospective studies should investigate whether the introduction of customized SIRS criteria can improve clinical outcomes. (Maguire 2016).

Using an amended SIRS score

In this PhD study, the SIRS score was amended (using CRP instead of WCC) to describe women with possible clinical signs of infection. It was not the original intention at the time of planning this study to use the SIRS as a screening tool for women who have clinical signs of possible early infection, and WCC was not measured in any woman. This was an opportunistic adaption of the SIRS score at the time of data analysis, as “triangulation” of data using this clinical algorithm, is more useful than using CRP levels or temperature measurements alone, as a measure of possible infection in women during and after pregnancy.

However, CRP has been shown to be more sensitive and specific than WCC in diagnosing infection, especially chorioamnionitis, against a background of premature prelabour rupture of membranes (Musilova 2017a); and it is also noted that during pregnancy, the maternal WBC count assessment has limited value owing to a broader range of reference values present across the trimesters than during non-pregnancy periods making the interpretation of WBC ranges difficult. WCC count has therefore not been considered as a very useful marker for infection in women during and after pregnancy (Musilova 2017a).

Some studies have compared the varying levels of CRP in response to inflammation or infection against WCC. In a study with a non-pregnant population, CRP had a higher sensitivity and specificity than white cell count and neutrophil count in the diagnosis of infection; and for every 1-mg/L increment in CRP, the risk of bacterial infection increased by 2.9% (Lui 2010). The authors concluded that CRP was a convenient and useful biomarker to predict early bacterial infection (Lui 2010). Two recent studies by the same researchers demonstrated that in a population of pregnant women with

premature prelabour rupture of membranes, WCC showed poor diagnostic indices and CRP showed much better diagnostic indices for the identification of chorioamnionitis (Musilova 2017a, Musilova 2017b). The authors conducted that WBC count at the time of admission could not serve as a non-invasive screening tool for identifying infective complications in women with premature prelabour rupture of membranes, whereas CRP could be used (Musilova 2017a, Musilova 2017b). Therefore, in the absence of a widely accepted and validated method to diagnose women with infection, an amended SIRS score was used as a pragmatic measure of women with clinical signs of possible infection in this PhD study.

Reference levels for C-Reactive Protein

In this PhD study, a raised CRP was defined as >5mg/L at each assessment stage, apart from at delivery (within 24 hours of childbirth) where “raised CRP” was defined as >10mg/L. There is currently lack of agreed reference standards on what is a normal and what is an abnormal CRP level in women at different stages of pregnancy and after childbirth; and what levels of CRP are sensitive and specific to indicate infection (Trochez-Martinez 2007).

In a non-pregnant woman, a normal CRP is 0.2–3.0 mg/L (Abbassi-Ghanavati 2009). There are no standardised ranges for a normal CRP level in a pregnant woman in the first trimester. The reported normal CRP range is wide in a pregnant female population (0.4–20.3 mg/L) in the second trimester; and the third trimester is 0.4–8.1 mg/L (Abbassi-Ghanavati 2009).

There is also lack of an agreed range regarding the level of CRP that could indicate infection, and various researchers have used different thresholds. In one study with an (non-pregnant) elderly population, a CRP cut-off value of 60 mg/L had the best combination of sensitivity and specificity in the diagnosis of bacterial infection and the CRP levels were 21.3 ± 36.0 mg/L (mean \pm SD) in the group with no infection (Lui 2010).

Most of the research that has investigated the use of CRP to diagnose infection in pregnant women has focused on complications of premature prelabour rupture of membranes, and the variation in the reported value of CRP for the diagnosis of chorioamnionitis is wide.

A recent study with a relatively large cohort of pregnant women with preterm prelabour rupture of membranes, demonstrated that chorioamnionitis was associated with higher maternal serum CRP concentrations; and the maternal serum CRP cut-off value of 17.5 mg/L was the best level to identify the presence of both microbial invasion of the amniotic cavity and/or intra-amniotic inflammation, as part of the diagnosis of chorioamnionitis (Musilova 2017a). Previous researchers used two different CRP thresholds (12 mg/L and 20 mg/L) and considered an increasing value above 12 mg/L on two consecutive estimations as highly reliable for chorioamnionitis (Nowak 1998). Other researchers have proposed using higher CRP thresholds of 30, 35 and 40 mg/L for single estimations to improve specificity but also accepted serial estimations of CRP of >20 mg/L as highly predictive of infection (Fisk 1987).

The Royal College of Obstetricians and Gynaecologists (RCOG) in the UK, recommend that a CRP >7mg/L is an abnormal parameter in pregnancy women with suspected infection (RCOG 2012). However, in this guideline, the RCOG recommend that CRP levels are not interpreted in isolation but serve as complimentary adjunct to clinical examination (RCOG 2012). It is noted that the definitions of a "raised CRP" in this PhD study used low cut-offs levels (>5mg/L and >10mg/L within 24 hours of childbirth); and this may have resulted in an over-estimation of women with possible infection. Caution in interpretation of the sensitivity and specificity of these results are required.

However, against the debate for the use of the exact criteria to use for SIRS; the use of CRP instead of WCC; and the cut-off levels for abnormal CRP levels in women during and after pregnancy, this PhD study suggests that there is a significant number of women who have possible signs of early infection. The definition and

measurement of infection and sepsis in women during and after pregnancy requires further investigation; and the use of SIRS criteria as an early warning score for possible infection in women during and after pregnancy in LMIC requires further research. Furthermore, the definite level of CRP or a “raised CRP” that could indicate definite infection in women during and after pregnancy, and especially in LMIC settings, requires further research; and the use of role of CRP instead of WCC in the SIRS criterion needs further evaluation.

Social morbidity

For the purposes of this study, social morbidity was defined as domestic violence and/or substance misuse, as these are two important screening aspects of a social history of any clinical consultation and gives healthcare providers insight into how a woman’s social circumstances may have an influence on other components of health. This definition does not include of all types of social morbidity and does not include the impact of poverty, or other social determinants of health, for example, social exclusion and lack of social support (WHO 2015d).

8.6 Discussion of main findings in relation to other studies

In this chapter so far, an overview of the study has been given and results have been summarised and interpreted in sequence and relative to each research question. The strengths and limitations of the study have been described.

In this section, the results of the study are linked to relevant research and any differences in results are discussed. For sake of readability, when referring to the findings of this research project, the term “this PhD study” is used.

To the best of the lead researcher’s knowledge, this is the first study to assess physical, psychological and social maternal morbidity at five assessment stages. Comparison between the findings of this PhD study and with the findings of other

studies is challenging, due to a lack of standardised definitions and methodology. Whilst, there are country or global estimates available for several single maternal morbidities (for example HIV, tuberculosis, malaria, anaemia), these are often based on relatively small sample sizes, non-specific regarding stage of pregnancy and/or have been defined using non-standardised, non-comparable methods.

Most studies that have measured two or more types of maternal morbidity to date have used different definitions of conditions, different data collection tools, and do not include all types of physical, psychological and social morbidity, and/or do not do so for each of the different stages.

In the following sections, for the sake of comparison, the prevalence of physical (infectious and medical/obstetric), psychological and social morbidity is compared to findings of studies that describe at least two or more maternal morbidities (as described in the systematic review chapter of this thesis) and/or the association between co-morbidities. The main findings of each results chapter have already been compared to literature in a summary at the end of the results chapters, and further interpretation and comparisons are given here also.

To compare the findings of key individual maternal morbidities, data from the World Health Statistics, international WHO documents and/or recent systematic reviews using data from LMIC are used.

In the following sections, the prevalence for each type of morbidity in this PhD study is compared against the prevalence described in the studies that were included in the systematic review of this thesis (Chapter 2). The similarities and differences in the main findings are reviewed and the reasons for the variations in the prevalence are given at the end of each section.

Perception of health

In this PhD study, despite most women reporting good quality of life (75.9%) and satisfaction with health (78.2%), almost three out of four women reported symptoms (73.5%), had abnormal findings on clinical examination (71.3%) or on simple laboratory investigation (73.5%). There is lack of published literature regarding what women consider health and ill-health to be in general, and specifically during and after pregnancy in LMIC settings. Furthermore, there is lack of literature regarding how each type of non-severe maternal morbidity affects the woman's wellbeing and/or "quality of life" and/or "satisfaction with health" and/or ability to function or complete her activities of daily living. These topics require further exploration by qualitative research, that is beyond the scope of this PhD study.

8.6.1 Physical morbidity

Physical morbidity can be described or measured in different ways: number of symptoms reported by a woman; and/or the level of severity of the symptom as experienced by a woman; and/or the number of abnormalities detected by a healthcare provider when performing a clinical examination and/or blood and urine testing; and/or by conditions that use the findings from symptoms, signs and investigations to create a medical "diagnosis". Studies included in the systematic review used a variety of means to describe physical morbidity. In the following sections, each approach is commented upon and explanation for the variations in the prevalence are given at the end of this section.

Self-reporting symptoms

The earliest reported estimate of maternal morbidity in a LMIC, is from a prospective community based study among 280 women in rural India, who were followed for five years and visited monthly (Bhatia 1995). This study reported pregnancy related morbidity in 30% of women (Bhatia 1995). A larger cross-sectional community based study from India among 3600 women aged less than 35 years with at least one child

under 5 years old found that 41% of women had experienced morbidity during the last pregnancy (Bhatia 1996). Postpartum morbidity was assessed by trained village workers in India in the first 28 days after delivery and estimated to occur in up to 42.9% of women (Bang 2004). Assarag et al conducted a cross-sectional study of 1523 postpartum women in Morocco and report that 44% of women expressed at least one complaint (Assarag 2013). When examined by a healthcare provider, 60% of women were considered to have a “medical diagnosis” (Assarag 2013). These estimates are much lower than the findings obtained in this PhD study, where almost three quarter of all women, (73.5%) reported at least one clinical symptom with a median (IQR) of 4.2 (0-27) symptoms per woman. In this PhD study, almost all women in Pakistan and India reported symptoms (92.1% and 90.4% of women respectively).

One unpublished community based cross sectional survey was performed in 1995, in 7325 households across one governate in Egypt and reported the burden of maternal morbidity based on women’s self-reported symptoms (Osman-Hassan 1995). Overall, 82.8% of women reported morbidity in the antenatal period, 20.4% intrapartum, and 19.1% postpartum (Osman-Hassan 1995). These findings are in line with this PhD study findings where similar percentages of women reported symptoms and were diagnosed with physical morbidity at all five stages of pregnancy with slightly more women reported symptoms in the late antenatal stage.

Surkan et al conducted a secondary data analysis from a population based community trial among 39,000 rural married pregnant women in Bangladesh and reported the commonest prevalence of postpartum illness was gastroenteritis (22.1%), in line with this PhD study. An unpublished study from Uganda in 1993 among 1261 women in 12 districts reported that 10.6% of women reported symptoms associated with pre-eclampsia (Uganda Ministry of Health 1993). Fever (44.9%), excessive headaches (26.9%), severe vomiting (19.6%), and symptoms related to anaemia (19.0%) were the most frequently reported pregnancy related morbidities among women in Uganda (Uganda Ministry of Health 1993).

In this PhD study, overall, when categorised by organ system, self-reported physical symptoms were most frequently related to the gastrointestinal tract (23.9% of all symptoms reported) followed by obstetric and breast (16.7%), uro-gynaecological (16.1%) cardiopulmonary (15.5%), musculoskeletal (12.8%) and miscellaneous (including immunology, dermatology, and endocrine) (15.0%). There were slight variations in the trend but the commonest category was gastrointestinal symptoms (all four countries), followed by cardiopulmonary symptoms (Malawi and Kenya), uro-gynaecological (Pakistan), and obstetric or breast related (India).

Clinical examination

In this PhD study, 73.1% of women had one or more abnormal findings at clinical examination. The most common findings were: conjunctival pallor (23.0%), breast problems (16.0%), gum and oral cavity problems (12.1%), and abdominal tenderness (10.9%). Overall, 25.9% of women had perineal problems (vaginal tears, excoriation, swelling), and 3.3% had leakage of urine. Similarly, overall 36.4% of women examined by speculum were noted to have abnormal vaginal discharge and 14.8% had abnormal vaginal bleeding.

There is little literature to compare these findings to, because many of the studies that have assessed two or more maternal morbidities did not offer clinical examination but collected self-reported symptoms from women only. Previously, of the 21 studies included the systematic review that collected primary data (described in chapter two of this thesis), only three studies included clinical examination and investigations to assess maternal morbidity. The prevalence of the findings on clinical examination and investigations in these three studies are incorporated into the next sections, where physical morbidity was described as a “diagnosis”.

8.6.3 Infectious morbidity

HIV, malaria and syphilis

In this study, overall, 4.8% of women tested positive for HIV, 2.7% for malaria and 0.9% for syphilis. In India, the percentage of women with HIV, malaria and syphilis was 0.1%, 0.1% and 0.0% respectively. This was similar in Pakistan where the percentage of women with HIV, malaria and syphilis was 0.3%, 0.0% and 0.0% respectively. These findings are in line with the estimated national rates of HIV in India (0.11%) and Pakistan (0.16%) (WHO 2017c).

In Kenya, the percentage of women with HIV was 3.6% and malaria and syphilis was low (0.2% and 0.3%) respectively. The prevalence of HIV is in line with the national rates of HIV in Kenya (3.5%). Overall, HIV positive status was highest in Malawi (14.5%) as was malaria (10.4%) and syphilis (3.4%). The prevalence of HIV in this study is four times more than the estimated national rates of HIV in Malawi (3.8%) (WHO 2017c).

In this PhD study, using an amended SIRS score, 23.1% of women had early signs of possible infection. In 43% of cases, a source could be identified which (based on symptoms and clinical examination) was most frequently gastroenteritis followed by lower respiratory tract, sexually transmitted or urinary tract infection or mastitis.

Several studies in the systematic review reported possible infectious morbidity. The description and prevalence of infectious morbidity varied in nature and included the following: abnormal vaginal discharge (25.0%); bacterial vaginosis (31.0%); burning during urination (2.0%); candida (7.0%); febrile symptoms (6.0%); fever (2.4-13.0%); gastroenteritis (22.1%); hepatitis (1.6%); HIV (3.0-16.0%); malaria (2.7-15.9%); pneumonia (4.9%); reproductive infection (2.5%); sexually transmitted infection (7.5-14.9%); trichomonas vaginalis (7.0%); suspected tuberculosis (0.8-10.1%); and urinary tract infection (5.4-14.5%) (**Chapter 2**).

There is little prevalence of sepsis in women during and after pregnancy in LMIC. One review estimated that the prevalence of sepsis ranged from 2.7 to 5.2 per 100 live births (Dolea 2003). Another review of hospital and community studies, estimated the prevalence of sepsis to be 4.4% of live births, giving an estimated number of puerperal sepsis cases of nearly 6 million per year globally (AbouZahr 2003).

Previously, a community-based study in India reported the incidence of puerperal sepsis in the first week postpartum as 1.2% after home delivery, 1.4% after facility-based delivery; and fever was reported in 4% of women (Iyengar 2012). Another study in India reported a high incidence of puerperal infections at home (10%) and of fever (12%), but the study uses broader definitions and followed women for only 28 days (Bang 2004).

It is recognised that estimating the prevalence of infection and sepsis is difficult to compare. This is may be because the aetiology and epidemiology of types of infection and sepsis vary across different settings; for example, related to lack of hygiene during delivery and/or due to high rates of co-infections, including sexually transmitted infections such as HIV.

8.6.4 Medical and obstetric morbidity

Anaemia

In this PhD study, overall, 47.9% of women were diagnosed with anaemia (Hb <11.0g/dL). This finding is more than the 2011 global estimated prevalence of anaemia for pregnant women, 38.2% (95% CI: 33.5—42.6) (WHO 2015d).

It is recognised that prevalence and severity of anaemia varies substantially across regions and countries. In this PhD study overall, anaemia was more common in women in Pakistan (67.8%) and India (60.4%), compared to Kenya (23.8%) and Malawi (40.4%). In studies included in the systematic review of this thesis, the reported prevalence of anaemia ranged from 18.7-52.0% across LMIC (**Chapter 2, Table 2.6**).

It is estimated that severe anaemia, associated with a substantially increased risk of maternal mortality, ranges from 0.9% to 1.5% globally (WHO 2015d). In this PhD study, more women had severe anaemia in Pakistan (2.5%) and India (2.4%) compared to Kenya (1.2%) and Malawi (1.1%).

In 2011, the WHO South-East Asia, Eastern Mediterranean and African Regions had the highest prevalence of anaemia (38.9% to 48.7% for pregnant women in these regions) (WHO 2015d). The countries with the lowest blood haemoglobin levels and highest prevalence of anaemia were in the WHO African Region and this was considered to be a reflection of the high prevalence of other conditions which can cause anaemia in this region, such as malaria, sickle cell anaemia and thalassaemia (WHO 2015d). The WHO report suggested that women in sub-Saharan Africa, represented the highest proportion of individuals affected with anaemia, at 62.3% (95% CI: 59.6-64.8) (WHO 2015d). However, these population estimates are based on mathematical modelling. In this PhD study, the prevalence and severity of anaemia was higher in Pakistan and India compared to Kenya and Malawi. This finding is different to that of the WHO estimates and may be due to the vegetarian dietary habits of women in South-East Asia. The difference in prevalence of anaemia reflects the need for more robust primary data collection for anaemia as a component of maternal morbidity in LMIC.

Antenatal haemorrhage

In this PhD study 4.6% of women assessed during pregnancy, were diagnosed with antenatal haemorrhage. This finding is comparable to other studies in LMIC, where the prevalence of antepartum haemorrhage has been reported as 1.2-5.5% (Chufamo 2015, Takai 2017). Studies included in the systematic review of this thesis report a prevalence of antenatal haemorrhage as 3.1-39.5%. One systematic review reports a global prevalence of 0.5% for placenta previa, as a cause of antenatal haemorrhage (Cresswell 2013).

Hypertensive disease

In this study, overall 2.4% and 0.6% of women were diagnosed with hypertension and pre-eclampsia respectively. Studies included in the systematic review report prevalence of hypertension as 13.0% and pre-eclampsia as ranged between 0.2-0.8%.

In the PhD study, more women were diagnosed with hypertension in Pakistan (4.8%). The prevalence of hypertension in Kenya was 1.8%, India 1.5% and Malawi 0.8%. The prevalence of pre-eclampsia in Pakistan was 1.5%, Kenya 0.4%, Malawi 0.3% and India 0.1%.

One systematic review reported that the global prevalence of pre-eclampsia is 4.6% (Abalos 2013). The review finds evidence of regional variations, with sub-Saharan Africa having the highest incidence of pre-eclampsia (Abalos 2013). Hypertension and pre-eclampsia are more common among women in their first pregnancy, women who are obese, women with pre-existing hypertension, and women with diabetes. These characteristics are increasingly becoming more common in pregnant populations in LMIC.

Incontinence

In this study 16.1% of women reported an uro-gynaecological symptom and 3.6% were diagnosed with incontinence. Studies included in the systematic review report prevalence of incontinence as 1.0-4.7%. Our findings are comparable.

However, there is little other information available on the incidence of incontinence in women in LMICs. Walker and Gunasekera (2011) find four studies of reproductive-age women published between 1985 and 2010, in which the prevalence ranged from 5-32%. Another systematic review calculates the mean pooled estimates for all types of incontinence during the first three months postpartum to be 33% for parous women and 29% for primigravida women (Thom 2010). Although the lead researchers of this paper attempted to obtain information for all countries, no papers from LICs were identified.

Obstetric fistula is a well-recognised and documented condition resulting in the continuous loss of urine and/or faecal matter. In previous studies, continuous urinary

incontinence has often been used to suggest vesico-vaginal fistula. A meta-analysis of the incidence of fistula in LMICs reported a pooled incidence of 0.09 (95% CI 0.01–0.25) per 1,000 recently pregnant women (Alder 2013). Another meta-analysis of DHS data reported a lifetime prevalence of 3 cases per 1,000 women of reproductive age (95% CI 1.3–5.5) in sub-Saharan Africa (Maheu-Giroux 2015). In this PhD study, 0.33% of women reported continuous leakage of urine; these findings could be suggestive of vesico-vaginal fistula, but this may also represent an over-estimate. In this PhD study, women who reported continuous loss of urine did not have a methyl blue dye test performed to make a confirmed diagnosis.

Comparison with studies that triangulated data

There are few studies that have used clinical examination and investigations to triangulate data to aggregate measures, and to compare the summative findings of this PhD study with.

In this study, the prevalence of summative physical morbidity is more, compared to the findings of Zafar et al who conducted a similar cross-sectional study to assess maternal morbidity in early pregnancy, late pregnancy and the postnatal stage among 3459 women in rural communities in Malawi (1732) and Pakistan (1727). In the study conducted by Zafar et al, 50.1% of women in Malawi and 53.0% of women in Pakistan were assessed to have at least one physical morbidity (infective or non-infective). In this PhD study, 84.8% of women had physical morbidity in Malawi (43.7% infectious and 41.1% medical/obstetric); and 81.5% of women had physical morbidity in Pakistan (12.2% infectious and 69.3% medical/obstetric).

Both infective (Pakistan) and non-infective morbidity (Pakistan and Malawi) was lower in the postnatal period than during pregnancy (Zafar 2015). These are similar findings to this PhD study, where overall (and in Malawi and Pakistan), the prevalence of physical morbidity, both infectious and medical/obstetric, was slightly more in the late antenatal stage. Very few women in this PhD study (1.2%) and less than 10% of

women were identified to have multiple morbidities in the study conducted by Zafar et al (Zafar 2015).

Variation in prevalence of physical morbidity

In this PhD study, the overall prevalence of diagnosed physical morbidity was 76.4% women. This may be due to several possibilities. One reason may be because the data collection tool was very detailed and included extensive clinical examinations and investigations, more than any other study. As part of this PhD study, healthcare providers were trained that “if you don't ask for it or look for it, you won't find it” and this may have resulted in more detection of maternal morbidity.

Another reason may be that this PhD study was conducted at the healthcare facility level and women may have sought care because they recognised that they had ill-health. However, in these study settings, antenatal attendance is very common with women attending at least once in India (74%); in Pakistan (73%); in Kenya (94%) and in Malawi (95%) (WHO 2017c). Therefore, women recruited for this study were probably attending the healthcare facility for “routine care”.

Another reason of the wide variations in the prevalence of physical morbidity is the way in which the morbidity is defined, described and measured. Different definitions are often used, different stages of pregnancy are assessed and are therefore non-comparable across settings. Further studies, with more consistent and standardized classifications and methodological approaches are needed.

8.6.4 Psychological Morbidity

In the following section, the prevalence of psychological morbidity in this PhD study is compared to studies included in the systematic review and possible explanations for the variations are given at the end of this section.

In this PhD study, psychological morbidity was assessed as part of the clinical history and depression (EDPS ≥ 10) was noted in 1 in 4 women (25.1%) with 15.2% of all

women reporting thoughts of self-harm. Depression and self-harm were reported by more women in Pakistan, 47.3% and 29.8% respectively. The prevalence of depression in India was 19.8%, Malawi 16.4% and Kenya 13.5%. In India, Malawi, Kenya, 15.6%, 10.1 and 4.5% of women reported thoughts of self-harm respectively.

In this PhD study, 47.3% of women in Pakistan and 16.4% of women in Malawi scored positive for depression. The finding of higher reporting in women in Pakistan as compared to women in Malawi, was similarly reported in the study by Zafar et al, where 25% and less than 5% of women reported symptoms of psychological morbidity in Pakistan and Malawi respectively (Zafar 2015). Zafar et al used the EDPS with a score of >9 to assess psychological morbidity in their study, whereas EDPS ≥ 10 was used in this PhD study.

Depression is a common cause of maternal ill-health, and many systematic reviews and meta-analyses have been conducted supported by large numbers of papers. However, a small proportion of these articles are from LMICs (Ngui 2010, Fisher 2016, Gelaye 2016). In studies that have measured psychological morbidity as a component of maternal morbidity, the reported range of prevalence of depression ranges from 13.5-39.5% and this finding is comparable to the 25.1% of women in this PhD study who scored EDPS ≥ 10 .

In Pakistan, Waqas et al conducted a cross sectional study in four teaching hospitals among 500 pregnant women in Lahore, and reported 31.8% of women were depressed, with 24.6% with borderline depression (Waqas 2015).

In this PhD study, the prevalence of depression in India was 19.8%. This is in line with a study conducted by Nasreen et al, who report the prevalence of depression as 18% in a cross-sectional study among 720 pregnant women in rural communities in Bangladesh (Nasreen 2011), but is more than the 13.5% of women with high depressive symptoms (3–5 symptoms) from a secondary data analysis of a population

based community trial among 39,000 married pregnant rural women in Bangladesh (Surkan 2017).

In this PhD study, the prevalence of depression in women in Malawi was 16.4% and Kenya was 13.5%. Ukachukwu et al conducted a retrospective study of medical case notes among 1716 women to assess maternal morbidity in an urban hospital in Kenya, and reported psychological disorders constituted 5.3% of reported postpartum complications (Ukachukwu 2009). This rate is much less compared to the findings of this PhD study, and a limitation of this estimate is that information is only extracted from medical notes.

In Zimbabwe, Shamu et al conducted a cross sectional study in six postnatal clinics in an urban setting among 842 woman who have given birth, and reported that one in five women 21.4% met the diagnostic criteria for postnatal depression symptomatology whilst 21.6% reported postpartum suicide thoughts (Shamu 2014).

In Ethiopia, Wado et al conducted a prospective study among 622 pregnant women in rural communities and reported 20% of women assessed with depressive symptoms in pregnancy (Wado 2014). EPDS was not used. Tsai conducted a secondary data analysis of population based community study among 1328 pregnant women in South Africa and report at baseline assessment, 39.5% of women screened positive for depression using the EPDS (Tsai 2016). Wong et al conducted a cross sectional study among 625 HIV positive pregnant women in an urban setting in South Africa and reported 11% of women had EPDS scores suggesting probable depression, and 6% reported self-harming thoughts (Wong 2017). Faisal-Cury et al conducted a prospective study among 831 pregnant women attending antenatal clinics in primary care settings in Sao Paulo in Brazil. The prevalence of common mental disorders (anxiety and depression) ranged from 20.2% to 33.6% (Faisal-Cury 2010).

In the following section, possible explanations for the variations in the reporting of the prevalence of psychological morbidity the studies described above as compared to this PhD study.

Variations in prevalence of psychological morbidity

There are many reasons for the variations in the reporting of the prevalence of psychological morbidity in this PhD study and the studies described above. It is thought that women in LMICs are more vulnerable to psychological ill-health due to contributing risk factors such as low socioeconomic status, unplanned pregnancies, and domestic violence, all of which can increase the likelihood of a woman developing psychological morbidity during or after pregnancy (Leigh 2008, Satyanarayana 2011).

The reporting of a potentially sensitive subject such as depression and thoughts of self-harm depend on how screening questions are asked, by who, and what tool is used to assess symptoms. In the studies described above, there were several different definitions, screening questionnaires and data collection tools used to screen for symptoms suggestive of depression. Even when a standardised validated questionnaire was used, (for example, the EPDS), different cut-off scores were used to determine women at risk for depression. A systematic review of validation studies of the EDPS reported one challenge is the reported wide variety of cut-off points of the EDPS and highlighted that the EDPS may not be equally valid across all settings (Gibson 2009). These issues limit the accuracy and comparison of reported prevalence of depression.

The stage of pregnancy (antenatal or postnatal) may contribute to the variation in the prevalence of psychological morbidity. Based three systematic reviews, these figures are estimated as 4.3%-25% of women during pregnancy; and 3.2%-48.0% of women following childbirth in LMIC (Sawyer 2010, Fisher 2012, Gelaye 2016). These results are in line with this PhD finding that depression was a significant problem along the continuum of pregnancy and women were not just “at risk” in the postnatal stage.

A further difference in the reported prevalence of psychological morbidity is related to the study setting. For example, women may feel more at ease to share more information if there are alone in their own home, compared to at a busy secondary level healthcare facility. Previously, Zafar et al also suggested that the differences in prevalence of psychological morbidity may be in part to the way that data were collected; more private home setting in Pakistan compared to the more public less intimate, health centre in Malawi that could negatively affect disclosure (Zafar 2015). Zafar et al also suggested that women in Malawi are generally active in agricultural or other work and not confined to the home environment as much as women in Pakistan might be (Zafar 2015).

Disclosure of potentially sensitive information by women is influenced by the degree of rapport, privacy, trust, confidentiality and time provided by the healthcare provider or data collector. The high reporting of psychological morbidity in this PhD may be because all data collectors were trained in respectful maternity care and good medical practice principles, to ensure a good rapport during the data collection process. Furthermore, all efforts were made by the research assistants to ensure that the face-to-face consultation, examination were almost always conducted in a private space and time was allocated.

A further reason for the varied prevalence in psychological morbidity is that the understanding and possibly willingness to speak about “mental health and well-being” varies between cultures and countries. For example, in Ghana psychological morbidity in women during and after pregnancy is considered a “spiritual issue” and women seek care from a religious leader as opposed to a healthcare provider (Aengibise 2010). Zafar et al also suggested that in many African settings, admitting to problems or feelings of anxiety or worry may be associated with “wishing this upon oneself”. There are a variety of cultural and social practices and beliefs surrounding pregnancy which may contribute to or prevent anxiety and depression, as well and determine if and how a woman can express this (Zafar 2015).

8.6.5 Social morbidity

In this following section, the prevalence of social morbidity is described in relation to studies included in the systematic review in this thesis and possible explanations for the variations in the reporting of the prevalence of social morbidity is given at the end of this section.

Domestic violence

It is well recognised that domestic violence can often first occur, and increase in frequency and severity for women during and after pregnancy (McCauley 2017). Domestic violence occurs across all countries, cultures, religions, socioeconomic status and ages (WHO 2012b). In this PhD study, domestic violence as a component of social morbidity was assessed as part of the clinical history using the HITS questionnaires. In our study, overall 33.9% of women reported domestic violence (HITS score >4). This overall prevalence is in line with a recent WHO estimation that one in three women will suffering domestic violence during their lifetime worldwide (WHO 2012).

In this PhD study, more women reported domestic violence in Pakistan (56.0%) and India (39.7%), compared to Kenya (21.7%) and Malawi (18.2%). Overall, domestic violence perpetrated by the husband (26.3%) was more commonly reported than from another family member (15.8%).

The percentage of women who reported domestic violence perpetrated by the husband in India was (38.6%), Pakistan (37.4%), Kenya (18.3%) and Malawi (13.6%). More women reported domestic violence from family members in Pakistan (31.8%) compared to Malawi (12.5%), India (10.1%), and Kenya (6.0%). These findings may reflect family living arrangements in these settings. For example, in Pakistan, it is common for women to live with their husband and his family, including all the in-law members of the family and it is recognised that domestic violence against pregnant women can be perpetrated from family members also (Ahmad 2005).

In studies included in the systematic review, the prevalence of domestic violence ranged from 2.3-72.8% across different settings.

Karmalini et al conducted a survey in an urban community in Hyderabad, Pakistan among 3324 pregnant women at 20–26 weeks gestation. In the six months prior to and/or during pregnancy, 51% reported experiencing verbal, physical or sexual abuse; and, 20% of women reported physical or sexual abuse alone. (Karmalini 2008).

In Tanzania, 19% of ever-partnered, ever-pregnant women reported being physically assaulted during pregnancy by their partner (Stöckl 2010). Of those experiencing partner violence during pregnancy, 61% reported physical blows to the abdomen. In Rwanda, 35.1% of 600 women reported intimate partner violence in the last 12 months (Ntaganir 2008). In Zimbabwe, 65.4% of 831 pregnant women reported any form of intimate partner violence (Shamu 2014). In South Africa, the prevalence of any intimate partner violence varied from 4.4–30.2% in a secondary analysis of 1328 pregnant women (Tsai 2016). In Iran, 72.8% of pregnant women reported that they had experienced intimate partner violence during their last pregnancy (Hassan 2014).

Substance use

In this PhD study, overall 6.5% of women reporting using alcohol, sedatives. This was higher in India (2.7%) and Kenya (2.0%) compared to Malawi (1.7%) and Pakistan (0.2%). The trend of these findings is comparable to the national estimates of proportion of men and women who drink alcohol in India 5.0%, Kenya 4.4%, Malawi (2.4%) and Pakistan (0.2%) (World Health Stat 2015).

Overall, 1.7% of women had an ASSIST score of >4 indicating that they would benefit from an intervention for substance use. More women scored an ASSIST score of >4 in Malawi (2.8%), Pakistan (1.5%), Kenya (1.4%) compared to India (0.8%).

Overall and per country, of all women who reported substance use, more than half did so in the early antenatal stage. There was not a large number (or variation in the percentage) of women who reported using any substances across the other four

stages of pregnancy. This would suggest that women stop using these types of substances as the pregnancy progresses and this change in substance use continues in the postnatal stage (assessed up to 12 weeks after the end of the pregnancy). In the study, not clear if they change in substance misuse was sustainable over time, for example at one year postnatal.

Only a few studies have included substance misuse as part of an assessment of maternal morbidity. In a secondary data analysis of a database of 34,090 women, the proportion of women reporting alcohol consumption during pregnancy decreased from was 21.5% in 2010 (Isaken 2015). In South Africa, among 625 women initiating anti-retroviral treatment, 16% reported risky alcohol use and 21 % alcohol-related harm (Wong 2015).

Variation in the prevalence of social morbidity

The reason for the wide variation in the reported prevalence of social morbidity may be in line with the reasons for the variation in physical and psychological morbidity. In all types of morbidity, different definitions and different data collection tools are used to measure maternal morbidity at different stages of pregnancy in different settings.

With regards to social morbidity, for example, some studies assessing domestic violence included emotional abuse and others report on physical assault only; and some studies use the index pregnancy and others depend on recall of domestic violence in previous pregnancies.

8.6.6 Factors associated with maternal morbidity

In this PhD study, on multivariate analysis, age, socioeconomic status, educational level, number of previous pregnancies, and/or adverse maternal or neonatal outcomes in the most recent pregnancy were **not** associated with the same type of maternal morbidity across all four LMIC.

Different factors were associated with different types of morbidity per country but there was no consistent direction of strength of association.

It is difficult to compare the findings of the associations with and between maternal morbidities in this PhD study and other studies that have assessed two or more types of maternal morbidity.

Assarag et al reported that women who were aged ≥ 30 years, employed, belonged to highest socioeconomic class, and had obstetric complications during birth or delivered in a private facility or at home were more likely to report a physical complaint postnatally in Morocco (Assarag 2013). Zafar et al reported that complications during a previous pregnancy, infective morbidity ($p < 0.001$), intra or postpartum haemorrhage ($p < 0.02$) were associated with psychological morbidity in rural communities in Malawi and Pakistan (Zafar 2015). Wong et al reported that younger women reported more depressive symptoms. Reports of self-harming thoughts was 11 % in younger and 4 % in older women ($p = 0.002$) (Wong 2017). Stöckl et al reported that in a study in Tanzania, domestic violence was significantly associated with adverse maternal health behaviours and outcomes, including drinking during pregnancy, and having an adverse neonatal outcome (Stöckl 2010). It is difficult to compare to the strength of associations between different types of maternal morbidities in this PhD study and other studies described above due to different definitions, data collection tools and methodology used.

8.6.7 Association between different types of maternal morbidity

Associations between different types of maternal morbidity was assessed using two-way and three-way interactions per country.

In this study, there were associations between the different types of morbidity and these associations varied between the countries.

For each country, women with medical/obstetric morbidity was more likely to report psychological and infectious morbidity, apart from Malawi where the association between medical/obstetric and psychological morbidity was negative.

Women with an infectious morbidity were more likely to report medical/obstetric, psychological and social morbidity in both Pakistan and Malawi. Women with psychological morbidity were more likely to report social morbidity in Pakistan and Kenya.

These findings suggest that the different components of maternal morbidity (physical, psychological and social aspects) are inter-linked and have an influence on the other components of health. However, the strength of the association between the different types of morbidity vary across settings.

8.7 Implications of findings and recommendations

In this chapter so far, an overview of the study has been given, results have been summarised in sequence and relative to each research question and the strengths and limitations of the study have been described. The results of the study have been linked to relevant research and any differences in results have been discussed.

In this section, implications of the findings for clinicians and policymakers, and implications for research are discussed. Recommendations for clinicians and for future research are given at the end of this section.

8.7.1 Implications for clinical practice and policy

In this study, comprehensive assessments of maternal morbidity have been carried out in a variety of settings across four LMIC to measure maternal morbidity. This study provides primary data regarding women's physical, psychological and social morbidity during and after pregnancy. Despite women reporting that they have a good quality of life and are satisfied with their health, there is evidence of a significant burden of ill-health (including infectious, medical/obstetric, psychological, and social morbidity) in women during pregnancy and up to 12 weeks postnatal.

Globally, women are increasingly accessing antenatal care. At least 77% of women access antenatal care at least once in sub-Saharan Africa and Southeast Asia in 2015 (WHO 2017c). More women are also accessing postnatal care (WHO 2017c). This PhD study suggest that there is currently a large burden of ill-health that is currently not detected in women during and after pregnancy. As women increasingly seek care at healthcare facilities, this represents a missed opportunity for healthcare providers working in LMIC, who are in a unique position with the potential to provide good quality care for women.

In this study, a standardised model and criteria for assessment of maternal morbidity was applied in both primary and secondary level care settings alongside routine existing antenatal and postnatal care packages. This study shows that in principle, it

is feasible and acceptable for healthcare providers in these settings to screen women for different types of ill-health during routine healthcare consultations using validated questions and point-of-care rapid diagnostic investigations that can be applied in low resource settings. The low refusal rate in this study suggests that women attending for care at primary and secondary level healthcare facilities in these study settings welcome such an assessment of their health.

Overall, women report good quality of life and satisfaction with health, despite having a detectable morbidity on further screening. This finding would suggest that even if women self-report that they are “satisfied with their current health”, it is useful for healthcare providers to take the time to conduct a full systematic assessment of a women including full history, examination and basic investigations.

Physical morbidity can be described or measured in different ways; for example, number and severity of self-reporting symptoms compared to number of abnormal examinations and investigations detected by a healthcare provider. An agreed classification of key physical maternal morbidities would be useful in a clinical setting.

Anaemia and early infection represent a significant burden of ill-health. The definition and measurement of infection and sepsis, and the accuracy of SIRS criteria to diagnosis possible early infection requires further evaluation in LMIC.

Simple diagnostic technology such as a battery operated Hemocue® to measure haemoglobin and urine dipsticks to measure proteinuria can be made available in these settings. In endemic areas, all women can be screened for HIV, malaria, syphilis using rapid diagnostic testing. This type of rapid diagnostic testing requires minimal infrastructure and equipment should be made available in these settings.

There are important differences among the four countries (the much higher prevalence of HIV and malaria in Malawi and the much higher prevalence of psychological and social morbidity in Pakistan). Antenatal and postnatal care

packages will need to be adapted as per country specific contexts burden of disease priorities.

Currently, psychological morbidity is not screened for in most LMIC settings as part of routine antenatal or postnatal care. In our study 1 in 5 women reported to have psychological morbidity throughout the continuum of pregnancy and not just in the early postnatal stage. This PhD study shows that psychological morbidity represents a burden of ill-health. There is a need, not only to introduce screening, but also to provide appropriate management for psychological morbidity as a component of antenatal and postnatal care.

As a component of social morbidity, domestic violence is significant problem for women during and after pregnancy in these study settings. Domestic violence is considered a taboo subject in many countries, resulting in a hidden burden of ill-health in women. Healthcare providers in the antenatal clinic are likely to be the first professional contact that women experiencing domestic violence will encounter during her pregnancy (NICE 2015).

WHO have produced clinical and policy guidelines on how to respond to women who report domestic violence during and after pregnancy, including identification, safety assessment and planning, communication and clinical skills, documentation and provision of referral pathways (WHO 2016). However, the WHO antenatal guidelines recommend that screening for domestic violence depends on the context. The current recommendation is that clinical enquiry about the possibility of domestic violence should be strongly considered at antenatal care contacts when assessing conditions that may be caused or complicated by domestic violence to improve clinical diagnosis and subsequent care, where there is the capacity to provide a supportive response (including referral where appropriate) and where the WHO minimum requirements are met (WHO 2016).

The feasibility of implementation and acceptability of this recommendation for as a routine component of antenatal care packages across LMIC has been uncertain (WHO

2016). Furthermore, the WHO antenatal guideline does not make a reference to domestic violence from other members of the family, apart from the partner. This PhD study shows that it is feasible for healthcare providers to ask women four questions to assess the level of domestic violence from both the partner/husband and/or family members during a routine antenatal or postnatal care consultation.

There is a however need to explore potential interventions that can be integrated and implemented for women who report domestic violence from their partner and/or family members during and after pregnancy across different settings and LMIC.

In this PhD study, substance use was not commonly reported in women during and after pregnancy in these settings. The WHO antenatal guidelines recommend that all women should be screened for substance use during pregnancy and that healthcare providers are advised to should ask all pregnant women about their use of alcohol, tobacco and other substances (past and present) and as early as possible in the pregnancy and at every antenatal care visit (WHO 2016). This PhD study would suggest that screening for substance misuse is less important in LMIC settings, compared to psychological and domestic violence screening. There may need to be a re-consideration of what is necessary and what is context specific on the basis on this PhD findings.

Routine screening for psychological and social morbidity

The detrimental impact of psychological and social morbidity on the overall health and well-being of mothers (and their babies) during and after pregnancy has resulted in public health policy in high income countries such as the United Kingdom (UK), where screening of depression and domestic violence is routinely conducted during and after pregnancy.

In many high-income countries, specially trained midwives routinely assess, screen, support and provide further referral for women with psychological and social morbidity (NICE 2015). There is debate as to the cadre of healthcare providers most suitable to undertake routine screening for and manage psychological and social morbidity in LMIC (Rahman 2013, Gureje 2015). This study shows that with support and training, it is feasible and acceptable for the cadres of healthcare providers already providing routine antenatal and postnatal care in LMIC (nurse-midwives, medical officers and doctors), to ask screening questions regarding psychological and social morbidity for women during and after pregnancy in these study settings.

8.7.2 Implications for research

In this section of the chapter, challenges and unanswered questions are discussed. At the end of this section recommendations for clinical practice and future research are described.

Study setting

This study was carried out in public healthcare facilities in India, Pakistan, Kenya and Malawi and the findings cannot be assumed to be the same in other settings. There is a need to assess the views of community based women during and after pregnancy who may have different types of maternal morbidity. Their assessment of maternal morbidity would be important to understand their specific health needs and inform what aspects of antenatal and postnatal care are required in the community setting.

Perception of health

Overall, women report good quality of life and satisfaction with health, despite many women having at least one form of morbidity. There is a need for qualitative research to enable a better understanding of what women, their families and their healthcare providers consider to be maternal morbidity and to understand the cultural context of how women report and describe ill-health.

Data collection tool for measurement of maternal morbidity

There is a need for an internationally accepted and user-friendly data collection tool that can be used to measure maternal morbidity in a comprehensive and holistic manner. The data collection tool used in this study is lengthy and could be adapted and shortened for use: (1) in a clinical setting and (2) as a research tool to measure maternal morbidity (as an outcome measure). There is a need to refine and condense the current data collection tool, and to build expert consensus regarding the inclusion and weight given to each key variable. There is a need to explore whether discriminant analysis can be used to identify what variables should be included in the data collection tool to develop a more concise but still representative and composite maternal morbidity assessment tool and score. Further research is required to assess the applicability of this score as a health outcome measure and a strategic and programmatic key performance indicator in different health systems both in a clinical and research capacity.

Routine screening for psychological and social morbidity

In this PhD study, many healthcare providers screened women for psychological and social morbidity. However, screening for psychological and social morbidity is not part of routine maternity care in many LMIC settings. The establishment of such services requires the prioritisation of available resources and a change in the attitudes and practices of healthcare providers (McCauley 2017).

The WHO have produced clinical and policy guidelines on how to screen and manage psychological and social morbidity during and after pregnancy (WHO 2013c). However, the feasibility of implementation and acceptability of such guidance in care packages in public healthcare facilities in LMIC, such as India, Pakistan, Kenya and Malawi are currently uncertain. There is a need to investigate knowledge, attitudes and perceptions regarding psychological and social morbidity during and after pregnancy among healthcare providers that provide routine maternity care across LMIC. In addition, further research regarding enabling factors and barriers to the

provision of psychological and social morbidity, potential management options, and how to translate these recommendations into clinical practice would be beneficial. There is a need to explore how best to educate healthcare providers, women and the wider community about psychological and social morbidity in women during and after pregnancy. Future research is required to assess a shortened version of the EPDS or other types of shorten screening questions for psychological ill-health. A remaining challenge is lack of cross-culturally valid perinatal depression screening and diagnostic tools. There is a clear need to develop, refine and rigorously evaluate the predictive validity and reliability of depression assessment tools for women during and after pregnancy in LMIC.

There is a need to further understand how psychological and social morbidity is experienced and understood within cultural contexts of LMIC to inform culturally and contextually appropriate interventions (McCauley 2017). The further development and implementation of culturally appropriate guidelines and interventions would be beneficial and result in better quality of maternity care.

8.8 Recommendations for clinicians and policy makers

1. Maternal morbidity represents a significant burden of ill-health and should not be ignored by clinicians and policy makers.
2. There is a need for increased screening and management of physical, psychological and social morbidity during and after pregnancy.
3. There is a need for an internationally agreed screening tool for maternal morbidity, including all components of physical, psychological and social morbidity, for use at different stages during and after pregnancy.
4. It would be useful to reach agreement on a narrower definition of maternal morbidity mirroring that of maternal mortality and SAMM (e.g. limiting the timeframe in first instance to 42 days after the end of the pregnancy). This would enable more accurate comparisons across settings.
5. There is a need to review and develop the content of current antenatal and postnatal care packages in LMIC and adapt these to ensure that care given is comprehensive and covers a woman's physical, psychological and social health needs.
6. Currently there is good coverage and uptake of antenatal care but content needs to be adapted to ensure good quality comprehensive care that is respectful, integrated and delivers physical, psychological and social care. The new WHO guidelines recommend that a woman should be reviewed eight times during her pregnancy. The emphasis seems to be on the frequency of visits with the aim to prevent neonatal complications. However, women need to be cared for in a holistic and comprehensive way and receive good quality, respectful maternity care at each contact. This implies the need to expand the

content of current antenatal packages, with an agreed minimum content and agreed country specific additional content.

7. Currently, there is poor uptake of postnatal care at healthcare facility and poor content of postnatal care packages. The provision of comprehensive postnatal care needs to link with the community and healthcare facility and focus on both the women and her baby together in an integrated way. There has been much focus in the postnatal stage to prevent neonatal mortality but there needs to be a renewed emphasis on both the general health and well-being of a woman and her baby together.
8. Despite women reporting that they are “satisfied with their health”, healthcare providers should still take the time to ask screening questions regarding symptoms and perform clinical examinations and basic investigations during and after pregnancy.
9. Possible infection represents a burden of ill-health and all women should have basic observations performed at each contact during and after pregnancy, including pulse rate, respiratory rate, temperature to assess for possible early signs of infection. If facilities are available, a white cell count should be performed to apply the SIRS scale for possible early infection.
10. Simple diagnostic technology such as a battery operated Hemocue® to measure haemoglobin and urine dipsticks to measure proteinuria should be made available in all settings to aid detection of physical morbidity.
11. In endemic areas, all women can be screened for HIV, malaria, syphilis using rapid diagnostic testing.
12. Rapid diagnostic testing for tuberculosis, Hepatitis B would be beneficial and should be incorporated in the data collection tool.

13. There is a need for women to be screened for psychological morbidity at least one stage during pregnancy and after childbirth. The women should be counselled and asked to contact a healthcare provider if they notice a change in their symptoms regarding possible psychological morbidity.
14. There is a need for women to be screened for domestic violence (perpetrated from a husband/partner and family members) at least one stage during pregnancy and after childbirth. The women should be counselled and asked to contact a healthcare provider if their circumstances change and they need help due to domestic violence.
15. The number of times a woman needs to be screened for psychological and social morbidity during and after pregnancy needs further evaluation.
16. There is a further need to explore potential interventions (counselling, support groups, educational material, legal advice) that can be integrated and implemented for women who report domestic violence from their partner and/or family members during and after pregnancy across different settings and LMIC.
17. There is a need for increase in the capacity of healthcare providers with further education (and legal support) to enable healthcare providers to routinely screen for and manage psychological and social morbidity in different settings in LMIC.
18. There is a need to increase services available to ensure health system readiness with appropriate management, referral systems for use when physical, psychological and social morbidity is detected.

19. There is a need to shorten and adapt the data collection tool into a “maternal morbidity score” that can be used as an indicator to determine woman’s ill-health and identify her health needs during and after pregnancy.

8.9 Recommendations for research

1. Maternal morbidity as a concept should be developed and used as an “outcome” evaluation measurement in maternal health interventions.
2. There is a need to conduct a longitudinal observational study to assess if and how maternal morbidity changes over time during the continuum of pregnancy and after childbirth.
3. There is a need to implement improved evidence-based antenatal and postnatal care packages. The findings from this PhD study can be used to inform and design targeted, effective antenatal and postnatal care packages effective to provide comprehensive care in a way that meets a woman’s health needs.
4. There is a need to understand how infection and sepsis is defined and measured in women in LMIC during and after pregnancy. The use of SIRS criteria as an early warning score for possible infection requires further research. Furthermore, adapted SIRS criteria using CRP instead of WCC need further evaluation.
5. There is a need to understand how best to screen and diagnose women for tuberculosis during and after pregnancy (for example, comparing the symptoms of productive cough for more than two weeks with microscopy and/or use of rapid diagnostic testing such as GeneXpert (WHO 2011c).

6. There is a need to conduct a step wedge design study to assess whether the implementation of an intervention of improved evidence based comprehensive antenatal and postnatal care packages result in improved women health outcomes, in addition to the health of the newborn baby.
7. There is a need to understand how healthcare providers can be best supported and enabled to provide comprehensive improved antenatal and postnatal care packages, beyond the provision of basic emergency care, that includes physical, psychological and social health assessment and management during and after pregnancy.
8. There is a need for qualitative research to enable a better understanding of what women, their families and their healthcare providers consider to be maternal morbidity and to understand the cultural context of how women report and describe ill-health.
9. Further research is required to assess how best clear effective referral pathways and support for women who report physical, psychological and social morbidity can be implemented, monitored and evaluated in LMIC settings.

CHAPTER 9: CONCLUSION

9.1 Summary

Despite women reporting that they have a good quality of life and are satisfied with their health, there is evidence of a significant burden of ill-health (including infectious, medical/obstetric, psychological, and social) in women during pregnancy and up to 12 weeks postnatal. Even though many women access care during pregnancy across LMIC, at present the available antenatal and postnatal care packages do not include comprehensive screening for all forms of ill-health. The focus till now has largely been on detection and prevention and treatment of HIV, malaria, and syphilis and on emergency preparedness for birth. Although laboratory screening for anaemia is advised, this is rarely implemented. Screening for psychological or social ill-health rarely happens. Furthermore, treatment pathways for women who do have identified health needs are often not in place or of very poor quality.

This study demonstrates that women have health needs, beyond simply the physical aspects of health and includes psychological and social well-being. To support the current international priority that all women have the right to the highest attainable standard of health and well-being, current antenatal and postnatal care packages need to be adapted and improved to provide comprehensive, holistic care in a way that meets a woman's health needs (UN 2015).

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Appendices

Appendix 1: Summary Table 1: reporting included studies, study design, country, setting, study participants, objective and main conclusion of the study.

No.	Author, year	Title	Study design	Country	Setting Facility	Study participants, gestation, and number	Objective of the study	Remarks and summary of study
1.	Assarag 2013	Maternal postpartum morbidity in Marrakech: what women feel, what doctors diagnose?	Cross-sectional	Marrakech, Morocco	All women in the Al Massira district	1523 women 6-8 weeks postpartum	To measure and identify the causes of postpartum morbidity 6-8 weeks after delivery and to compare women's perceptions of their health during this period to their medical diagnoses	A better understanding of postnatal conditions required, to increase quality of care, healthcare providers must be sensitised and trained in mental health concerns

2.	Brittain 2017	Social support, stigma and antenatal depression among HIV - infected pregnant women in South Africa	Cross sectional	Western Cape, South Africa	Not clear from manuscript	623 HIV positive pregnant women	Factors associated with social support and stigma among pregnant women initiating anti-retroviral therapy and what are the associations with depressive symptoms?	There is a need for interventions to reduce stigma associated with HIV and to address risk factors for depressive symptoms
3.	Chersich 2009	Maternal morbidity in the first year after childbirth in Mombasa Kenya; a needs assessment	Cross sectional	Mombasa, Kenya	Provincial hospital	500 postnatal women at child - health clinic - split into early, middle and late postnatal (4-12 weeks) (12-24 weeks) (24-56 weeks)	Needs assessment- not clear	Need to screen mothers at child clinics for anaemia, reproductive tract infections, family planning and counselling

4.	Faisal-Cury 2009	Common mental disorders during pregnancy: prevalence and associated factors among low-income women in São Paulo, Brazil: depression and anxiety during pregnancy	Prospective study	São Paulo, Brazil	Antenatal clinics in primary care	831 women in their 20th to 30th weeks of pregnancy, who attended antenatal clinics in primary care	To estimate the prevalence of common mental disorders and factors associated with these disorders among pregnant women of low socio-economic status in São Paulo	Primary healthcare professionals need to be aware of how common mental disorders in such settings, and should be properly trained to deal with common mental disorders during pregnancy
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5.	Faisal-Cury 2010	Common mental disorders during pregnancy and adverse obstetric outcomes	Prospective study	São Paulo, Brazil	Antenatal clinics in primary healthcare	831 pregnant women from antenatal clinics in primary healthcare	To estimate the association between common mental disorders, during pregnancy and risk of low birth weight or preterm birth	Common mental disorders prevalence is high among low-income and low-risk pregnant women attended by public health services in a middle-income country, but not confer an increased risk for adverse obstetric outcome
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6.	Karmaliani 2009	Prevalence of anxiety, depression and associated factors among pregnant women of Hyderabad, Pakistan	Prospective observational	Pakistan	All women in Hyderabad, Pakistan	1368 pregnant women at 20-26 weeks	To determine the prevalence of anxiety and depression and evaluate associated factors including domestic violence among pregnant women in an urban community in Pakistan	Developing a screening and treatment program for domestic violence and depression/anxiety during pregnancy may improve the mental health status of pregnant Pakistani women
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7.	Isaksen 2015	Alcohol consumption among pregnant women in Northern Tanzania a registry-based study	Secondary data analysis	Tanzania	Kilimanjaro Christian Medical Centre in Moshi, Tanzania	Data related to 34,090 births between 2000 and 2010 was obtained from the Medical Birth Registry at Kilimanjaro Christian Medical Centre in Moshi, Tanzania and analysed	1) To describe time trends in level of alcohol consumption, 2) To assess socio-demographic predictors of alcohol consumption, and 3) To describe associations between alcohol consumption and health-related maternal and fetal outcomes	The proportion of pregnant women consuming alcohol in Northern Tanzania is high, and greater awareness of health outcomes associated with alcohol consumption is advised
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8.	Hassan 2014	Maternal outcomes of intimate partner violence during pregnancy: study in Iran	Cross sectional	West, Azerbaijan Iran	Hospitals in Miandoba and Mahabad	1300 pregnant women, aged 18-39 years, who were referred to hospitals in the Iranian cities of Miandoab and Mahabad	To investigate the prevalence of intimate partner violence against pregnant women and its relationship with adverse maternal outcomes, including preterm labour, abortion, Caesarean section, antenatal hospitalization and vaginal bleeding	This study demonstrated a high prevalence of intimate partner violence during pregnancy, and found that intimate partner violence was associated with adverse maternal outcomes including preterm labour, Caesarean section, antenatal hospitalization and vaginal bleeding
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9.	Hanlon 2009	Impact of antenatal common mental disorders upon perinatal outcomes in Ethiopia: The P-MaMiE population-based cohort study	Population based cohort study	Butajira, Ethiopia	Rural district	1065 pregnant women	To examine the impact of antenatal psychosocial stressors, including maternal common mental disorders upon low birth weight, stillbirth and neonatal mortality, and other perinatal outcomes in rural Ethiopia.	This study provides preliminary evidence of important public health consequences of poor maternal mental health in low-income countries but does not replicate the strong association with low birth weight found in South Asia
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10.	Nasreen 2011	Prevalence and associated factors of depressive and anxiety symptoms during pregnancy: a population based study in rural Bangladesh	Cross sectional data from a prospective cohort study	Bangladesh	Rural community based-interviews in women's homes	720 randomly selected women in their third trimester of pregnancy from the Mymensingh district of Bangladesh	To estimate the prevalence of depression and anxiety symptoms and explore the associated factors in a cross section of rural Bangladeshi pregnancy women	Depression and anxiety are common and need to be screened for antenatally, policies to reduce domestic violence and increase social support beneficial
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11.	Natasha 2015	Prevalence of depression among subjects with and without gestational diabetes mellitus in Bangladesh: a hospital based study	Cross sectional	Bangladesh	Outpatient department of specialist tertiary hospital setting	748 pregnancy women (382 with gestational diabetes mellitus, 366 without gestational diabetes mellitus)	To measure the prevalence of depression during pregnancy with or without gestational diabetes mellitus	Higher relate of depression in pregnancy deserves medical attention especially women diagnose with gestational diabetes mellitus. Further studies should estimate adverse pregnancy outcome for untreated depression especially in gestational diabetes mellitus cases
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12.	Ntaganira 2008	Intimate partner violence among pregnant women in Rwanda	Cross sectional survey	Rwanda	Two urban antenatal clinics in Kigali and two rural antenatal clinics (one south and one north province)	600 pregnant women attending antenatal clinic	To identify variable associated with intimate partner violence among pregnant women in Rwanda	Screening for intimate partner violence against women as an integral part of HIV care as well as routine antenatal care. Services for battered women should also be made available
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13.	Prost 2012	Predictors of maternal psychological distress in rural India: a cross-sectional community-based study	Cross sectional	India	Rural Jharkhand and Orissa, Eastern India	5801 mothers around 6 weeks after delivery	To assess the prevalence and predictors of psychological distress as a proxy for common mental disorders among mothers in rural Jharkhand and Orissa, eastern India	Mothers living in underserved areas of India who experience infant loss, an unwanted pregnancy, health problems in the perinatal and postpartum periods and socio-economic disadvantage are at increased risk of distress and require access to reproductive healthcare with integrated mental health interventions
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14.	Romero-Gutiérrez 2011	Prevalence of violence against pregnant women and associated maternal and neonatal complications in Leon, Mexico	Cross sectional design	Mexico	Postpartum area at a tertiary care referral hospital in Leon, Mexico	1623 postpartum women.	To determine the prevalence of violence against women and associated maternal and neonatal complications in a developing country setting	Violence during pregnancy is quite common in the study setting. Maternal complications are higher in women who experience violence during pregnancy. Implications for practice: it is recommended that pregnant women who are experiencing violence should be identified during antenatal care to avoid maternal or neonatal complications
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15.	Rees 2016	A high-risk group of pregnant women with elevated levels of conflict-related trauma, intimate partner violence, symptoms of depression and other forms of mental distress in post-conflict Timor-Leste	Cross sectional	Timor-Leste	Four main government antenatal clinics in Dili district	1672 women in the second trimester of pregnancy	To assess an index of exposure of two forms of trauma to identify women attending antenatal clinic in conflict affected Timor-Leste at high risk of depression and other forms of stress	The findings offer a framework for a tiered approach to detection, guiding prevention and intervention strategies for intimate partner violence and associated mental health problems in low-income post-conflict countries
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16.	Shamu 2014	Intimate partner violence after disclosure of HIV test results among pregnant women in Harare, Zimbabwe	Cross sectional	Zimbabwe	Six postnatal clinics in Harare	Data were collected from 842 women interviewed postnatally in six postnatal clinics	To report intimate partner violence following disclosure of HIV test results by pregnancy women	Interconnectedness of intimate partner violence, HIV status. Efforts to involve men in antenatal care must also be strengthened
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17.	Shamu 2016	High-frequency intimate partner violence during pregnancy, postnatal depression and suicidal tendencies in Harare, Zimbabwe	Cross sectional study	Zimbabwe	Six postnatal clinics in Harare	Data were collected from 842 women interviewed postnatally in six postnatal clinics	This study investigated the association of postnatal depression and suicidal ideation with emotional, physical and sexual intimate partner violence experienced by women during pregnancy	Emotional intimate partner violence during pregnancy negatively affects women's mental health in the postnatal period. Further research must look at possible indirect relationships between sexual and physical intimate partner violence on mental health
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18.	Stewart 2014	A cross-sectional study of antenatal depression and associated factors in Malawi	Cross sectional	Malawi	Antenatal clinic at Mangochi District Hospital, Mangochi, Malawi	583 pregnant women were recruited from a district hospital antenatal clinic	To measure symptoms of depression and anxiety, and non-specific somatic symptoms commonly associated with distress	This study demonstrates that antenatal depression and common mental disorders are common in Malawi and are associated with factors that may be amenable to psychosocial interventions
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19.	Stöckl 2010	Physical violence by a partner during pregnancy in Tanzania: prevalence and risk factors	Household survey	Tanzania	Mbeya, Dar is Salaam	1298 pregnant women	To further analyse the WHO multi-country study data to investigate the magnitude and patterns of violence during pregnancy in two settings and to explore the associate between violence during pregnancy and matron health outcome and potential risk and protective factors for the onset of violence during pregnancy	Interventions on intimate partner violence in high income countries have been tested on antenatal clinics but effective solution for how to intervene in low recourse settings like Tanzania are still needed
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20.	Surkan 2017	Risk of Depressive Symptoms Associated with Morbidity in Postpartum Women in Rural Bangladesh	Secondary data analysis from population based data community trial	Bangladesh	Population based	39, 000 married rural pregnant women	To examine the relation between women's' reported morbidity symptoms from childbirth to three months postpartum, and subsequent depression symptoms assessed at six months postpartum	Physical illness during the first three months postpartum were risk factors for depressive symptoms with the strongest associations noted for convulsion and hepatobiliary disease. Symptoms of depression may be of concern to women suffering from depressive symptoms
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21.	Tsai 2016	Intimate Partner Violence and Depression Symptom Severity among South African Women during Pregnancy and Postpartum: Population-Based Prospective Cohort Study	Secondary data analysis of population based longitudinal data.	South Africa	Home visit	1328 pregnant women.	To estimate the association between intimate partner violence and depression in a pregnant study population.	Intimate partner violence and depression significantly linked with depression symptom severity. Intensive health sector Responses to reduce intimate partner violence and improve women's mental health should be explored
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22.	Ukachukw 2009	Maternal morbidity and mortality in peri-urban Kenya- assessing progress in improving maternal healthcare	Retro- spective case notes review	Kenya	PCEA Kikuyu Hospital, Kenya	Data on sociodemographic, recorded antenatal care activities, maternal morbidities and deaths were elicited from case notes of all pregnancies and births over a two-year period	To assess antenatal care activities, maternal morbidities and deaths were elicited from case notes of all pregnancies and births over a 2-year period.	Urinary tract infection is an important cause of maternal illness during pregnancy. Routine screening is recommended. Diagnosis and management of psychological disorders in pregnancy remain unsatisfactory. Further studies to identify the true burden of these conditions are needed
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23.	Wado 2014	Effects of maternal pregnancy intention, depressive symptoms and social support on risk of low birth weight: a prospective study from southwestern Ethiopia	Prospective study	Ethiopia	Community based -in rural villages	622 pregnant women followed up until delivery	The effects of unwanted pregnancy, prenatal depression and social support on the risk of low birth weight in rural south west Ethiopia	Identifying women's pregnancy intention during antenatal care visits, and providing appropriate counselling and social support will help improve birth outcomes
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24.	Waqas 2015	Psychosocial factors of antenatal anxiety and depression in Pakistan: is social support a mediator?	Cross sectional study	Pakistan	Department of OB&G in four teaching hospitals in Lahore, urban setting	500 pregnant women	To assess the relationship between intimate partner violence during pregnancy and both postnatal depression and suicidal ideation	Because of the predominantly patriarchal sociocultural context in Pakistan, the predictors of antenatal anxiety and depression may differ from those in developed countries. Authors suggest that interventions designed and implemented to reduce antenatal anxiety and depression should consider these unique factors
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25.	Wong 2017	Depression, alcohol use, and stigma in younger versus older HIV-infected pregnant women initiating antiretroviral therapy in Cape Town, South Africa	Cross sectional	Cape Town, South Africa	625 HIV positive women	Comparison of younger (18-24 years old) and older (≥ 25 years old) HIV-infected pregnant women initiating antiretroviral therapy in Cape Town, South Africa	To compare young and older HIV infected pregnant women and their risk of alcohol abuse and depression	In multivariable analysis, age remained significantly associated with depressive symptoms and report of self-harming thoughts. Level of HIV-related stigma and report of intimate partner violence modified the association between age and depressive symptoms
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26.	Zafar 2015	Non-Life Threatening Maternal Morbidity: Cross Sectional Surveys from Malawi and Pakistan	Cross sectional	Malawi and Pakistan	Rural community	Total sample size was 3459. (Malawi-1732 and Pakistan-1727) Women were assessed at three stages of pregnancy: early pregnancy, late pregnancy, postnatal period	To define maternal morbidity with clear criteria for identification at primary care level and estimate the distribution of and evaluate association between physical (infective and non-infective) and psychological morbidities in two low-income countries	Strengthen availability and quality of antenatal and postnatal care packages, need for more robust assessment of non-severe maternal morbidity
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Appendix 2: Summary Table 2: Included studies, data collection tools, types of maternal morbidity measured.

No	Author, year	Type of data collection Primary Secondary	Data collection tool used	Physical			Psycho-logical	Social	Association between morbidities and/or any other major findings
				Medical	Obstetric	Infectious			
1.	Assarag 2013	Self-reported examination, laboratory investigations	Own design	44% at least one complaint; 60% had a medical diagnosis; 19% anaemia	Gynae 22% post-natal	10% genital infections	10% postnatal depression		
2.	Brittain 2017	Self-reported	Authors own questionnaire for physical morbidity and EDPS			HIV all positive (pre-selected population)	EPDS ≥ 10 = 19%; EDPS ≥ 13 11%	Social support assessed	

3.	Chersich 2009	Structured questionnaire, clinical examination, blood, using, cervical swabs and PAP smear	Own design, used ICD-10 definitions for mild and major depression; AUDIT tool for harmful alcohol use; trichomonas vaginalis and candida diagnosed on wet mount; Nugent's criteria for bacterial vaginosis	52% of women had anaemia; 5% had severe anaemia; 17% had abdominal pain. 1% incontinence; dysuria 10%; 25% abnormal vaginal discharge		6% had febrile symptoms; no syphilis, bacterial vaginosis 31%, candida 7%; 7% had trichomonas vaginalis; 4% urinary nitrites	2% major depression	21% intimate partner violence	Across three assessments points in the postnatal stage
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4.	Faisal-Cury 2009	The clinical interview schedule-revised and demographic questionnaires were administered between the 20th and 30th weeks of gestation. Information on infant weight and gestational age at birth were obtained from hospital records	Own questionnaire for physical. Clinical Interview Schedule-Revised. Own questions for alcohol and tobacco use		Premature contractions, hypertensive disorders that required the use of medication (details not given).		The prevalence of common mental disorders was 20.2% (95%CI 17.5 to 23.0)	Use of alcohol and tobacco was higher in women with common mental disorders (details not given)	Age at current pregnancy and at first delivery, not having friends in the community, living in a crowded household, lower occupational status and history of previous psychiatric treatment was all independently associated with increased prevalence of common mental disorders
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									Current obstetric complication associated with common mental disorders.
5.	Faisal-Cury 2010	The clinical interview schedule-revised and demographic questionnaires were administered between the 20th and 30th weeks of gestation. Information on infant weight and gestational age at birth were obtained from hospital records. Hospital records	Own questionnaire. Clinical Interview Schedule-Revised. Own questions for alcohol and tobacco use		Sixty-three (7.6%) newborns were classified as low birth weight and 56 (6.9%) were classified as pre-term birth		The prevalence of common mental disorders during gestation was 33.6 (95% CI: 30.4-36.9)		Common mental disorders during pregnancy was not associated with risk of PTB (adjusted OR:1.03, 95% CI: 0.57-1.88) or low birth weight (adjusted OR:1.09, 95% CI: 0.62-1.91)

6.	Karmal- iani 2009	Interview, self- reported symptoms	No details given	93.6% reported physical morbidity			84.4% reported psycho- logical morbidity		
7.	Isaksen 2015	Self-reported symptoms	Validated Aga Khan University Anxiety Depression Scale; own questionnaire for domestic violence				18% depression and/or anxiety; factors associated were abuse	15% physical and/or sexual abuse; 30% verbal abuse	The strongest factor associated with depression/ anxiety was physical/ sexual and verbal abuse

8.	Hassan 2014	Self-reported	Own questionnaire	Not reported	Premature birth	Not reported	Not reported	Decrease in alcohol consumption from 49.5% in 2000 to 21.5% in 2010.	Maternal alcohol consumption during pregnancy was associated with a decrease risk of being small for gestational age and decreased risk of premature birth
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9.	Hanlon 2009	Self-reported	Abuse Assessment Screen Scale, and sexual abuse by a partner was defined according to Finkelhor and Yllo. The final questionnaire was developed by the authors using relevant textbooks and dissertations, and then homogenized with the sociocultural situation of the study population. A woman with at least one positive response to any of the questions		Adverse maternal outcomes included: preterm labour (30.3%); abortion (1.5%); Caesarean section (24.4%); antenatal hospitalization (55.4%); premature rupture of the membranes (0.1%); and vaginal bleeding during pregnancy (31%)			72.8% pregnant women, reported that they had experienced intimate partner violence during their last pregnancy. Smoker (52.6%)	A significant association was found between intimate partner violence and preterm labour, Caesarean section antenatal hospitalization and vaginal bleeding
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			regarding physical, emotional or sexual violence was classified as a 'woman experiencing violence'						
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10.	Nasreen 2011	<p>Self-reported and secondary data analysis.</p> <p>Information about other perinatal outcomes was obtained shortly after birth from the mother's verbal report and via the Demographic Surveillance System.</p>	<p>Symptoms of antenatal common mental disorders (Self-Reporting Questionnaire-20: SRQ-20), stressful life events during pregnancy (List of Threatening Experiences: LTE) and worry about the forthcoming delivery</p>		<p>Low birth weight (7.1%); poor/bad global health (3.8%); past stillbirth (4.3%); past neonatal death (25.0%)</p>	<p>≥1 episode of fever in pregnancy; ≥1 episode of malaria 15.9%.</p>	<p>High symptom levels (SRQ scores ≥6) were present in 128 women, (12.0%), low symptoms (SRQ scores 1–5) were present in 634 women (59.5%) and no symptoms (SRQ = 0) in 303 (28.5%) of women</p>	<p>Uses alcohol weekly or more (5.0%); uses “khat” weekly or more (12.9%); physical assault in pregnancy (2.3%)</p>	<p>None of the psychosocial stressors were associated with lower mean birth weight, stillbirth or neonatal mortality. Increasing levels of antenatal common mental disorders symptoms were associated with prolonged labour</p>
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11.	Natasha 2015	Background information, depression, anxiety, literacy, relationship, forced sex. Physical violence, social support	EDPS for depression; authors own questionnaire for background information				EDPS -18% of women positive for depression and 29% of women positive for anxiety	Multiple acts of physical violence-33.8%; forced sex 79.2%; physical violence -18.1%	Women's literacy, poor household economy, poor relationship with husbands, and partner violence showed strong associations with depression and anxiety
12.	Ntagan-ira 2008	Self-reported	MADRS scale Own questionnaire	13% hypertension; gestational diabetes not clear	3.74% history of neonatal death; gestational diabetes		Overall, depression 18.3%; higher in gestational diabetes 25.9%; without gestational diabetes 10.4%	2% took sedatives	No association with depression and gestational diabetes with other obstetric factors

13.	Prost 2012	Demographics, HIV status, intimate partner violence	Authors own tool for intimate partner violence assessment			HIV status, negative and positive women compared. HIV positive women reported more intimate partner violence		35.4% of women with intimate partner violence in the past 12 months	
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14.	Romero-Gutiérrez 2011	Self-reported	Kessler-10 item scale for psychological distress; own design otherwise; severe stomach pain; excessive vomiting; fever for more than 24 h; excessive vaginal bleeding; jaundice; reduced/no fetal movement; self-reported symptoms of malaria; high fever in the 3 days before labour, foul smelling vaginal discharge; prolonged labour; fits		Health problems in the antepartum (46.3%) delivery (35.1%); or postpartum periods (30.5%) Caesarean section (1.7%)		11.5% (95% CI: 10.7-12.3) of mothers had symptoms of distress (K10 score >15)	43.9% use of local alcohol 'handia' unwanted pregnancy (11.3%)	Unwanted pregnancy for the mother, small perceived infant size and a stillbirth or neonatal death were all independently associated with an increased risk of distress. The loss of an infant or an unwanted pregnancy increased the risk of distress considerably respectively
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			<p>or convulsions; vaginal bleeding; retained placenta; tear around birth passage; umbilical cord around infant's neck; foul smelling discharge; excessive vaginal bleeding; leaking from vagina</p>						
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15.	Rees 2016	Self-reported	Face to face questionnaire; the diagnosis and severity of violence were assessed using a modified questionnaire based on the Index of Spouse Abuse and Severity of Violence against Women Scale		Maternal and neonatal complications -prevalence not reported -only associations reported			43.8% of women reported violence during pregnancy. Of these women 79.1% had mild violence and 20.9% severe violence Maternal complications were higher in women who experienced violence (30.2% vs 23.6%, p=0.004). Women who experienced sexual violence had more maternal complications (43.2%), and women who experienced psychological violence had more neonatal complications (54.2%)
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16.	Shamu 2014	Self-reported	Edinburgh Postnatal Depression Scale, the Kessler-10 psychological distress scale and the Harvard Trauma Questionnaire. Intimate partner violence was assessed by the World Health Organization questionnaire				EPDS ≥ 13 - (19.7%); PTSD ≥ 2 (5.7%); Kessler (K10) ≥ 30 (6.3%); any mental distress (24.1%)	No abuse (10.8%); low respect (32.9%); severe psychological abuse (30.6%); physical abuse (6.2%); physical and psychological abuse (19.5%)	Intimate partner violence showed a dose-response relationship with depressive symptoms
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17.	Shamu 2016	Self-reported	Adapted WHO questionnaire for intimate partner violence. HIV status from clinical notes			HIV prevalence was 15.3%	Not reported in this paper	60% of women reported at least one episode of physical, sexual or emotional abuse in the past 12 months	Positive HIV status was associated with intimate partner violence. Factors associated with intimate partner violence were gender inequity, past intimate partner violence, risky sexual behaviour and living with relatives
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18.	Stewart 2014	Self-reported	Adapted WHO intimate partner violence questionnaire. HIV status from clinical notes			HIV positive 15.1%.	One in five women (21.4%) met the diagnostic criteria for PND symptomatology whilst 21.6% reported postpartum suicide thoughts and 4% reported suicide attempts	Two thirds (65.4%) reported any form of intimate partner violence	Strong associations were found between postnatal depression and severe emotional abuse or severe combined forms of intimate partner violence. Suicidal ideation was associated with emotional abuse
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19.	Stöckl 2010	Maternal socio-demographic and health variables were measured, and associations with SRQ score and depression diagnosis were determined.	Symptoms of depression and anxiety, and non-specific somatic symptoms commonly associated with distress, were measured using validated local versions of the Self-Reporting Questionnaire (SRQ). In a sub-sample, Diagnostic Statistical Manual (DSM)-IV diagnoses of major and minor depressive disorders were made using the Structured Clinical		Complication in previous pregnancy (15.4%); had a child die (17.2%)	HIV positive (10.8%)	Depressive episodes: major (10.7%) minor (10.4%). The adjusted weighted prevalence of current major depressive episode and current major or minor depressive episode were 10.7 % (95 % CI 6.9-14.5 %) and 21.1 % (95 % CI 15.5-26.6 %) respectively	Intimate partner violence (22%).	On multivariate analysis, SRQ score was significantly associated with lower perceived social support, experience of intimate partner violence, having had a complication in a previous delivery, higher maternal mid-upper arm circumference and more years of schooling
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			Interview for DSM-IV						
20.	Surkan 2017	Self-reporting	Intimate partner violence and social circumstances; a woman was categorised as having experienced violence during pregnancy if she answered yes to the question “Was there ever a time when you were beaten or physically assaulted by (any of) your partner(s) whilst you were pregnant?”	No data reported in paper	No data reported in paper		No data reported in paper	7% (n=88) of women in Dar es Salaam and 12% (n=147) of women in Mbeya reported having experienced violence. Substance misuse (alcohol) -not reported	Women's odds of drinking during their last pregnancy were significantly increased if they had experienced violence during pregnancy

21.	Tsai 2016	Self-reporting based on symptomatic reporting	Questionnaire using symptoms	Prolapse (2.2%); Stress incontinence (3.2%); continuous dripping of urine (0.33%); severe headache (14.2%); anaemia (18.7%)		Reproductive infection (2.5%); urinary tract infection (6.04%); pneumonia (4.9%); gastro-enteritis (22.1%)	The percentage of women who experienced high depressive symptoms (3–5 symptoms) was 13.5%		All postpartum illnesses were associated with an increased relative risk of depressive symptoms by 6 months postpartum
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22.	Ukachu- kw 2009	Self-reporting	Xhosa version of the EDPS for depression; items inquiring about the frequency with which a woman's current or previous intimate partner had, during the past 12 months, slapped or thrown anything at her; pushed or shoved her; hit her with a fist or another object; or threatened or attacked her with a gun, knife, or other weapon. Responses were scored				39.5% of women screened positive for depression	At baseline, the prevalence of any intimate partner violence varied from 4.4–30.2%	After multivariable adjustment, intimate partner violence intensity had a strong and statistically significant association with depression symptom severity, regardless of the specification
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			on a four-point Likert type scale ranging from 1 (“never”) to 4 (“many”)						
23.	Wado 2014	Data extracted from case notes reviews	Data on sociodemographic, recorded antenatal care activities, maternal morbidities and deaths were elicited from case notes of all pregnancies and births over a 2-year period; own data extraction questionnaire used		Genital tract trauma was the commonest morbidity suffered by the women during delivery (90.6%)	Urinary tract infection was the commonest maternal illness in pregnancy (14.5%); (3%) HIV positive	Psychological disorders constituted 5.3% of reported postpartum complications		Urinary tract infection was not found to be associated with any adverse outcome

24.	Waqas 2015	Self-reporting and mid upper arm circumference (MUAC) measurements were conducted	EDPS for depression; social support was measured using the MSSS (Maternity Social Support Scale); own questionnaire otherwise	MUAC <230 (18.1%); >230 (68.1%)	Mean birth weight measured (2989g). Low birth weight 17%.		Prenatal depression (17.2%) unwanted pregnancy (10.8%)	Social support - details not clear	Unwanted pregnancy, prenatal depression and social support were associated with low birth weight
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25.	Wong 2017	Self-reported	Demographics, the Hospital Anxiety and Depression Scale (HADS) and the Social Provisions Scale (SPS)		Previous miscarriage (8.8%), and previous abortion (22%). A history of at least one episiotomy was reported (16.2%), and a history of at least one Caesarean delivery was reported by 136 (27.2%) women		Anxiety levels in participants were categorized as normal (145 women, 29%), borderline (110, 22%) or anxious (245, 49%). Depression levels were categorized as normal (218 women, 43.6%), borderline (123, 24.6%) or depressed (159, 31.8%)	SPS scores - not clear from the paper; unplan- ned pregnan- cy (73%); Harass- ment 33 (6.6%)	Inferential analysis revealed that higher HADS scores were significantly associated with lower scores on the SPS, rural background, history of harassment, abortion, cesarean delivery and unplanned pregnancies (P <0.05)
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26.	Zafar 2015	Semi structured questionnaires documents signs and symptoms, examination and laboratory tests	EDPS for depression; symptoms and signs bundled to reflect infectious, non-infectious, psychological morbidity	Malawi - APH (3.1%); anaemia (39.5%); pre-eclampsia (0.2%); incontinence (0%); nausea and vomiting (19.1%); epilepsy (0.3%); asthma (1.0%). one non-infective morbidity (28.8%) two non-infective morbidities (1.2%); three non-infective morbidities (0.2%)	One in 10 women in Malawi reported a previous pregnancy complication	Malaria (8.2%); fever (2.4%); UTI (5.4%); STI (7.5%); HIV positive (16.0%); suspected TB (0.8%); hepatitis (0%); one infective morbidity (25.9%) two infective morbidities (5.4%); three infective morbidities (1.3%)	2.6% of women in Malawi had EPDS >9		Antepartum bleeding increased the odds of psychological morbidity 5-fold
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				<p>Pakistan-APH (4.1%); anaemia (35.3%); pre-eclampsia (0.8%); incontinence (4.7%); nausea and vomiting (18.8%); epilepsy (0.8%); asthma (1.4%). one non-infective morbidity (34.4%) two non-infective morbidities (6.9%); three non-infective morbidities (1.8%)</p>	<p>1 in 5 women in Pakistan reported a previous pregnancy complication.</p> <p>Multiple morbidities were uncommon (<10%)</p>	<p>Malaria (2.7%); fever (3.1%); UTI (8.2%); STI (14.9%); HIV positive (6.3%); suspected TB (10.0%); hepatitis (1.6%); one infective morbidity (21.1%) two infective morbidities (6.4%); three infective morbidities (4.1%)</p>	<p>26.9% of women in Pakistan had EPDS >9</p>	<p>For Pakistan, results show a 56% increase in odds of psychological morbidity due to increasing burden of infective morbidity.</p> <p>Complications during a previous pregnancy, infective morbidity (p <0.001), intra or postpartum haemorrhage (p <0.02) were associated with psychological morbidity in both settings</p>
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Appendix 3: Reasons for exclusion of papers at full text stage data extraction for the systematic review

Reason for exclusion at full text	Number of papers excluded
The outcome of interest was gynaecology conditions in a non-pregnant population	12
The outcome of interest was severe acute maternal morbidity	2
The outcome of interest was neonatal morbidity and not related to maternal morbidity	2
The outcome of interest was the health systems	1
The outcome of interest was one maternal morbidity condition only	6
TOTAL	23

Appendix 4: Grading the quality of articles included in the systematic review

Description of the study		Are the results of the study valid?				What are the results?						Are the results helpful?		Summary
No	Author, year	Did the study address a clearly focused issue?	Did the authors use an appropriate method to answer the research question?	Are the participants recruited in an acceptable way?	Are the measurements used valid & reliable?	Are appropriate analytical methods used?	Did the results answer the research question /aim?	How precise are the results ?	Did the author/s discuss the study limitations ?	Do we believe the results (bias, chance, confounding)?	Can the results be generalized?	Do the results of this study fit with other available evidence ?	Did the results answer the research question /aim?	Grading of study
1.	Assarag 2013	2	1	1	1	1	2	1	2	1	1	1	2	16
2.	Brittain 2017	1	1	1	1	1	1	1	1	1	1	1	1	12
3.	Chersich 2009	2	1	2	1	1	1	1	2	1	1	1	2	16
4.	Faisal-Cury 2009	1	1	1	1	1	1	1	1	1	1	1	1	12
5.	Faisal-Cury 2010	1	1	1	1	1	1	1	1	1	1	1	1	12
6.	Karmalini 2009	1	1	2	1	1	1	1	1	1	1	1	1	12
7.	Isaksen 2015	2	1	2	1	1	2	1	1	1	1	1	1	15
8.	Hassan 2014	1	1	1	1	1	1	1	1	1	1	1	0	11
9.	Hanlon 2009	1	1	0	1	1	0	1	1	1	1	1	1	10

10.	Nasreen 2011	2	1	2	1	2	2	1	1	1	1	1	1	15
11.	Natasha 2015	2	1	1	1	1	1	1	1	1	1	1	1	13
12.	Ntaga- nira 2008	2	1	2	1	2	2	1	1	1	1	1	1	15
13.	Prost 2012	1	1	1	1	1	1	1	1	1	1	1	0	11
14.	Romero Gutiérrez 2011	1	1	1	1	1	0	0	1	1	1	1	0	9
15.	Rees 2016	2	1	2	1	1	2	1	2	1	1	1	2	17
16.	Shamu 2014	1	1	2	1	1	1	1	1	1	1	1	1	12
17.	Shamu 2016	1	1	2	1	1	1	1	1	1	1	1	1	12
18.	Stewart 2014	1	1	1	1	1	0	1	1	1	1	1	1	10
19.	Stöckl 2010	1	1	1	1	1	0	1	0	1	1	1	0	9
20.	Surkan 2017	2	1	2	1	1	1	1	1	1	1	1	1	13
21.	Tsai 2016	2	1	2	2	1	1	1	1	1	1	1	1	14
22.	Ukachu- kw 2009	1	1	2	1	1	1	1	1	1	1	1	1	12
23.	Wado 2014	1	1	1	1	1	0	1	1	1	1	1	1	10
24.	Waqas 2015	1	1	1	1	1	0	1	0	1	1	1	0	9

25.	Wong 2017	1	1	1	1	1	1	1	1	1	1	1	1	11
26.	Zafar 2015	2	1	2	2	1	2	1	2	1	1	1	2	18

Adapted from Critical Appraisal Skills Programme (CASP 2015)

*Variable of quality	Score per variable
No	0
Yes -to an extent	1
Yes-fully	2

*Quality of study	Score per variable
Low	<10
Medium	10-17
High	18-22

Appendix 5: Details of papers excluded from systematic review

Table A: Details of excluded studies due to sample size <500 women including descriptions of study design, country, setting, study participants, objective and main conclusion of the study.

No.	Author, year	Title	Study design	Country	Setting Facility	Study participants, gestation, and number	Objective of the study	Remarks and summary of study
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1.	Chibanda 2010	Postnatal Depression by HIV Status Among Women in Zimbabwe	Cross sectional study	Zimbabwe	Urban postnatal clinics	210 women > or equal to 18 years, attending postnatal clinic 6 weeks post- delivery and residing within the Chitungwiza catchment area.	To determine the prevalence and risk factors of PND.	64 (33%) met DSM-IV criteria for depression. HIV prevalence was 14.8% out of which 54% were depressed. Univariate analysis showed that multiparty both parents deceased and a recent adverse life event were significantly associated with PND. Multivariate analysis showed that PND was significantly associated with adverse life event, being unemployed and multiparity.
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2.	Dewing 2013	Food insecurity and its association with co-occurring postnatal depression, hazardous drinking, and suicidality among women in peri-urban South Africa	Cross sectional study	South Africa	Community households	249 women at three months postnatal.	To assess association of food insecurity, postnatal depression symptom severity, suicide risk, and hazardous drinking.	Each additional point on the food insecurity scale was associated with increased risks of probable depression (adjusted risk ratio [ARR], 1.05; 95% CI, 1.02–1.07), hazardous drinking (ARR, 1.04; 95% CI, 1.00–1.09), and suicidality (ARR, 1.12; 95%CI, 1.02–1.23).
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3.	Khalifa 2018	Determinants of postnatal depression in Sudanese women at 3 months postpartum: a cross-sectional study	Cross sectional study	Sudan	Two major public antenatal care clinics in two maternity teaching hospitals in Khartoum state	300 pregnant Sudanese women in their second or third trimester and were followed up and screened for postnatal depression at 3 months postpartum.	To explore the factors associated with postnatal depression at 3 months postpartum.	History of violence increased the odds of postnatal depression sevenfold. Older age of mothers decreased the odds of postnatal depression by almost 20%. Exclusive breast feeding and regular prenatal vitamins during pregnancy are associated with an 80% decrease in odds of PND.
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4.	Hamadani 2012	Association of Postpartum Maternal Morbidities with Children's Mental, Psychomotor and Language Development in Rural Bangladesh	Cross sectional study	Bangladesh	A poor rural area	Women who became pregnant (n=4,88) over a two-year period (2007-2008) as part of the MATLAB study and their babies.	To document the relationships of maternal morbidities with care-giving practices by mothers, children's developmental milestones and their language, mental and psychomotor development.	Maternal anaemia measured in the postpartum period showed a small but significantly negative effect on children's language expression and an approaching effect on language comprehension. No other postpartum conditions of the mother showed an effect on children's development.
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5.	Lukose 2013	Nutritional Factors Associated with Antenatal Depressive Symptoms in the Early Stage of Pregnancy Among Urban South Indian Women	Cross-sectional study	South India	Urban: Hosahalli Hospital	365 pregnant women aged between 18 and 40 years, who were 14 weeks of gestation and registered for antenatal screening at the Hosahalli Hospital.	To assess the prevalence of antenatal depressive symptoms in early pregnancy, and to identify the demographic and nutritional factors associated with these symptoms in a sample of urban South Indian pregnant women.	121 (33 %) of the women in the first trimester had symptoms consistent with depression (K-10 score). Antenatal depressive symptoms in early pregnancy are highly prevalent in urban Indian women and are more common in women with vomiting and without anemia.
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6.	Natamba 2014	Reliability and validity of the centre for epidemiologic studies- depression scale in screening for depression among HIV-infected and - uninfected pregnant women attending antenatal services in northern Uganda: a cross-sectional study	Cross-sectional survey	Northern Uganda	Facility based	123 (36 HIV-infected and 87 - uninfected) pregnant women receiving antenatal care.	To study the reliability and accuracy of the Center for Epidemiologic Studies Depression (CES-D) scale.	The CES-D is a suitable instrument for screening for probable major depression among pregnant women of mixed HIV status attending antenatal services in northern Uganda.
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7.	Ola 2011	Factors associated with antenatal mental disorder in West Africa: A cross-sectional survey	Cross-sectional survey	Lagos Nigeria	Facility based	200 consecutive pregnant women attending the antenatal clinic second or third trimester at the maternity clinic of the Lagos State University Teaching Hospital, Ikeja.	To assess the scale of antenatal and postnatal mental illness.	7% of women met the criteria for experiencing a common mental disorder. Exposure to interpersonal violence within the last 12 months and increasing numbers of female children predict the presence of mental illness in a sample of pregnant Nigerian women.
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8.	Rahman 2007	Association between antenatal depression and low birthweight in a developing country	Case Control	Rawalpindi, Pakistan.	Rural community	143 women depressed and 147 non-depressed aged 17–40 years in their third trimester of pregnancy.	To test the hypothesis that, in the setting of a low-income Pakistani community ICD-10 defined maternal depressive disorder in the third trimester of pregnancy is associated with LBW after controlling for possible confounders.	Infants of depressed mothers had lower birthweight than infants of non-depressed mothers.
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9.	Rao 2016	The impact of domestic violence and depressive symptoms on preterm birth in South India	Cross sectional	South India	Facility based	150 women over 18 years of age, Tamil speaking, in their second or third trimester of pregnancy, and seeking care at antenatal clinics in the cities of Vellore and Chennai.	To examine the impact of domestic violence and its psychosocial correlates on pregnancy and birth outcomes.	Psychological abuse and mild or greater depressive symptoms were significantly associated with increased risk of preterm birth. Physical abuse was also associated with increased risk of preterm birth, but this was not statistically significant. Low maternal education was associated with increased risk of preterm birth.
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10.	Vythilingum 2012	Risk factors for substance use in pregnant women in South Africa	Cross sectional self-reports	Cape town, South Africa	Facility based in an antenatal clinic	323 women presenting for their first antenatal visit who consented.	To study the prevalence of alcohol and substance use in a South African antenatal population and its correlates with socio-demographic factors, depression and perceived stress.	There were high rates of both alcohol abuse and antenatal depression, and a significant association between depression, substance use and alcohol abuse; EDS scores greater than 12 could be used to identify women at risk of alcohol dependence and/or substance abuse.
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11.	Rwakarema 2015	Antenatal depression is associated with pregnancy-related anxiety, partner relations, and wealth in women in Northern Tanzania: a cross-sectional study	Cross-sectional study	Northern Tanzania	Facility based at the antenatal clinic.	397 pregnant women in their second and first, second and third trimesters were recruited from three antenatal clinics.	To assess depression in pregnancy and related psychosocial risk factors among select pregnant women residing in Mwanza region, Northern Tanzania.	33.8 % of pregnant women had antenatal depression. Pregnancy-related anxiety was associated with antenatal depression. Pregnant women with poor relationship with partner and low/moderate socio-economic status had the highest OR for antenatal depression after adjusting for other covariates.
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12.	Tran 2012	Interactions among alcohol dependence, perinatal common mental disorders and violence in couples in rural Vietnam: a cross-sectional study using structural equation modelling	Cross-sectional study	Rural area of Vietnam	Population-based in randomly selected communes in Ha Nam and Hanoi, Vietnam.	364 women at least 28 weeks pregnant or were mothers of 4-6-week-old babies in the recruitment period. Overall, 230/360 (64%) of their husbands also participated.	The aim of this study was to examine the relationships among perinatal common mental disorders, alcohol abuse and domestic violence in couples in a rural, low-income setting.	Co-morbidities, perinatal common mental disorders and alcohol dependence in husbands have a significant adverse effect on the mental health of their wives in rural areas of Vietnam.
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13.	Tran 2013	Psychological and Social Factors Associated with Late Pregnancy Iron Deficiency Anaemia in Rural Viet Nam: A Population-Based Prospective Study	Prospective cohort	Rural area of Vietnam	Population-Based	378 women at 12 - 20 weeks gestation.	The aim of this study was to examine the relationships between psychological and social factors and late pregnancy iron deficient anemia among pregnant women in rural Vietnam.	Persistent common mental disorders were found in 16.9% pregnant women and was predicted by intimate partner violence, fear of other family members, experience of childhood abuse, coincidental life adversity, and preferring the sex of the baby.
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14.	Yator 2016	Risk factors for postpartum depression in women living with HIV attending prevention of mother to-child transmission clinic at Kenyatta National Hospital, Nairobi	Cross-sectional study	Nairobi, Kenya	Hospital based	123 postnatal women living with HIV attending prevention of mother-to-child transmission clinic at Kenyatta National Hospital located in Nairobi, Kenya.	To determine the prevalence and severity of postpartum depression among women living with HIV and to further understand the impact of stigma and other psychosocial factors.	Lower education and lack of family support were associated with presence of elevated depressive symptoms. PMTCT is an ideal context to reach out to women to address mental health problems especially depression screening and offering psychosocial treatments bolstering quality of life of the mother.
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Table B: Excluded studies due to sample size < 500 women, with details of data collection tools, types of maternal morbidity measured and association between morbidities and/or any other major findings.

No	Author, year	Type of data collection	Data collection tool used	Physical			Psycho-logical	Social	Association between morbidities and/or any other major findings
				Medical	Obstetric	Infectious			
1.	Chibanda 2010	Primary	Shona version of the Edinburgh Postnatal Depression Scale (EPDS)			14.8% of women were HIV positive.	33% of women screened positive for depression.		Multiparity, adverse life events, and unemployment were associated with postnatal depression.

2.	Dewing 2013	Primary	Xhosa version of the 10-item Edinburgh Postnatal Depression Scale (EPDS); suicidality module of the Mini International Neuropsychiatric Interview (MINI), version 5.0.0, for hazardous drinking; TWEAK screening instrument, Household Food Insecurity Access Scale (HFIAS).				31.7% women met screening criteria for probable depression; 7.6% women had significant suicidality of whom (2.8%) were classified as high risk.	59.8% women were severely food insecure; 15.7% women met screening criteria for hazardous drinking.	Each additional point on the food insecurity scale was associated with increased risks of probable depression (adjusted risk ratio [ARR], 1.05; 95% CI, 1.02–1.07), hazardous drinking (ARR, 1.04; 95% CI, 1.00–1.09), and suicidality (ARR, 1.12; 95% CI, 1.02–1.23).
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3.	Khalifa 2018	Primary	<p>EPDS at a cut-off score of ≥ 12. Data were collected on the history of any psychological condition, history of violence, place of stay after birth, supportive person after birth, complications during pregnancy and birth, planning of current pregnancy, regular uptake of prenatal vitamins, breastfeeding practices, circumstances during and after pregnancy and satisfaction with current quality of life.</p>				9.2% of women screened positive for depression.	8.8% of women reported a history of violence.	<p>History of violence increased the odds of postnatal depression sevenfold, OR=7.4 (95% CI 1.9 to 27.6). Older age of mothers decreased the odds by almost 20%, OR=0.82 (95% CI 0.73 to 0.92). Exclusive breast feeding and regular prenatal vitamins during pregnancy are associated with an 80% decrease in odds OR=0.2 (95% CI 0.06 to 0.70) and 0.17 (95% CI 0.06 to 0.5) respectively.</p>
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4.	Hamadani 2012	Follow up of a primary study	SES index available in the HDSS. Community Health Research Workers (CHRWs) collected information on place and mode of delivery, pregnancy outcomes, any complication during or after delivery, reason for and duration of hospitalization, and haemoglobin level using a HemoCue; urine was checked for pus cells and red blood cell count; EDPS was used for depression, modified version	Moderate or severe anaemia was present in 35% women; UTI in 5% women.	4% of women had a major morbidity, 62% a minor morbidity. Vesico-vaginal fistula 10%; Recto-vaginal fistula 2.5%; 21% uterine prolapse; 15% haemorrhoids; 11% pelvic inflammatory disease; 22% dysuria; 18%	9% of women had signs of abdominal infection.	17% and 11% suffered from postpartum depression at six weeks and six months post-delivery.		<p>Maternal postpartum anaemia had a small but significantly negative effect on children's language expression, and the effect on comprehension approached significance.</p> <p>Other factors that predicted the development of children were age at test, gestational age, psychosocial stimulation at home, concurrent nutritional status, SES, and maternal education</p>
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			<p>of the Home Observation for Measurement of Environment (HOME) for infants and toddlers. 10 motor milestones were used for assessing children’s motor development at six months of age. Children’s mental and psychomotor development indices were assessed using the revised version of Bayley Scales of Infant Development.</p>		<p>stress incontinence; 1% perineal tear; 15% pelvic organ prolapse.</p>				
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5.	Lukose 2013	Primary	Food frequency questionnaire (FFQ), Kessler Psychological Distress Scale (K-10), haemoglobin and complete blood count, Vitamin B12, homocysteine and methylmalonic acid, medical morbidity through a questionnaire.	35% of women reported nausea; 57.7% vomiting, 57.7% of women had anaemia (Hb < 11.0 g/dL).			33% of women reported antenatal depressive symptoms	The median dietary intake of energy, protein, iron, calcium and folate among pregnant women was lower compared to the Indian recommended dietary allowance (RDA)	In multivariate log binomial regression analysis, presence of antenatal depressive symptoms in the first trimester were positively associated with vomiting, prevalence ratio (PR) = 1.54 (95 % CI 1.10, 2.16) and negatively with anemia, PR = 0.67 (95 % CI 0.47, 0.96). Nutrient intakes, serum vitamin B12, methylmalonic acid, homocysteine and red cell folate levels were not associated with measures of depression.
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6.	Natamba 2014	Primary	Center for Epidemiologic Studies Depression (CES-D) scale and the Mini-International Neuropsychiatric Interview (MINI) for current major depressive disorders.			36 HIV-infected and 87 - uninfected	35.8% of women reported depression		The CES-D had high internal consistency and good discriminatory ability in detecting MINI-defined current major depressive disorders. The optimum CES-D cutoff score for the identification of probable major depressive disorders was between 16 and 17.
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7.	Ola 2011	Primary	<p>Self-reporting questionnaire 20 items – SRQ 20. The WHO Multi-Country Study on Women’s Health and Domestic Violence Questions were used to assess women’s exposure to violence.</p>				7% of women met the criteria for a common mental disorder	<p>12.2% of women had ever been exposed to violence. History of IPV in the past 12 months (9.5%). 11.1% of women reported a history of substance use. 15.3% of women reported an unplanned pregnancy (15.3%).</p>	<p>Of variables examined only the number of female children and the presence of inter personal violence predicted being a case of mental illness (OR = 3.400; 95%CI = 1.374 - 8.414 and OR = 5.676; 95% CI = 1.251 - 25.757 respectively).</p>
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8.	Rahman 2007	Primary	<p>Schedules for Clinical Assessment in Neuropsychiatry (SCAN). Birth weight using 25kg spring balance Salter Scale. Ownership of household assets using the World Bank Assets Questionnaire for Pakistan.</p> <p>LHWs, who lived in the same locality and had intimate knowledge about the families being studied, rated the household on a five-point Likert scale ranging from 1 (richest) to 5(poorest).</p>		25% of women in the sample had a baby with a low birth weight.		25% of women were diagnosed with a depressive disorder.		<p>Infants of depressed mothers had lower birth weight (mean 2910 g) than infants of non-depressed mothers (mean 3022 g). The relative risk for LBW (2500 g) in infants of depressed mothers was 1.9 (95% CI 1.3–2.9). The association remained significant after adjustment for confounders by multivariate analyses.</p>
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9.	Rao 2016	Primary	Domestic violence questions, adapted from the India SAFE study questionnaire. Posttraumatic Stress Disorder (PTSD). Checklist-civilian version (PCL-C), (PHQ-9).		12% of women had pregnancy complications (gestational diabetes and preeclampsia); 14.3% of women had a Caesarean section, 2.7 % of the newborns had problems at birth, and 2.7 % were stillborn. 12 % of women had babies that were		21% of women reported clinically significant depressive symptoms and 19 % reported clinically significant post-traumatic stress disorder symptoms.	24% of women reported psychological abuse, and 29 % of women reported physical abuse.	Psychological abuse (OR 3.9; 95 % CI 1.19–12.82) and mild or greater depressive symptoms (OR 3.3; 95 % CI 0.99–11.17) were significantly associated with increased risk of preterm birth. Physical abuse was also associated with increased risk of preterm birth, but this was not statistically significant (OR 1.9; 95 % CI 0.59–6.19). In each of the above adjusted models, low maternal education was associated with increased risk of preterm birth, in the analysis with depressive symptoms OR 0.18,
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					born preterm.				CI 0.04–0.86 and in the analyses with psychological abuse OR 0.19, CI 0.04–0.91.
10.	Vythilingum 2012	Primary	Alcohol Use Disorders Identification Test (AUDIT); Drug Use Disorders Identification Test (DUDIT); Edinburgh Postnatal Depression Scale (EDPS) and Perceived Stress Scale (PSS).				Using EPDS cut-off scores of 12 and 15, 48.9% and 33.6% of women had scores consistent with major depression.	During pregnancy 36.8% of women smoked, 20.2% used alcohol and 4% used substances	An EPDS cut-off score of 12 was significantly associated with both alcohol use (25.9% v. 15.2%, p=0.019) and risky drinking (76.9% v. 36.8%, p=0.04), while an EPDS cut-off score of 15 was significantly associated with substance use (8.2% v. 1.4%, p=0.004) as well as alcohol dependence (23.1% v. 3.1%).

11.	Rwakarema 2015	Primary	<p>Edinburgh Postnatal Depression Scale. structured questionnaire assessing psychosocial, demographic, and behavioural risk factors related to antenatal depression. Pregnancy-related anxiety was assessed using the pregnancy-related anxiety 10-item tool (4-point Likert scale) evaluating a woman's feelings. For social ill-health, three closed-ended questions were asked: (a) Are you involved in decision-making</p>				<p>33.8 % (n = 134) of pregnant women had antenatal depression. Pregnancy-related anxiety – 6%.</p>	<p>24.4% of women reported poor support from their family; 12.6% of women reported poor relations with their partner.</p>	<p>Pregnant women with poor relationship with partner and low/moderate socio-economic status had the highest OR for antenatal depression (82.34, 95 % CI 4.47, 1516.60) after adjusting for other covariates. Pregnant women with poor relationship with partner and high socio-economic status had an OR of 13.48 (95 % CI 1.71, 106.31) for antenatal depression.</p>
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			<p>regarding your pregnancy? (always, sometimes, never); (b) How would you describe your relationship with your partner? (very good, fair, poor); and (c) Do you feel supported by members of your family? (very much supported, fairly supported, not supported).</p>						
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12.	Tran 2012	Primary	<p>Clinical Interviews for the DSM IV Axis 1 Diagnoses (SCID-I) modules for depression, generalised anxiety, and panic disorders.</p> <p>Alcohol dependence was assessed using the CAGE questionnaire.</p> <p>Experience of intimate partner violence was measured by experiences in three domains: fear of and actual physical violence, controlling behaviours, and absence of affection and care.</p>				<p>30.9% of women and 17% of men reported depression.</p> <p>Overall, in 7.4% of couples both wife and husband were diagnosed with depression; and 41.2% of couples had at least one member with depression.</p>	<p>26.8% of men and no women were alcohol dependent.</p>	<p>After controlling for other psychosocial risk factors, comorbid common mental disorders and alcohol dependency in husbands increased by 4.7 times the probability of common mental disorders in their wives via intimate partner violence.</p>
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13.	Tran 2013	Primary	<p>Iron deficient anaemia was defined as Haemoglobin < 11 g/dL and serum ferritin < 15 ng/mL. Symptoms of Common Mental Disorders were assessed by the Edinburgh Postnatal Depression Scale-Vietnam (EPDS-V).</p> <p>Persistent antenatal common mental disorder was defined as having an EPDS-V score ≥ 4 in both W1 and W2.</p>	<p>The incidence risk of iron deficient anaemia in the third trimester was 13.2% (95% confidence interval (CI): 9.8-16.7)</p>			<p>Persistent common mental disorder was found in 16.9% (95% CI: 13.1-20.7) pregnant women.</p>	<p>The prevalence of lifetime experience of intimate partner violence (13%), fear of other family members (5.9%) and household food insecurity (30%).</p>	<p>Persistent common mental disorders were predicted by intimate partner violence, fear of other family members, experience of childhood abuse, coincidental life adversity, and preferring the sex of the baby. Early pregnancy Iron deficient anaemia and being multiparous also contributed to late pregnancy Iron deficient anaemia.</p>
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14.	Yator 2016	Primary	Edinburgh Postnatal Depression Scale and HIV/AIDS Stigma Instrument – PLWHA (HASI – P).			9.8% of women were treated for STI in previous months. Child HIV positive 3%	48% (n=59) of women screened positive for elevated depressive symptoms. 29% (n =36) of women had suicidal ideation.	9% of women reported high levels of stigma; physical abuse by husband 8.4%; Women reported good social support from family 44%; friends 30%; and significant others 15%.	Multivariate analyses showed that lower education (OR = 0.14, 95% CI [0.04–0.46], p = .001) and lack of family support (OR = 2.49, 95% CI [1.14–5.42], p = .02) were associated with the presence of elevated depressive symptoms. Stigma was positively correlated with an increase in post- partum depression.
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Appendix 6: Data collection tool

The following section contains the paper version of the data collection tool that was used in the antenatal stages in Malawi. For India, Pakistan and Kenya, this data collection tool was formatted onto iPads® for electronic data collection. For women in the postnatal stages, all obstetric questions were not asked.

Scanned

Questionnaire for Assessment of Maternal Morbidity

Antenatal Period

Section A: Identification

- A1 Stage of pregnancy: Early antenatal (<= 20 weeks) Late antenatal (> 20 weeks)
- A2 Study number:
- A3 Date of completion: / /
- A4 Completed at:
- A5 Completed by:
- A6 Data collector ID:

Section B1: Socio-Demographic Characteristics

- B1.1 Date of birth: / /
- B1.2 Marital status Single Married Divorced Widowed Other
- B1.3 Occupation:
- B1.4 Does your household have: *(mark all that apply)*
- | | | |
|--|---|---|
| <input type="checkbox"/> Electricity | <input type="checkbox"/> Television | <input type="checkbox"/> Sofa set |
| <input type="checkbox"/> Kolobori | <input type="checkbox"/> Cell phone | <input type="checkbox"/> Table and chairs |
| <input type="checkbox"/> Paraffin lamp | <input type="checkbox"/> Telephone (landline) | <input type="checkbox"/> Refrigerator |
| <input type="checkbox"/> Radio | <input type="checkbox"/> Bed with mattress | |
- B1.5 Level of formal education completed: *Please mark only one option* None Primary Secondary Post-secondary
- B1.6 Number of years of formal education completed: years

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Section B2: History of Previous Pregnancy and Childbirth

B2.1 How many times have you been pregnant including this pregnancy?

B2.2 How many times have you delivered a baby after 28 weeks (7 months) of pregnancy?

Please tell us about your last 6 completed pregnancies, starting with the most recent:
(Please use code sheet 1)

	Year	Pregnancy complications	Born alive	Mode of delivery	Maternal outcomes	Newborn outcomes
B2.3 Pregnancy 1	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8
B2.4 Pregnancy 2	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8
B2.5 Pregnancy 3	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8
B2.6 Pregnancy 4	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8
B2.7 Pregnancy 5	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8
B2.8 Pregnancy 6	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="checkbox"/> Ectopic <input type="checkbox"/> Misc <input type="checkbox"/> Bleed	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/>	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> 1 <input type="checkbox"/> 5 <input type="checkbox"/> 2 <input type="checkbox"/> 6 <input type="checkbox"/> 3 <input type="checkbox"/> 7 <input type="checkbox"/> 4 <input type="checkbox"/> 8

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Section C: Symptoms

C1. In the past 30 days, how good has your health been? Very good Good Neither good nor poor Poor Very poor

Have you experienced any of the following symptoms in the last 24 hours and if so how much were you bothered by them?

	Yes	No	Not at all	Slightly	Moderately	A lot
C2. Gastrointestinal						
C2.1 Yellowness of the eyes (jaundice)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.2 Lesions in the mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.3 Vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.4 If yes, do you vomit with blood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.5 Diarrhoea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.6 If yes, is it bloody	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.7 Constipation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.8 Rectal bleeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.9 Weight loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.10 Upper abdominal pains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.11 Lower abdominal pains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.12 Abdominal distension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C2.13 Incontinence of faeces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3. Infections						
C3.1 Fever	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.2 Lumps in the groin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.3 Lumps in the armpit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C3.4 Offensive discharge from a wound site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4. Cardio-pulmonary						
C4.1 Feeling dizzy or faint	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.2 Feel your heart beating very fast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.3 Easy bruising	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.4 Breath faster than usual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.5 Swollen fingers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.6 Swollen legs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.7 Generalized body swelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.8 Cough	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C4.9 If yes, less than 2 weeks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.10 If yes, more than 2 weeks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.11 Yellowish sputum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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■ Have you experienced any of the following symptoms and if so how much were you bothered by them? ■

	Yes	No	Not at all	Slightly	Moderately	A lot
C4.12 Blood sputum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.13 Difficulty breathing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.14 Chest pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C4.15 Wheezing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5. Urinary tract						
C5.1 Blood-stained urine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.2 Leakage of urine (if No, go to C5.5)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.3 Leakage of urine all the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.4 Leakage of urine with coughing, sneezing and laughing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C5.5 Pains while passing urine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6. Vulva and vagina						
C6.1 Discharge from the vagina which you consider abnormal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.2 Any itching	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.3 Vaginal bleeding (if No, go to C6.6)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
C6.4 Spontaneous vaginal bleeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.5 Provoked vaginal bleeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.6 Wound on the vulva	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.7 Swelling on the vulva	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C6.8 Pain during sex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7. Pelvic organ						
C7.1 Usually have a bulge or protrusion that you can see or feel coming out of your vagina	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.2 Have to push on the vagina or around the rectum to correct a bowel movement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.3 Have to push up on the bulge in the vagina to start or complete urination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C7.4 Feeling of incomplete emptying of the bladder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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	Yes	No	Not at all	Slightly	Moderately	A lot
C8. Skin						
C8.1 Skin rash	<input type="checkbox"/>					
C8.2 Itchy skin	<input type="checkbox"/>					
C8.3 Lumps on your skin	<input type="checkbox"/>					
C8.4 Wounds on your skin	<input type="checkbox"/>					
C9. Nervous system						
C9.1 Abnormal skin sensation (tingling, pricking)	<input type="checkbox"/>					
C9.2 Visual disturbance	<input type="checkbox"/>					
C9.3 Speech disturbance	<input type="checkbox"/>					
C10. Endocrine system						
C10.1 Always feeling cold	<input type="checkbox"/>					
C10.2 Having excessive thirst that you find disturbing	<input type="checkbox"/>					
C11. Pregnancy complications						
C11.1 Loss of water from vagina	<input type="checkbox"/>					
C11.2 Baby not moving	<input type="checkbox"/>					
C11.3 Baby not growing big enough	<input type="checkbox"/>					
C11.4 Baby's growth is excessive	<input type="checkbox"/>					
C12. Breast						
C12.1 Sore nipples	<input type="checkbox"/>					
C12.2 Discharge from your nipples	<input type="checkbox"/>					
C12.3 Feel a lump or swelling in your breast	<input type="checkbox"/>					
C12.4 Pain in your breast	<input type="checkbox"/>					
C12.5 Skin changes on your breast	<input type="checkbox"/>					
C12.6 Excessive production of breast milk	<input type="checkbox"/>					
C13. Musculoskeletal system						
C13.1 Limping and cannot walk well	<input type="checkbox"/>					
C13.2 Back pains	<input type="checkbox"/>					
C13.3 Joint pains	<input type="checkbox"/>					
C13.4 Calf swelling on one leg	<input type="checkbox"/>					
C13.5 Leg pain and redness	<input type="checkbox"/>					
C14. Mouth, throat, nose and ear						
C14.1 Sore throat	<input type="checkbox"/>					
C14.2 Ulcers in the mouth	<input type="checkbox"/>					
C14.3 White coating on the tongue and mouth	<input type="checkbox"/>					
C14.4 Hearing impairment	<input type="checkbox"/>					
C14.5 Difficulty with perceiving smell	<input type="checkbox"/>					

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Are there any other symptoms you would like to report and if so how much are you bothered by them?

	Not at all	Slightly	Moderately	A lot
<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="text"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section C: Comments

Section D: Mental Health

In the past 7 days have you:
(mark most appropriate answer)

- | | | |
|---|--|--|
| D1 been able to laugh and see the funny side of things | <input type="checkbox"/> As much as I always do
<input type="checkbox"/> Not quite so much now | <input type="checkbox"/> Definitely not so much now
<input type="checkbox"/> Not at all |
| D2 looked with enjoyment to things | <input type="checkbox"/> As much as I ever did
<input type="checkbox"/> Rather less than I used to | <input type="checkbox"/> Definitely less than I used to
<input type="checkbox"/> Hardly at all |
| D3 blamed yourself unnecessarily when things went wrong | <input type="checkbox"/> No, never
<input type="checkbox"/> Not very often | <input type="checkbox"/> Yes, some of the time
<input type="checkbox"/> Yes, most of the time |
| D4 felt anxious or worried for no good reason | <input type="checkbox"/> No, not at all
<input type="checkbox"/> Hardly ever | <input type="checkbox"/> Yes, sometimes
<input type="checkbox"/> Yes, very often |
| D5 felt scared or panicked for no good reason | <input type="checkbox"/> No, not at all
<input type="checkbox"/> No, not much | <input type="checkbox"/> Yes, sometimes
<input type="checkbox"/> Yes, quite a lot |
| D6 been coping well with your daily routines | <input type="checkbox"/> I have been coping as well as ever
<input type="checkbox"/> Most of the time I have coped well | <input type="checkbox"/> Sometimes, I haven't been coping as well as usual
<input type="checkbox"/> Most of the time I haven't been able to cope at all |
| D7 unhappy and had difficulty sleeping | <input type="checkbox"/> No, not at all
<input type="checkbox"/> Not very often | <input type="checkbox"/> Yes, quite often
<input type="checkbox"/> Yes, most of the time |
| D8 felt sad | <input type="checkbox"/> No, not at all
<input type="checkbox"/> Not very often | <input type="checkbox"/> Yes, quite often
<input type="checkbox"/> Yes, most of the time |
| D9 been so unhappy that you have been crying | <input type="checkbox"/> No, never
<input type="checkbox"/> Only occasionally | <input type="checkbox"/> Yes, quite often
<input type="checkbox"/> Yes, most of the time |
| D10 thought of harming yourself | <input type="checkbox"/> Never
<input type="checkbox"/> Hardly ever | <input type="checkbox"/> Sometimes
<input type="checkbox"/> Yes, quite often |

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Section D: Comments

Section E: Treatment Received

- E1 Are you currently on treatment for any illness? Yes No If no, go to Section F.
- E2 Where were you treated?
- | | |
|--|--|
| <input type="checkbox"/> In patient healthcare facility | <input type="checkbox"/> Home treatment by health worker eg. Nurse, midwife, doctor |
| <input type="checkbox"/> Out-patient healthcare facility | <input type="checkbox"/> Home treatment by traditional healer/herbalist/spiritualist |
- E3 What were you treated with?
- Orthodox treatments**
- | | | |
|---|--|--|
| <input type="checkbox"/> Intravenous fluids | <input type="checkbox"/> Anti-epileptic | <input type="checkbox"/> Psychotropic drugs (for mental illness) |
| <input type="checkbox"/> Blood transfusion | <input type="checkbox"/> Anti-diabetic (insulin, oral hypoglycaemic) | <input type="checkbox"/> Steroids |
| <input type="checkbox"/> Antibiotic | <input type="checkbox"/> Dietary management | <input type="checkbox"/> Chemotherapy (anti-cancer) |
| <input type="checkbox"/> Antimalarial | <input type="checkbox"/> Lipid lowering treatment | <input type="checkbox"/> Haematinics (treatment of anaemia: Iron, folate, Vit B12) |
| <input type="checkbox"/> Anti-fungal | <input type="checkbox"/> Anti-hypertensive | <input type="checkbox"/> Bronchodilators (oral, intravenous, inhalers) |
| <input type="checkbox"/> Anti-retroviral treatment: (HIV) | <input type="checkbox"/> Anti-emetics (for excessive vomiting) | <input type="checkbox"/> Stool softeners |
| <input type="checkbox"/> Anti-virals (non-HIV) | <input type="checkbox"/> Dialysis | <input type="checkbox"/> Pain medications |
| <input type="checkbox"/> Anti-helminthics (de-worming) | <input type="checkbox"/> Diuretics | <input type="checkbox"/> Uterotonics (oxytocin, misoprostol, ergot) |
| <input type="checkbox"/> Anti-convulsant | <input type="checkbox"/> Anticoagulation (for blood clots) | <input type="checkbox"/> Tocolytics (uterine relaxant) |
- E4 **Traditional treatments**
- | | | |
|--|---|--|
| <input type="checkbox"/> Herbal potions | <input type="checkbox"/> Incantation | <input type="checkbox"/> Drinking potash-based preparation |
| <input type="checkbox"/> Praying | <input type="checkbox"/> Scarification with application of traditional herbs powder | <input type="checkbox"/> Hot pepper |
| <input type="checkbox"/> Drinking holy water | <input type="checkbox"/> Hot water bath | <input type="checkbox"/> Other traditional treatment (specify below) |
- E5 **Surgical treatments**
- | | | |
|--|--|--|
| <input type="checkbox"/> Cervical cerclage | <input type="checkbox"/> Incision and drainage | <input type="checkbox"/> Pelvic/rectal surgery (prolapse, fistula, perineal tear repair etc) |
| <input type="checkbox"/> Caesarean section | <input type="checkbox"/> Hysterectomy | <input type="checkbox"/> Laparotomy |
| <input type="checkbox"/> Instrumental vaginal delivery | <input type="checkbox"/> Uterine compression surgery | <input type="checkbox"/> Laparoscopy |
| <input type="checkbox"/> Appendectomy | <input type="checkbox"/> Uterine artery ligation | |

Section E: Comments

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■ **Section F: Quality of Life** ■

- F1 In the past 30 days, how would you rate your quality of life?
 Very good Good Neither good nor poor Poor Very poor
- F2 How satisfied are you with your health?
 Very satisfied Satisfied Neither satisfied nor dissatisfied Dissatisfied Very dissatisfied
- F3 How satisfied are you with your ability to perform your daily living activities?
 Very satisfied Satisfied Neither satisfied nor dissatisfied Dissatisfied Very dissatisfied
- F4 How satisfied are you with yourself?
 Very satisfied Satisfied Neither satisfied nor dissatisfied Dissatisfied Very dissatisfied
- F5 How satisfied are you with your personal relationships?
 Very satisfied Satisfied Neither satisfied nor dissatisfied Dissatisfied Very dissatisfied
- F6 How satisfied are you with the conditions of your living place?
 Very satisfied Satisfied Neither satisfied nor dissatisfied Dissatisfied Very dissatisfied
- F7 Do you have enough energy for everyday life?
 Never Rarely Sometimes Mostly Completely
- F8 Do you have enough money to meet your needs?
 Never Rarely Sometimes Mostly Completely

Section F: Comments

■ **Section G: Risk Factors** ■

G1. Use of Tobacco, Alcohol, Drugs and Other Substances

In the past 3 months, how often have you used the following substances?

- G1.1 Tobacco products (cigarettes, chewing tobacco, cigars)
 Never Only once or twice in last year Monthly Weekly Daily or almost daily
- G1.2 Alcohol (beer, wine, spirits)
 Never Only once or twice in last year Monthly Weekly Daily or almost daily
- G1.3 Inhalants (nitrous, glue, petrol, paint thinner)
 Never Only once or twice in last year Monthly Weekly Daily or almost daily
- G1.4 Sedatives or sleeping pills (valium, serepax, rohypnol)
 Never Only once or twice in last year Monthly Weekly Daily or almost daily

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G2. Domestic Violence

In the past 3 months, how often have you been:
(mark as appropriate)

	0	1	2	3	4	5+
G2.1.1 Physically hurt by husband/partner?	<input type="checkbox"/>					
G2.1.2 Physically hurt by other family member?	<input type="checkbox"/>					
G2.2.1 Insulted or talked down to by husband/partner?	<input type="checkbox"/>					
G2.2.2 Insulted or talked down to by other family member?	<input type="checkbox"/>					
G2.3.1 Threatened with harm by husband/partner?	<input type="checkbox"/>					
G2.3.2 Threatened with harm by other family member?	<input type="checkbox"/>					
G2.4.1 Screamed at or cursed by husband/partner?	<input type="checkbox"/>					
G2.4.2 Screamed at or cursed by other family member?	<input type="checkbox"/>					

Section G: Comments

Section H: Clinical Examination

H1. General Examination

H1.1 Does the woman agree to this examination? Yes No If no, go to Section H2

H1.2 Height cm

H1.3 Weight kg

H1.4 Temperature (oral) °C

H1.5 Respiratory rate /min

H1.6 Pulse rate /min

H1.7 Systolic BP mmhg

H1.8 Diastolic BP mmhg

H1.9 Conjunctival palor Yes No

H1.10 Sclera - Jaudice Yes No

H1.11 Goitre Yes No

H1.12 Pitting ankle oedema Yes No

H1.13 Pitting lower back oedema Yes No

H2. Examination of the Skin and Oral Cavity

H2.1 Does the woman agree to this examination? Yes No If no, go to Section H3

H2.2 Skin lumps Yes No

H2.3 Skin rashes Yes No

H2.4 Skin ulcers Yes No

H2.5 Skin pigmentation Yes No

H2.6 Growth Yes No

H2.7 Bleeding gums Yes No

H2.8 Coating of the tongue (thrush) Yes No

H2.9 Mouth ulcers Yes No



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H3. Examination of the breasts

Please use code sheet 3

- H3.1 Does the woman agree to this examination? Yes No If no, go to Section H4
- H3.2 Cracked nipple Yes No
- H3.3 Breast engorgement Yes No
- H3.4 Breast tenderness Yes No If yes, location code:

- H3.5 Breast abscess Yes No If yes, location code:

- H3.6 Lumps Yes No If yes, location code:

H4. Examination of the Abdomen

Please use code sheet 4

- H4.1 Does the woman agree to this examination? Yes No If no, go to Section H5
- H4.2 Abdominal scar Yes No If yes, location code:

--	--
- H4.3 Abdominal tenderness Yes No If yes, location code:

--	--
- H4.4 Abdominal masses Yes No If yes, location code:

--	--

H5. Obstetric Examination

- H5.1 Does the woman agree to this examination? Yes No If no, go to Section H6
- H5.2 Date of LMP

--	--

 /

--	--

 /

--	--

 /

--	--
- H5.3 Weeks of pregnancy

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 weeks
- H5.4 Symphysis-fundal height

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 cm
- H5.5 Fetal heart rate

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 /min
- H5.6 Lie of the fetus

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- H5.7 Presentation of the fetus Cephalic Breech

H6. Examination of the Vulva and Perineum (only for women with indication)

- H6.1 Does the woman agree to this examination? Yes No If no, go to Section H7
- H6.2 Vulval excoriation Yes No
- H6.3 Leakage of urine Yes No
- H6.4 Vulval swelling Yes No
- H6.5 Perineal excoriation Yes No
- H6.6 Perineal swelling Yes No
- H6.7 Perineal tear Yes No

H7. Speculum Examination (only for women with indication)

- H7.1 Does the woman agree to this examination? Yes No If no, go to Section I
- H7.2 Vaginal growth Yes No
- H7.3 Vaginal defect Yes No
- H7.4 Cervical growth Yes No
- H7.5 Cervical defect Yes No
- H7.6 Discharge Yes No
- H7.7 Bleeding from cervix Yes No
- H7.8 Amniotic fluid from cervix Yes No
- H7.9 Any other abnormality (specify) Yes No

H. Comments

DEACTIVATED

Section I: Investigations

11. Does the woman agree to be tested? Yes No
12. Haemoglobin . g/dl
13. Malaria test (RDT) Positive Negative
14. Syphilis Positive Negative
15. HIV (Performed previously) Not done Done - negative Done - invalid
 Done - positive Done - don't know result
16. HIV (Performed today) Positive Negative
17. Urine sugar 0 + ++ +++ ++++
18. Urine protein 0 Trace + ++ +++ ++++
19. Urine ketones 0 + ++
110. Urine red blood cells Positive Negative
111. Urine leucocytes 0 + ++ +++
112. CRP .

First ultrasound scan of this pregnancy:

113. Ultrasound Scan: Done Not done
- 113.1 Date done: / /
- 113.2 Gestational age
- 113.3 Multiple pregnancy Yes No Unknown

Please list any other tests performed on patients condition at time of interview:

Other test 1	<input type="text"/>	Result	<input type="text"/>
Other test 2	<input type="text"/>	Result	<input type="text"/>
Other test 3	<input type="text"/>	Result	<input type="text"/>

Section I: Comments

- Outcome: Continue routine care
 Additional care required in same facility
 Referral to another health care facility for further care
 Other, please specify

Checked by: Name (please print clearly) Signature

DEACTIVATED

Appendix 7: Training timetable for the maternal morbidity study research team

Time	Activity	Mode
8.15 - 9.00	Registration	
9.00 - 9.10	Welcome and introductions Getting to know each other	Each person introduces themselves
9.10- 9.20	Training objectives and outline	Short presentation
9.20 - 9.40	Session 1: Introduction to the study - Background and objectives	Interactive lecture Q&A
9.40 – 10.00	Session 2: Obtaining informed consent - The participant information sheet - How to administer the participant information sheet - Signing the consent form	Interactive lecture Small group work Q&A
10:00 - 10:15	Refreshments	
10.15 - 11:00	Session 3: Introduction to the maternal morbidity data collection tool Electronic data collections Explanation of each sections of the questionnaire How to navigate the questionnaire	Interactive lecture Demonstration of the use of the hand held computerized device Q&A
11.00 - 13.00	Session 4: Role play using questionnaire Obtaining consenting Administering the electronic questionnaire using the hand-held device	Participants practice how to obtain consent and conduct a practice interview using the questionnaire in pairs with a facilitator observing.
13.00 - 14.00	Lunch	
14.00 - 15.00	Session 5: Feedback from group work on consenting and administering the tool.	Plenary Discussion of problems and solutions
15.00 - 16.30	Session 6: Practice of data entry into electronic questionnaire	Participants practice how to obtain consent and conduct a practice interview using the questionnaire in pairs with a facilitator observing.
16:45	Summary of day one	

Time	Activity	Mode
8.15 - 9.00	Registration	
9.00 - 13.00	<p>Session 1: Standards of examination and completion of questionnaires</p> <p>Details of examination</p> <p>Simultaneous data entry into hand held devices</p>	<p>Demonstration of obtaining blood samples</p> <p>Each data collector to demonstrate competency in examination</p>
13.00 - 14.00	Lunch	
14.00 - 15.00	<p>Session 2. Introduction of the test kits and details of how to perform investigations</p> <ul style="list-style-type: none"> - Details of each test kit - Practice conducting urine and blood investigations - Simultaneous data entry into hand held devices 	<p>Interactive lecture</p> <p>Actual demonstration and each researcher to practice obtaining samples</p>
15:00 - 16:30	<p>Session3: Data management and logistics</p> <ul style="list-style-type: none"> - Logistics of the use of hand held devices <p>Monitoring and evaluation</p> <ul style="list-style-type: none"> - Password protection -Storage of information - Ensuring confidentiality 	Plenary
15.45- 16.00	Summary of day two, plan for pilot study	

Time	Activity	Mode
8.15 - 9.00	Registration and briefing for pilot study	
9.00 - 13.00	Conduct pilot study under supervision	- Field work at selected facility

	<ul style="list-style-type: none"> - Face to face interviews - Conducting basic examinations - Simultaneous data entry into hand held device 	<p>under supervision with facilitators</p> <ul style="list-style-type: none"> - Aim to conduct full interview, examination for one patient for each data collector
13.00 - 14.00	Lunch	
14.00 - 15.30	Feedback from the pilot	<ul style="list-style-type: none"> - Plenary - Discussion of problems encountered and solutions
15.30 - 16.00	Summary and details of work plan for main study	

Time	Activity	Mode
8.15 - 9.00	Registration and briefing for pilot study	
9.00 - 13.00	<p>Detailed feedback</p> <ul style="list-style-type: none"> - How to give feedback - Practice giving feedback for: <ul style="list-style-type: none"> ➤ Face to face interviews ➤ Conducting basic examinations ➤ Simultaneous data entry into hand held device • Details of changes to questionnaires • In depth discussion of each item on questionnaire 	<ul style="list-style-type: none"> - Lecture theatre - Group discussion
13.00 - 14.00	Research assistants -ongoing piloting	1 case each

Appendix 8: Consent form

Participant Identification Number for this Study:

1. I confirm I have read and understood the information sheet dated/...../..... for the above study.
Yes [] No []
2. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
Yes [] No []
3. I understand that participation in this study is voluntary and I am free to withdraw consent at any time, without giving a reason, without any penalties.
Yes [] No []
4. I understand that data collected during the study, may be looked at by individuals from LSTM and from regulatory authorities. I give permission for these individuals to have access to my records.
Yes [] No []
5. I hereby declare that I have not been subjected to any form of coercion in giving this consent.
Yes [] No []
6. I voluntarily agree to take part in this study.
Yes [] No []

Signing this declaration does not affect your right to decline to take part in any future study.

Name of participant	Date	Signature or thumb print
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Name of person obtaining	Date	Signature
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Consent

Appendix 9: Information sheet

You have been contacted to participate in this study entitled, **Assessing Maternal Morbidity**.

We are very interested to hear about your health and experiences during your current pregnancy and period after childbirth.

Purpose The purpose of this study is to learn about conditions that affect women while pregnant, during labour and delivery or within three months of childbirth which may not be life-threatening but could be a source of worry and discomfort to them.

Procedure During the study, you will be asked questions about some of the problems related to your pregnancy or childbirth or postnatal period. Afterwards a trained health care provider will examine you for any pregnancy or childbirth related problems taking care to avoid discomfort to you as much as possible.

As part of the physical examination, your height, weight and measurement of your pulse, blood pressure, and temperature will be taken. Your breasts and abdomen will be examined to find out any swelling, pain or infection. Depending on your symptoms, you may be offered an internal vaginal examination, only if this will help determine any ill-health.

You will be asked to provide a urine sample which will be checked for infection and the presence of protein and sugar that may suggest you may have a problem related to high blood pressure or diabetes. You will be asked if you are willing to have a simple blood test (finger prick test). This will be used to test your haemoglobin level. In addition, we would like to be able to check your blood for infections which could affect you and your baby. These include malaria, syphilis and HIV. We will go through the details of the implications of each of these tests prior to taking the blood.

Risks The interview will last 45-60 minutes. The physical examination procedure is very short and simple. Blood collection will be by a trained person taking all necessary precautions to avoid harm to you. All information obtained from you will be kept

private and will be strictly used for this study only. Overall, we expect this consultation to take around 90 minutes.

Benefits If during this assessment, it becomes clear that you have a health problem, we will provide you information about where and how to seek care for this.

Privacy We will keep all your data private. We will use an identity number for you, so your name and address will never be mentioned anywhere in any form. No one will have access to the data other than the study staff. Data obtained from you will be used only for the study and your name will not be reported in any publication in the future.

Voluntary participation Your participation in this interview and physical examination is completely voluntary. You have the right to refuse to participate at any time during the interview. You can also refuse to respond to specific questions or answer questions but not take part in the clinical examination if you choose. Finally, although the investigation of urine and blood will help us understand whether your health is in order or not -you can still participate in the first part of the study but decline to have any of these tests carried out.

Right of the participant Please feel free to ask any questions you have about the interview, clinical examination and investigations planned at any stage. If you have any additional questions or questions that cannot be adequately addressed now, you can also contact the lead investigator of this study at this health care facility.

Complaints If you have a concern about any aspect of this study, you should ask to speak to the local research leader who will do their best to answer your questions. If you remain unhappy and wish to complain formally, you can do this through the head of the department of this healthcare facility who have given us permission to conduct this study. You can also contact the local research committee, details of which can be obtained from the local research team.

If you agree, we would like to interview you, and conduct the physical examination and collect blood and urine sample from you.

Do you agree to participate?

Tick box if agreed to participate in the study-interview.

Tick box if agreed to participate in the study-clinical examination.

Tick box if agreed to participate in the study-urine and blood tests.

Tick if not agreed to participate in the study

If participant not wishing to participate, thank her for her time and end here.

Please document on the daily record form why the woman has refused to participate.

If the participant wishes to participate in any part of the study, ask her to sign below and thank her for participating.

Signature or thumb print of women

Date