The Role of Weight Perception and Weight Stigma Concerns in Relationship to Health Behaviours and Psychological Well-Being

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By

Eugenia Romano

Institute of Life and Human Sciences

University of Liverpool

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DECLARATION IN HIGHER DEGREE THESES

University of Liverpool

Institute of Life and Human Sciences

Psychological Sciences

DECLARATION

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

Signed  (Candidate)

Date  (Candidate)

THESIS ABSTRACT

Overweight and obesity are now common in the developed world. It has been widely assumed that a failure to identify oneself as being overweight is detrimental to weight management and health. However, recent findings indicate that self-perception of overweight is instead related to a number of negative health and psychological outcomes. This could be caused by the widespread stigma of overweight and obesity, whereby those who self-identify their weight status as being overweight experience heightened concerns of being discriminated because of their weight. The aim of this thesis is to examine the relationship between weight perception and weight stigma concerns, and their impact on health behaviours and psychological well-being. After introducing the literature on weight perception and weight stigma in Chapter 1, Chapter 2 investigates whether perceived overweight results in increased attitudinal conformity towards unhealthy risky peer behaviours due to weight stigma concerns. The relationships between weight perception, weight stigma concerns and overeating tendencies are investigated across two studies in the general population (Chapter 3), and among post-bariatric surgery participants (Chapter 4). Chapter 5 then examines the associations between weight perception, perceived weight discrimination and weight-loss outcomes in the context of a weight loss trial. To conclude, Chapter 6 investigates the role of weight perception and weight stigma concerns in explaining the well-established relationship between body mass index and depression.

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DISSEMINATION

Conferences

The contents of this thesis have been presented at the Association for the Study of Obesity during the 4th UK Congress on Obesity (7th of September, 2017, Cardiff, UK), at the British Feeding and Drinking Group during the 42nd annual meeting (13th of April, 2018, Lyon, France) and at the Obesity Society during the 2018 Obesity Week (15th of November, 2018, Nashville, Tennessee, USA).

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Chapter 1: General introduction

1.1 Obesity in modern society

There have been large increases in Body Mass Index (BMI) and obesity in most developed countries during the last 40 years (Finucane et al., 2011). A study analysing data collected between 1980 and 2013 (Ng et al., 2014) reported an increase in obesity of 27.5% for adults and 47.1% for children, with men being more at risk in developed countries and women more at risk in developing countries (Ng et al., 2014). BMI rates were also explored among different countries (Finucane et al., 2011): in 2008 there was a 30% prevalence of obesity among men in North America, followed by Southern Latin America, Australasia and Central Europe, while among women the prevalence was almost 40% in Southern Africa, followed by North Africa and Middle East and Central Latin America. Projections suggest that the numbers of people with overweight and obesity worldwide will increase to 1.35 billion people with overweight and 573 million of people with obesity in 2030 (Kelly, Yang, Chen, Reynolds, & He, 2008).

The increasing prevalence of obesity is a cause for concern because of the health consequences associated with obesity. Comorbidities include diabetes, cancer, and cardiovascular diseases (Bray, 2004; Calle, Rodriguez, Walker-Thurmond, & Thun, 2003; Chan, Rimm, Colditz, Stampfer, & Willett, 1994; Manson et al., 1995; Mokdad et al., 2003). Psychological health is also compromised by obesity, as obesity is a risk factor for depression (De Wit et al., 2010; Luppino et al., 2010) and anxiety (Gariepy, Nitka, & Schmitz, 2010). Obesity is now a substantial burden on healthcare systems (Withrow & Alter, 2011).

1.2 Perception of overweight status

Weight perception refers to how a person perceives and categorises their own weight status. Accuracy of weight perception is obtained by comparing perceived weight status to objective measures of weight, such as BMI. Weight perception can be assessed by asking participants to report their weight status on scales ranging from "underweight" to "overweight" (Robinson, Hunger, & Daly, 2015) or from "very thin" to "very heavy" (Major, Hunger, Bunyan, & Miller, 2014), or by asking them to identify their body shape among a series of figures (Maximova et al., 2008).

Women are more likely to perceive themselves as of overweight status compared to men (Emslie, Hunt, & Macintyre, 2001; Paeratakul, White, Williamson, Ryan, & Bray, 2002; Tiggemann & Rothblum, 1988). This difference holds both when women's perception of their weight status is correct (i.e. they are objectively classed as meeting the criteria for overweight) and when this perception is incorrect (i.e. they are not objectively classed as meeting the criteria for overweight) (Paeratakul et al., 2002). As for ethnicity, Caucasians are more likely to report a self-perception of overweight compared to other ethnicities, and higher income and high education also play a role in the likelihood of self-perception of overweight status (Paeratakul et al., 2002). However, in case of people with overweight, there is often a mismatch between their objective weight and their perceived weight status (Paul et al., 2015). This has been explained as an effect of a "visual normalization" of heavier body weights due to the increased obesity prevalence, which has increased the threshold for considering someone as of overweight status (Robinson, 2017). Previous research has reported how exposure to heavy body weights can influence the underestimation of weight perception (Oldham & Robinson, 2016). Likewise, a study of UK participants showed

that as obesity became more prevalent in the UK people became less likely to accurately identify their overweight status (Johnson, Cooke, Croker, & Wardle, 2008). A study on a sample of UK adults reports that about one half of men and one third of women with overweight fail to identify themselves as such (Robinson & Oldham, 2016).

1.2.1 Overweight perception, weight management, and related behaviours.

There is a widely held belief that perceiving oneself as 'overweight' among people with overweight and obesity is necessary for weight management. In support of this, individuals with overweight who fail to identify their overweight status (underestimation of weight status) are less likely to report weight loss attempts (Duncan et al., 2011), while individuals with overweight who correctly identify their weight status (weight perception) are more likely to report trying to control their weight and report weight loss intentions (Lebrun et al., 2013; Yaemsiri, Slining, & Agarwal, 2011). Among children aged between 8 and 15, both of overweight and healthy weight, perceived overweight is associated with increased odds of weight loss attempts (H.-Y. Chen et al., 2014). Similarly, adolescents with accurate overweight perception are more likely to exercise to lose weight and value healthy eating habits (Edwards, Pettingell, & Borowsky, 2010), and the same results on the effect of overweight perception on weight-loss attempts among adolescents have been reported regardless of BMI (Patte, Laxer, Qian, & Leatherdale, 2016). Even in adulthood, a heavier perceived weight is associated with the likelihood of taking action to lose weight, both for individuals with overweight (Cai et al., 2014; Lebrun et al., 2013) and for those with normal weight (Southerland, Wang, Richards, Pack, & Slawson, 2013).

However, evidence on the beneficial effect of overweight perception is mixed, and intentions to lose weight among people who perceive their weight status as overweight may not translate to healthier behaviours. Considering the association of perceived overweight and exercise, a study by Cai and colleagues found that self-perceived overweight is associated with less amount of physical activity in children with overweight, and with increased TV screen time and less intake of fruit and vegetables among children with normal weight (Cai et al., 2017). Among adolescents, some findings report a positive association between perceived overweight and odds of exercising to lose weight, such as a study on American adolescents of normal weight (Talamayan, Springer, Kelder, Gorospe, & Joye, 2006). However, there is also evidence among adolescents that a self-perception of overweight can be associated with physical inactivity, as reported by a study on a nationally representative sample of US students (Fan & Jin, 2015; Lenhart, Daly, & Eichen, 2011), while other studies on adolescents with obesity found no association between the two factors (Fagan, Diamond, Myers, & Gill, 2008). Similarly, there are inconsistent findings among adults, with studies reporting an association between perceived overweight and fewer physically-active days in individuals of normal weight (Southerland et al., 2013) or with sedentariness among adults of average and overweight, although findings have not been consistent across ethnicities and gender (Yancey, Simon, McCarthy, Lightstone, & Fielding, 2006).

There are also mixed results on the association between overweight perception and the recurrence of unhealthy weight loss strategies, such as fasting or use of diet pills. Among adolescents, some studies report a positive association between the two factors after accounting for BMI (Armstrong, Westen, & Janicke, 2014; Kim, Cho, Cho, & Lim, 2009) and for accuracy of weight perception among those of normal

weight (Hadland, Austin, Goodenow, & Calzo, 2014). On the contrary, other authors found that self-perception of an overweight status was associated with fewer unhealthy weight control strategies among students with obesity (Lenhart et al., 2011), or reported a lack of association among adolescents with overweight (Edwards et al., 2010). Results are mixed for adults as well, with findings differing based on gender and weight-status (Harring, Montgomery, & Hardin, 2010; Sonneville, Thurston, Milliren, Gooding, & Richmond, 2016).

Finally, there is also some evidence on the association between overweight perception and weight management among bariatric surgery candidates, as an accurate perception of weight status is associated with more history of weight cycling previous to surgery (White, Masheb, Burke-Martindale, Rothschild, & Grilo, 2007). Further to that, a lingering self-perception of overweight is also associated with negative consequences after weight-loss surgery. A study by Perdue and colleagues (Perdue, Schreier, Swanson, Neil, & Carels, 2018) found that after bariatric surgery people can still think of themselves as individuals with overweight, and this tendency is associated with negative body image, regardless of the amount of weight lost. Overall, these findings suggest that self-identifying as having an overweight status is not consistently associated with self-reported healthier lifestyle behaviours and weight management strategies.

1.2.2 Overweight perception, overeating and weight gain.

Although overweight perception is not reliably associated with self-reported weight-loss behaviours, a meta-analysis of multiple studies reports the association of overweight perception with overeating and weight gain to be more consistent (Haynes, Kersbergen, Sutin, Daly, & Robinson, 2018). Examining the association between

perceived overweight and overeating, Saules and colleagues found self-perceived overweight to be associated with binge eating among adults of normal and overweight status (Saules et al., 2009), and specifically, that the association between BMI and binge-eating tendencies was mediated by weight perception. Thus, people who self-identify as being 'overweight' are at an increased risk of binge eating. Similarly, adolescents of normal weight who consider themselves to be of overweight status are more likely to report compulsive overeating episodes, as well as weight preoccupations, compared to those correctly perceiving their weight status (Deschamps, Salanave, Chan-Chee, Vernay, & Castetbon, 2015). On the contrary, when people with overweight fail to identify their weight status, they are less likely to report uncontrolled eating. A study by Sonneville and colleagues found that under-perception of weight status was associated with less loss of control over eating among female adolescents with overweight (Sonneville et al., 2016). Similarly, it has been found that when individuals with obesity underestimate their weight status as simply overweight, they report lower rates of binge eating, less distress about overeating, and a lower likelihood of loss of control over eating, compared to people with obesity that accurately identify their weight status (Jones, Grilo, Masheb, & White, 2010).

Self-perception of overweight has also been shown to be associated with an increased risk of future weight gain. A number of studies have found that perceiving one's own weight status as overweight is a risk factor for onset of weight gain among adolescents ranging from those with underweight to those with overweight and obesity, regardless of accuracy of this weight perception (Duong & Roberts, 2014; Liechty & Lee, 2015). During adolescence, misperception of weight status is associated with smaller weight gain over time for adolescents with overweight (Rancourt, Thurston, Sonneville, Milliren, & Richmond, 2017), and self-perception of

overweight is associated with a higher likelihood for future onset of obesity among adolescents with normal weight (Sutin & Terracciano, 2015). Self-perception of overweight status is also a risk factor for increased weight gain among adults after controlling for BMI at baseline (Daly, Robinson, & Sutin, 2017; Robinson et al., 2015); individuals who self-identify as being overweight go on to gain more weight than adults who do not identify their weight status as overweight.

1.2.3 Overweight perception and depression.

A number of studies have now examined the association between self- perception of overweight and depressive symptoms. Among adolescents, a study on an American population found a higher likelihood for major depression among young people with self-perceived overweight, regardless of their actual weight status (Roberts & Duong, 2013). The same pattern of results has been observed among US adolescents and young adults with overweight; participants underestimating their weight status had fewer depressive symptoms than participants accurately identifying their weight status (Thurston et al., 2017). Even among adults, a study on a US population found that independently of baseline BMI, perceived overweight predicts increased symptoms of depression over time (Daly et al., 2017). Further to that, overweight perception is associated with suicidal ideation. A study on Korean women whose weight ranged from underweight to overweight found overweight perception to mediate the association between increased BMI and increased risk for suicidal ideation (Kim, 2011), and findings from Korean young participants whose weight ranged from underweight to overweight found the association between BMI and suicidal ideation to be mediated by a perception of overweight status (Kim et al., 2009).

However, there have been mixed findings. A study by Lo and colleagues on Chinese adolescents, for example, found no association between weight perception and the subsequent development of depressive symptomatology while controlling for BMI (Lo et al., 2009). Gender may also be important to consider, as, irrespectively of objective weight, females may be more susceptible than males both in the association between perceived overweight and depressive symptoms (Gaskin et al., 2013), and between overweight perception and suicidal ideation (Seo & Lee, 2013), although some results on adult women report a significant association between perceived overweight and suicidal ideation only in participants of normal weight (Shin et al., 2015). Nonetheless, despite some findings taking into account gender and weight status differences (Brown & Blanton, 2002; Byeon, 2015; Gaskin et al., 2013; Seo & Lee, 2013; Shin et al., 2015), a meta-analysis reports perceived overweight to have an overall consistent association with increased risk for depression and suicidality, in both cross-sectional and longitudinal studies (Haynes, Kersbergen, Sutin, Daly, & Robinson, 2019).

1.2.4 Overweight perception and risky behaviours among adolescents.

Self-perception of overweight has also been found to increase the likelihood of risky behaviours among adolescents. A US study found that among adolescents whose weight ranged from extremely underweight to obesity, those who overestimate their weight status are more likely to engage in several risky behaviours such as smoking, drinking, and use of illegal drugs (Jiang, Kempner, & Loucks, 2014). Similar findings have also been reported for engagement in risky sexual behaviours among girls, both with overweight misperception (Akers et al., 2009) or regardless of actual weight status (Farhat, Haynie, Summersett-Ringgold, Brooks-Russell, & Iannotti, 2015).

Despite an inconsistent effect of gender across studies (Caria, Bellocco, Zambon, Horton, & Galanti, 2009; Dowdell, 2002; Tomeo et al., 1999; Winter, de Guia, Ferrence, & Cohen, 2002), several authors have also reported an association between perceived overweight and adolescents' tendency to smoke. Adolescents who perceive their weight status as overweight are more likely to be current or frequent smokers (Yoon & Bernell, 2016), and a positive association with electric vapour use has also been found among young girls (Cho et al., 2018). Moreover, as years pass, the association between overweight perception and smoking gets stronger: a study examining data from the 1999-2005 Youth Risk Behavior Survey found that the more recent the cohorts examined were, the stronger the link between current smoking and perceived body weight status (Seo, Jiang, & Kolbe, 2009). However, these results were not controlled for actual body weight.

Overweight perception in young people is also associated with alcohol use. A study on US adolescents found that, controlling for BMI, girls who perceived themselves as too heavy were more likely to drink alcohol, while among boys the relationship between weight perception and drinking habits was reversed (Ramseyer Winter, Kennedy, & O'Neill, 2017). On the contrary, a study by Antin found no association between overweight perception and episodes of drinking among female young adults when controlling for BMI, while among males, the relationship between episodic drinking and overweight perception was negative after adjusting for BMI (Antin & Paschall, 2011). However, it has been found that adolescents with overweight and obesity who correctly identify their weight status are more likely to report increased alcohol and soft drinks consumption respectively (Khambalia, Hardy, & Bauman, 2012).

Concerning the association between weight perception and use of illicit substances, the published evidence is limited. Two studies by Jian and colleagues found an association between weight perception and use of illicit drugs. In one study from 2012 on adolescents whose weight ranged from extremely underweight to obesity, the authors found that adolescents perceiving themselves as "very overweight" were more likely than those who perceived themselves as "normal weight" to report current cocaine use (Jiang, Risica, Arias, Perry, & Viner-Brown, 2012), but the association was not controlled for objective weight. Results were consistent in a following study on adolescents whose weight ranged from extremely underweight to obesity, where the same authors found that illicit drugs use was more common in adolescents overestimating their weight status, with the kind of drugs used differing depending on the extent of the overestimation (Jiang et al., 2014).

1.3 Weight stigma in modern society

Weight stigma, defined as the social devaluation and denigration of people perceived to carry excess weight (Tomiyama, 2014), is frequent in our society, as people carrying excess weight are often perceived as lazy, stupid, or worthless (Schwartz, Chambliss, Brownell, Blair, & Billington, 2003). Due to that, people can often report weight bias, defined as a negative attitude toward people with overweight or obesity (Blanton, Brooks, & McKnight, 2016), and this bias can manifest itself under the form of weight-based discrimination.

Weight discrimination is increasing. A study by Andreyeva and colleagues found a growing trend of weight-based discrimination among Americans: when analysing the main reason for the experienced discrimination reported by participants, the authors found that the prevalence of reported discrimination based on weight went

from 7% in 1995–1996 to 12% in 2004–2006. Further to that, the authors reported that this applied to people of all ages, and, more interestingly, changes in body weight did not explain this growing trend in weight discrimination (Andreyeva, Puhl, & Brownell, 2008).

Despite some variations based on demographic characteristics like gender, ethnicity, or actual weight status (Hatzenbuehler, Keyes, & Hasin, 2009; Puhl, Andreyeva, & Brownell, 2008; Scott-Johnson, Gross, Gray, Zhu, & Browne, 2010; Van Den Berg, Neumark-Sztainer, Eisenberg, & Haines, 2008), weight-based discrimination is widespread enough to be found in several settings, and consistently reported both among young people and adults. Media representation of individuals with overweight communicate several negative stereotypes, even in content targeting children and adolescents, which implicitly reinforces stigma against people with overweight and obesity (Ata & Thompson, 2010). With a few exceptions (Patt, Yanek, Moy, & Becker, 2004; Viner & Cole, 2005), there is also a documented association between heavier body weight and educational attainment. Not only do children with overweight often report frequent victimization and bullying due to their weight (Puhl & King, 2013), but a higher BMI also affects the likelihood of being admitted in graduate schools, especially for female applicants (Burmeister, Kiefner, Carels, & Musher-Eizenman, 2013). A large study using data from the National Longitudinal Study of Adolescent Health also reports weight bias in educational settings (Crosnoe, 2007). The authors, however, report that the rates of admission for students with overweight is related to how common obesity is in the school they attend (Crosnoe, 2007). This finding is consistent with a study reporting a strong association between risk of obesity and educational achievement for those schools where students' average body size was lower (Crosnoe & Muller, 2004).

People with overweight are also discriminated against in the workplace. Weight status is a barrier for employment. Employees with overweight are often perceived as lazy, less intelligent, untidy and incompetent (Giel, Thiel, Teufel, Mayer, & Zipfel, 2010). More specifically, women are more likely than men to report weight-based discrimination in the workplace (Roehling, Roehling, & Pichler, 2007). Finally, there is also evidence for weight stigma in the healthcare setting: high rates of weight bias have been found among both clinicians specialising in obesity treatment (Schwartz et al., 2003) and among medical students (Phelan et al., 2014). These findings reflect patients' experiences, as patients with overweight often report receiving inappropriate comments from clinicians and healthcare professionals because of their weight (Puhl & Brownell, 2006). Likewise, a certain level of unfair treatment because of body weight has also been reported among bariatric surgery candidates (Anderson & Wadden, 2004). Further to that, a study on UK patients attending dietetic outpatients clinics found that a higher BMI in patients was associated with a more negative perception of clinicians (Thompson & Thomas, 2000).

1.3.1 Mechanisms and consequences of stigma.

Link and Phelan define stigma as a co-occurrence of several mechanisms (Link & Phelan, 2001). The authors postulate that stigma acts firstly by highlighting and labelling differences among groups of people, which creates groups based on an oversimplification of traits. In turn, these highlighted differences are linked to a set of undesirable characteristics that create negative stereotypes, separating the stigmatised group from the rest of society (e.g. "overweight people"). These labels, and the set of negative stereotypes they are associated with, then cause a stigmatised group to experience a downgrade in social status (Link & Phelan, 2001).

When a negative stereotype about a group a person belongs to becomes personally relevant, the sense that a person can be judged or threatened according to this stereotype, or that the stereotype can be inadvertently confirmed by a person's action, is defined as a "stereotype threat" (Steele, Spencer, & Aronson, 2002, p. 389). When describing the moderating factors influencing the perception of a stereotype threat, Steele, Spencer and Aronson indicate that identification with the negatively stereotyped group, and individual differences in sensitivity to stereotype threat, may influence the perception of the threat itself (Steele et al., 2004). There is evidence supporting this; in experimental conditions eliciting perceived discrimination, individuals who are stigmatised because of their race or age have a significantly poorer cognitive performance than when they are not exposed to stigmatising conditions (Hess, Auman, Colcombe, & Rahhal, 2003; Thames et al., 2013). Similarly, studies on performance-inhibiting effects of gender-based stereotypes found that individuals' performance depended on the level of participants' gender identification (Kaiser & Hagiwara, 2011; Schmader, 2002).

When exposed to a stereotype threat, a person's "important aspect of the self-identity is or could be negatively judged by others", so the socially threatened person experiences what is called a "social-evaluative threat" (Dickerson & Kemeny, 2004, p. 358). In a meta-analysis of more than 200 studies, Dickerson and Kemeny found that the stress derived from a social evaluative component has significant influence on production of the stress hormone cortisol (Dickerson & Kemeny, 2004). This finding suggests that the experience and worry of social rejection because of stigma can threaten a person's physical and psychological well-being.

There are several findings on the impact of stigma on physical health. Some studies have found that increased exposure to stigma, for example, is associated with

poorer cardiovascular health (E. M. Friedman, Williams, Singer, & Ryff, 2009; Richman, Pek, Pascoe, & Bauer, 2010). Moreover, stigma can also be associated with increased severity of illness in patients with psoriasis (Alpsoy et al., 2017) and higher frequency and perceived intensity of symptoms in patients with hepatitis (Golden, Conroy, Marie O'Dwyer, Golden, & Hardouin, 2006). Furthermore, among young people with chronic illness (e.g. diabetes, asthma, gastrointestinal disorders) stigma was positively related to illness intrusiveness (Bakula et al., 2019).

Following the impact of stigma on physical well-being, one of the most consistent findings on the consequences of stigma-related stress is its impact on psychological health. A meta-analysis of 49 empirical studies by Mak and colleagues reports that stigma can affect both positive (e.g. self-esteem) and negative (e.g. distress) indicators of mental health (Mak, Poon, Pun, & Cheung, 2007). For example, stigma has been found to be associated with anxiety among lung cancer patients (Cataldo & Brodsky, 2013) and among people with dementia (Burgener, Buckwalter, Perkhounkova, & Liu, 2015). Moreover, a longitudinal study found that stigma predicted depressive symptoms among adults with epilepsy (Reisinger & DiIorio, 2009), and similar results have been found among homosexual men (Logie, Newman, Chakrapani, & Shunmugam, 2012). Furthermore, stigma has been found to be associated with suicidality risk among people with mental illness (K. Wang, Weiss, Pachankis, & Link, 2016) and with attempted suicide among transgender people (Clements-Nolle, Marx, & Katz, 2006).

1.3.2 Consequences of weight stigma.

The specific impact of weight stigma on physical and psychological health has also been examined. Clinical (K. E. Friedman, Ashmore, & Applegate, 2008) and non-

clinical populations (Hatzenbuehler et al., 2009; Savoy, Almeida, & Boxer, 2012) who experience weight stigma have increased anxiety symptoms. For example, a study on American children reported that experiencing weight discrimination coming from peers predicts the likelihood of developing social anxiety and body dissatisfaction one year later (Juvonen, Lessard, Schacter, & Suchilt, 2017). Similarly, weight stigma is associated with depression. Weight teasing in particular has been shown to be predictive of depressive symptoms among children and adolescents (Eisenberg, Neumark-Sztainer, Haines, & Wall, 2006). A study by Eisenberg and colleagues found that, even after controlling for actual body weight, weight-based teasing was consistently associated with thinking about and attempting suicide among adolescents, and that the association held for both genders across racial, ethnic, and weight groups (Eisenberg, Neumark-Sztainer, & Story, 2003). The association between weight stigma and depression is also present among adults with overweight, both in clinical and non-clinical samples. Among weight-loss surgery candidates, depressive symptoms are better predicted by weight discrimination than BMI (E. Y. Chen et al., 2007) and other studies on treatment-seeking participants with overweight report an association between weight discrimination and depressive symptoms (K. E. Friedman et al., 2008, 2005). Robinson, Sutin and Daly (2016) found that perceived experiences of weight stigma accounted for the prospective association between obesity and depressive symptoms (Robinson, Sutin, & Daly, 2016). Overall, these findings summarise a consistent association of weight stigma with compromised psychological health (Papadopoulos & Brennan, 2015).

Weight stigma has been proposed to be a way to encourage weight loss (Bayer, 2008; Callahan, 2013), but findings suggest this is likely to fail. Studies on American and English populations have found weight discrimination to be associated with a

higher risk for developing obesity over time (Jackson, Beeken, & Wardle, 2014; Sutin & Terracciano, 2013). Further to that, a study on a Swedish population found that people with severe obesity experiencing weight discrimination in a health-care setting are at increased risk of gaining weight (Hansson & Rasmussen, 2014). This relationship may be explained by an association between weight discrimination and eating behaviours (Vartanian & Porter, 2016). Weight stigma is linked with consumption of unhealthy convenience food (Sutin, Robinson, Daly, & Terracciano, 2016), as well as with unhealthy eating tendencies (Puhl & Luedicke, 2012; Puhl & Suh, 2015). Binge eating, for example, has been shown to be associated with weight stigma both in young treatment-seeking and non-clinical populations (Almeida, Savoy, & Boxer, 2011; Ashmore, Friedman, Reichmann, & Musante, 2008). Participants who have undergone bariatric surgery also report an association between overeating tendencies and weight stigma (Raves, Brewis, Trainer, Han, & Wutich, 2016), while participants in weight-loss intervention programs report less weight loss, greater caloric intake, and less caloric expenditure through exercise if they have experienced weight stigmatization (Wott & Carels, 2010). Finally, studies on children (Faith, Leone, Ayers, Heo, & Pietrobelli, 2004) and on female undergraduates (Vartanian & Shaprow, 2008) found that weight stigma is also associated with exercise avoidance. Moving beyond weight-related behaviours to other unhealthy behaviours there is also evidence of an association of weight stigma with nicotine, alcohol, and substance use (Hatzenbuehler et al., 2009; Papadopoulos & Brennan, 2015), whereby the more people report weight stigma, the more likely they are to report substance use and dependence. Taken together, these findings indicate that weight stigma compromises psychological and physical health. In support of this, a recent study has

shown that experiencing stigma because of body weight is associated with an increased risk of early mortality (Sutin, Stephan, & Terracciano, 2015).

Some experimental studies have further investigated the associations of weight stigma with its negative physiological consequences. A study by Schvey and colleagues found that, when exposed to a potentially weight-stigmatising situation, female participants show enhanced cortisol reactivity and report feeling upset by the stigmatising content they are exposed to, regardless of their actual weight status (Schvey, Puhl, & Brownell, 2014). Similarly, Major and colleagues examined whether women with overweight exposed to a situation that activated concerns about weight stigma by making weight visible (i.e. while being videotaped while giving a speech) would experience increased stress compared to women exposed to a situation where weight is not visible (i.e. when only being audiotaped) (Major, Eliezer, & Rieck, 2012). The authors found that women having their weight exposed in the videotape condition exhibited an increased blood pressure and a poorer control over executive performances compared to women in the audiotape condition (Major et al., 2012). This lack of self-control due to weight-stigma exposure has been also reported in studies investigating caloric intake and self-control. A study by Major and colleagues found that exposure to weight-stigmatizing content causes women who perceive their weight as overweight to feel less capable of controlling their eating (Major et al., 2014). Similarly, Schvey and colleagues found that, among women with overweight, exposure to a weight stigmatising situation was associated with a significantly higher consumption of calories (Schvey, Puhl, & Brownell, 2011).

1.3.3 Mechanisms of weight stigma.

There are several mechanisms through which weight stigma may cause negative health outcomes. Self-regulation is defined as the ability to alter one's own behaviour to conform to socially defined standards (Baumeister, Nathan Dewall, Ciarocco, & Twenge, 2005). Self-regulation is therefore integral for engaging in behaviours that are health protective (e.g. diet, exercise) and maintaining these behaviours in the long-term. Feeling excluded or rejected can compromise self-regulation (Baumeister et al., 2005). A study by Inzlicht and colleagues found that, when conscious of their stigmatised status or when exposed to a threatening situation, individuals belonging to stigmatized groups report compromised self-regulation (Inzlicht, McKay, & Aronson, 2006). Following this reasoning, the ego-depleting effect of weight stigma could explain why women with overweight (Schvey et al., 2011), or who perceive themselves as of overweight status (Major et al., 2014), consume more calories after experiencing weight stigma. Similarly, ego-depletion could explain why women with overweight report increased stress-related emotions and poorer self-control when their weight is visible compared to when it is not (Major et al., 2012). Likewise, behaviours like frequent exercise require effortful self-regulation (e.g. to plan and then go to the gym to exercise) and therefore weight discrimination may reduce physical activity via its negative effects on self-regulation (Faith et al., 2004; Vartanian & Shaprow, 2008; Wott & Carels, 2010).

The negative affect that comes with weight stigma could be a distinct reason why weight stigma can result in unhealthy behaviours. The high levels of anxiety (Hatzenbuehler et al., 2009; Savoy et al., 2012) and depression (Hatzenbuehler et al., 2009; Robinson, Sutin, et al., 2016; Savoy et al., 2012) associated with weight discrimination may explain the maladaptive eating habits often reported by people

experiencing weight stigma (Vartanian & Porter, 2016) as a way of coping with negative affect. A study by Puhl and Brownell, for example, has found that people with overweight often report eating more as a coping mechanism for dealing with weight stigma (Puhl & Brownell, 2006). Furthermore, another study by Farrow and Tarrant on undergraduate students reports an association between weight stigma and emotional eating (Farrow & Tarrant, 2009). Coping could also explain the association found between weight discrimination and substance abuse (Hatzenbuehler et al., 2009; Papadopoulos & Brennan, 2015). The use of smoking, alcohol, and illegal drugs are in fact common coping strategies among people belonging to stigmatised groups (Gruskin, Byrne, Altschuler, & Dibble, 2008; Guthrie, Young, Williams, Boyd, & Kintner, 2002; Hatzenbuehler, Corbin, & Fromme, 2011; J. K. Martin, Tuch, & Roman, 2003; Parker, Kinlock, Chisolm, Furr-Holden, & Thorpe, 2016; Reisner et al., 2015). Finally, since avoidance is another form of coping associated with weight stigma (Puhl & Brownell, 2006), avoiding stigmatising situations in which weight may be highly visible (e.g. the gym) could also explain the poor engagement in physical activity associated with weight-related discrimination (Faith et al., 2004; Vartanian & Shaprow, 2008; Wott & Carels, 2010).

Both effects of negative affect and ego-depletion are described in the Cyclic Obesity/Weight-Based Stigma (COBWEB) model developed by Tomiyama (Tomiyama, 2014), which explains how experiencing weight stigma can lead to weight gain. Building on the literature reporting the association between weight stigma and increased blood pressure, enhanced cortisol reactivity, and poor executive control (Major et al., 2012; Schvey et al., 2014), the COBWEB model suggests that weight discrimination can be considered as a chronic stressor (Tomiyama, 2014). Hence, it can trigger a cascade of intertwined responses – behavioural, emotional, and

physiological ones, which would in turn lead to weight gain (Tomiyama, 2014). On an emotional level, Tomiyama highlights the role of shame as a consequence of weight stigma (Tomiyama, 2014). Previous research has shown that when people with obesity experience social exclusion, they report enhanced levels of shame (Westermann, Rief, Euteneuer, & Kohlmann, 2015). Moreover, a study assessing German adults with obesity found that weight-related shame is associated with disengaging coping styles (e.g. criticism, social withdrawal, and problem avoidance) (Conradt et al., 2008), and avoidance coping styles have been found to be associated with more disordered eating among bariatric surgery candidates (McGarrity et al., 2019).

In the COBWEB model, Tomiyama also highlights the effect of physiological mechanisms that could lead to weight gain through elevated secretions of cortisol (Tomiyama, 2014). There is biological evidence of how chronic concentration of cortisol can affect weight gain (Jayo, Shively, Kaplan, & Manuck, 1993), as exemplified in Cushing syndrome, where chronic obesity is a result of a prolonged exposure to glucocorticoids (Shibli-Rahhal, Van Beek, & Schlechte, 2006). Through its influence on the reward system (Adam & Epel, 2007), cortisol can also elicit appetite and drive food consumption (Epel, Lapidus, McEwen, & Brownell, 2001). Furthermore, previous research has suggested that shame has a strong effect on cortisol secretion when combined with acute threats to the social self (Dickerson, Gruenewald, & Kemeny, 2004). Hence, drawing from previously published evidence, Tomiyama suggests that the enhanced shame caused by weight discrimination (Westermann et al., 2015) could trigger physiological reactions (Schvey et al., 2014) that would in turn cause overeating (Major et al., 2014; Schvey et al., 2011), and, consequently, lead to weight gain (Jackson et al., 2014; Sutin & Terracciano, 2013).

1.3.4 Weight-based Social Identity Threat and Weight Stigma Concerns.

Building on Dickerson's definition of "social-evaluative threat" (Dickerson & Kemeny, 2004), Hunger and colleagues have proposed a weight-based social identity threat model (Hunger, Major, Blodorn, & Miller, 2015). The authors define weight-based social identity threat as a situationally triggered psychological state in which a person is concerned that they have been or will be discriminated because of their weight (Hunger et al., 2015). In their model, Hunger and colleagues suggest that weight-based social identity threat can be activated when discrimination is directly experienced, suspected, or even anticipated, due to the shared awareness of the stigmatization placed on individuals with overweight (Hunger et al., 2015). Weight-based identity threat can therefore be described a consequence of a self-categorization as 'overweight' (self-identification with the stereotyped group) and a heightened concern of being stigmatised due to the awareness of a widespread weight stigma (sensitivity to stereotype threat) (Hunger et al., 2015). In support of this model a study by Hunger and colleagues has reported how the heavier people are, the more likely it is for them to report past experiences of discrimination, and the association between experiences of stigma and poor health is explained by the concerns of facing more stigma in the future (Hunger & Major, 2015). Collectively, these results suggest that, when considering self-perception of overweight, weight stigma concerns could be a potential mechanism to explain the negative health and psychological outcomes associated with weight-related stigma.

1.3.5 Consequences of weight stigma concerns.

Weight stigma concerns may affect physical and psychological health through several pathways, and the most directly relevant research on this topic is a study by

Hunger and colleagues (Hunger & Major, 2015). The authors found that the relationship between higher BMI and poorer physical and psychological health was mediated by increased experiences of weight-based discrimination and concerns about weight-based stigmatization. More importantly, after controlling for experiences of weight discrimination, stigma concerns was a significant mediator of the association between BMI and health (Hunger & Major, 2015). This suggests that independent of the actual experience of being discriminated against, the *concern* that one may be discriminated against is predictive of worse well-being.

Based on these findings, the hypothesis of this thesis it that concerns about being stigmatised due to body weight (weight stigma concerns) may explain the negative outcomes (psychological and physical) associated with perceived weight status. Since literature suggests that the stressful effect of weight stigma can impact self-control (Major et al., 2012; Tomiyama, 2014), concerns over being stigmatised because of one's weight could cause ego-depletion, promoting overeating (Major et al., 2014; Schvey et al., 2011) and, consequently, weight gain (Jackson et al., 2014; Sutin & Terracciano, 2013). Moreover, the stress due to the concern over being a victim of weight stigma could also promote maladaptive coping mechanism and in turn lead to comfort eating (Farrow & Tarrant, 2009; Puhl & Brownell, 2006).

In addition, the negative affect due to weight stigma concerns could explain the association between weight stigma and depression (Robinson, Sutin, et al., 2016). It is possible that the more people feel concerned over being stigmatised, the more they behave in ways that may increase risk of depression, such as social isolation. Consistent with this proposition, stigmatised groups have been reported to use self-isolation as a coping strategy due to fears of negative evaluation from others (Audet, McGowan, Wallston, & Kipp, 2013). Moreover, a qualitative study on patients with

mental illness (a stigmatised group) found that the choice of self-isolation may be a consequence of a fear of being judged negatively by others (Gee, Pearce, & Jackson, 2003). Such a process would lead to a higher likelihood of developing depressive symptoms, as there is evidence that loneliness is an important risk factor for subsequent depression (Cacioppo, Hawkley, & Thisted, 2010; Ladd & Ettekal, 2013; Qualter, Brown, Munn, & Rotenberg, 2010).

Finally, concerns over being stigmatised because of body weight could lead people to try to compensate for it through self-presentation strategies that could lead to increased conformity, explaining the association between weight stigma and substance abuse (Hatzenbuehler et al., 2009; Papadopoulos & Brennan, 2015). In line with this, previous studies on alcohol consumption have reported on how people tend to conform to peers' behaviours when they are motivated to ingratiate themselves (Robinson, Oldham, et al., 2016). There is also evidence on how people with self-reported overweight select impression-management strategies to make up for potential negative judgement coming from others (Neel, Neufeld, & Neuberg, 2013). Hence, when concerned over being a victim of weight stigma, people could endorse risky health behaviours as a way to conform to peers and ingratiate themselves, avoiding social discrimination and social isolation.

1.4 Thesis aims

This thesis reports five studies investigating weight perception, weight stigma concerns, and their relationships with physical and psychological well-being. The main hypothesis is that self-perception of overweight results in concerns about being stigmatised due to weight and this in turn promotes unhealthy lifestyle behaviours.

Given that there has been very little research on the damaging effects of weight perception or weight stigma concerns, the aim of this thesis is to identify how weight perception and weight stigma concerns affect several negative health behaviours and health outcomes. Chapter 2 first focuses on risky behaviour as a result of overweight perception and weight stigma concerns. More specifically, it tests whether perceived overweight may cause heightened conformity towards risky peer behaviours due to a concern of being stigmatised because of body weight. Chapter 3 tests the hypothesis that a higher perceived weight would be associated with heightened weight stigma concerns, which would in turn be related to increased overeating tendencies in the general population. In Chapter 4, the focus moves to a clinical sample, in order to explore whether weight perception and weight stigma concerns explain overeating among bariatric surgery patients. Chapter 5 then explores the impact of weight perception and perceived weight discrimination on weight-loss outcomes through the analysis of secondary data from a 12-week weight-loss trial. Finally, Chapter 6 examines the role of weight perception and weight stigma concerns in explaining the well-established link between obesity and depression (see Figure 1.1).

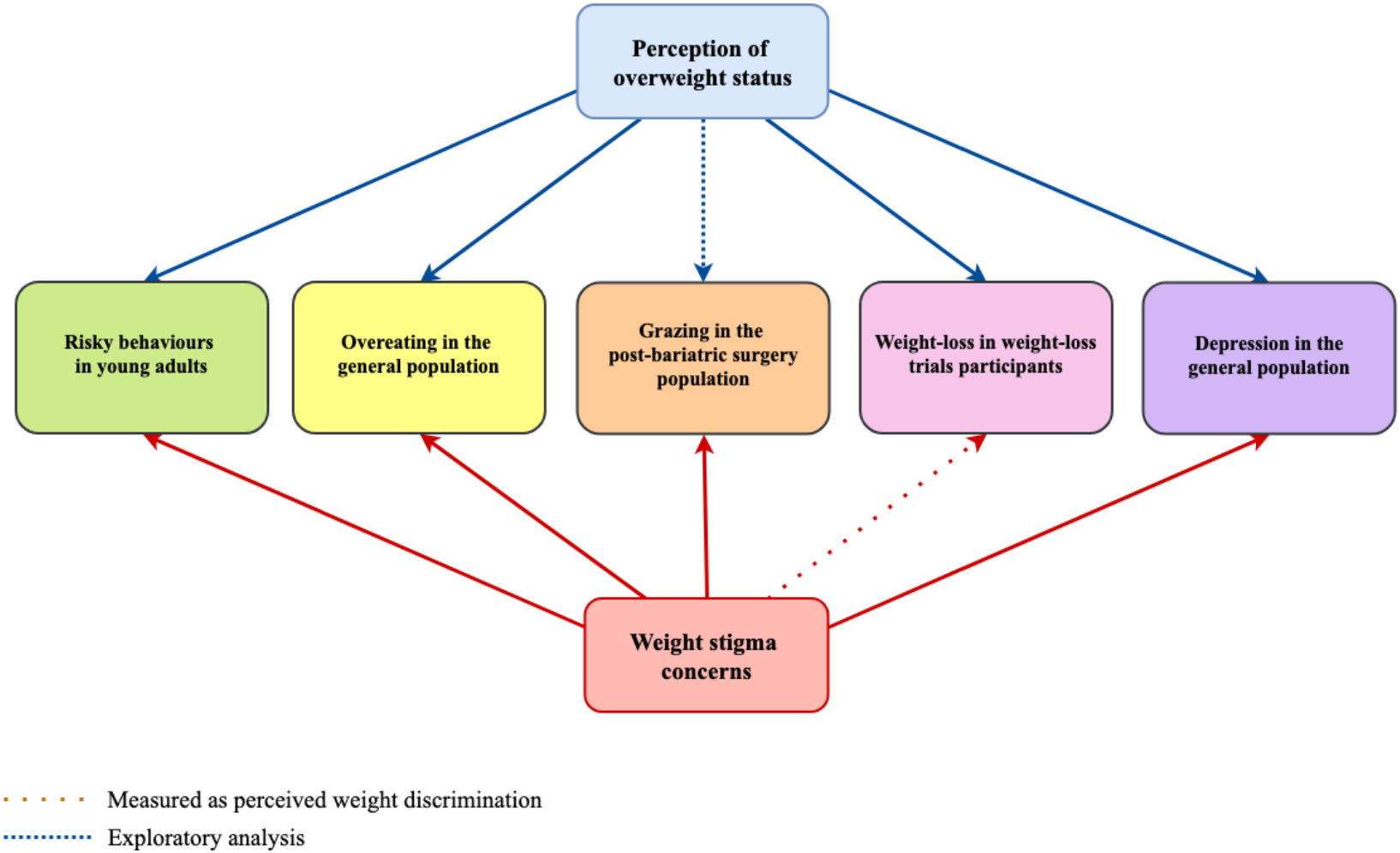

Figure 1.1. Thesis structure.

Chapter 2: Weight perception, weight stigma concerns, and attitudinal conformity towards risky peer behaviours

2.1 Chapter abstract

Young people who either live with or feel overweight are more likely to report high rates of unhealthy risky behaviours, such as smoking, drinking, using illegal drugs an engaging in unprotected sex. A potential explanation of these findings is that the widespread stigma of heavier body weight may cause people who self-identify as being overweight to report higher weight stigma concerns, and to adopt ingratiation strategies in order to avoid a negative judgement from others. Conformity is an ingratiation strategy, and people who perceive their weight status as overweight may therefore conform to risky peer behaviours as a way to achieve ingratiation. This chapter reports on two lab-based experiments designed to examine whether perceived overweight results in increased attitudinal conformity towards risky peer behaviours due to weight stigma concerns.

2.2 Introduction

A number of studies have shown that young people with overweight and obesity are more likely than their peers with normal weight to engage in risky health-related behaviours, such as binge-drinking, smoking, substance use (Adams & Rini, 2007; Huang, Lanza, Wright-Volel, & Anglin, 2013; McLaren, Beck, Patten, Fick, & Adair, 2008; Pasch, Nelson, Lytle, Moe, & Perry, 2008) and unprotected sex (Averett, Corman, & Reichman, 2013; Leech & Dias, 2012). However, these findings have not

been consistently replicated (Baek & So, 2012; Farhat, Iannotti, & Simons-Morton, 2010; Huang et al., 2013; Lanza, Grella, & Chung, 2014). There is however a very consistent finding which suggests that self-perception of overweight, rather than objective overweight, is reliably predictive of an increased likelihood of engaging in risky health-related behaviours (Farhat, 2015; Jiang et al., 2014, 2012). However, why self-perception of overweight is associated with increased likelihood of engaging in risky behaviours is unclear.

Many risky health behaviours are social in nature (Viner et al., 2012). The Social Identity Theory posits that individuals identify with those they perceive as more similar to themselves, and affiliate to groups that positively enhance their social identity (Tajfel & Turner, 1986). This theory finds its application during adolescence, a period during which belonging to a group is crucial, as it strongly relates to self-worth (Pittman & Richmond, 2007) and emotional functioning (Shochet, Dadds, Ham, & Montague, 2006). This need for a sense of belongingness seems to explain why there is a strong association between teens' endorsement of risky health behaviours and that of their close friends, depending on the groups the affiliate with (La Greca, Prinstein, & Fetter, 2001). Oyserman's identity-based motivation model (Oyserman, 2007) suggests that behaviours are not just personal choices, but rather habits strongly linked to social identity. Following this theory, previous studies on unhealthy risky behaviours among undergraduate and eighth-grade students of different ethnicities have shown that if a behaviour is associated with the identity of an ethnic group, engaging the behaviour comes with a feeling of inclusion in the group itself (Oyserman, Fryberg, & Yoder, 2007).

Social exclusion, on the other hand, comes with many negative consequences (K. D. Williams, 2007), so people may end up conforming to the ones they are ostracized by as an attempt to overcome exclusion (K. D. Williams, Cheung, & Choi, 2000). Research reports several examples of how people conform as a way to socially ingratiate themselves with others, such as by imitating their actions to facilitate social interactions (Lakin & Chartrand, 2003), or by matching their food intake to the one of those they feel the need to ingratiate with (Hermans, Engels, Larsen, & Herman, 2009; Robinson, Tobias, Shaw, Freeman, & Higgs, 2011). Regarding risky health behaviours, a study on alcohol consumption by Robinson and colleagues reported across two experiments that young adults have a tendency towards social mimicry in alcohol consumption when they are motivated to ingratiate themselves with a confederate (Robinson, Oldham, et al., 2016). The authors found that participants drank more when they were exposed to a heavy drinking confederate if they believed the other person would judge them in a second moment, but they did not adjust their alcohol consumption to the one of the confederate when they thought the other person would not judge them. Moreover, participants imitated the alcohol consumption of a confederate if they were unsure whether they had ingratiated themselves with the confederate, while this same imitation was reduced when participants were led to believe they had already ingratiated themselves with the confederate (Robinson, Oldham, et al., 2016). These strategies for ingratiation may explain why adolescents engage in risky health behaviours. Seeing others engaging in risky behaviours may result in adolescents also enacting those behaviours as a way to meet their need for acceptance (Stewart-Knox et al., 2005). In line with this, peer pressure and peer conformity have been found to be strong predictors of risky behaviours during adolescence (Santor, Messervey, & Kusumakar, 2000).

Conformity may also explain the more consistent association found among adolescents between risky health behaviours and perceived overweight (Farhat, 2015; Jiang et al., 2014, 2012), as opposed to an objective overweight status (Adams & Rini, 2007; Averett et al., 2013; Baek & So, 2012; Farhat et al., 2010; Huang et al., 2013; Lanza et al., 2014; Leech & Dias, 2012; McLaren et al., 2008; Pasch et al., 2008). There is a shared awareness among adolescents regarding the stigma placed on their peers with overweight (Puhl, Luedicke, & Heuer, 2011). Individuals with overweight are generally associated with many derogative attributes (Puhl & Heuer, 2009), and adolescents report they would be more willing to socialise with thinner peers rather than those with overweight (Greenleaf, Chambliss, Rhea, Martin, & Morrow, 2006). Due to awareness of the stigma placed on overweight (Puhl et al., 2011) this may trigger a fear of rejection (Blodorn, Major, Hunger, & Miller, 2016) among individuals who perceive themselves as being overweight. In turn, this fear of rejection may lead people who perceive themselves as overweight to behave in ways that they believe will provide a better impression of themselves (Miller, Rothblum, Felicio, & Brand, 1999; Neel et al., 2013) in order to overcome negative stereotypes and exclusion. Following the above, the reported tendency to engage in risky peer health behaviours among adolescents who perceive their weight status as overweight (Farhat, 2015; Jiang et al., 2014, 2012) may reflect an attempt to conform to their peers as a way to avoid a negative judgment based on their perceived weight. As an example, it has been found that engaging in alcohol consumption comes with a significant popularity gain among adolescents with overweight (Ali, Amialchuk, & Pentina, 2013).

In line with the proposition that the stigma of obesity may result in self-presentation techniques, it has been reported that people with overweight purchase less food when in company (Krantz, 1979), and at times may be more responsive to social influence than adults with normal weight when making food choices (Herman, Olmsted, & Polivy, 1983). Previous research has also indicated that people with obesity are more likely to be compliant and conform than individuals of normal weight (Rodin & Slochower, 1974; Steinberg & Birk, 1983). Taken together these findings suggest that the stigmatised social identity of people with overweight or obesity may cause people who fear negative appraisal because of their weight (i.e. individuals who self-perceive themselves as being overweight) to engage in self-presentation behaviours, such as conformity, in order to gain social acceptance. Moreover, it is hypothesised that this process may explain why self-perception of overweight is associated with an increased tendency to engage in risky behaviours. However, no research to date has directly examined whether perceiving one's own weight status as overweight increases conformity towards risky health behaviours. The studies reported in this chapter aimed to assess whether perceived overweight (Study 1) or manipulated perceived overweight (Study 2) result in increased attitudinal conformity towards risky peer behaviours, due to a concern of being judged negatively because of weight.

2.3 Study 1

2.3.1 Introduction.

The aim of the study was to assess whether people who perceive their weight status overweight are more likely to conform to the attitudes expressed by others

regarding risky health behaviours, due to a heightened fear of negative social evaluation. In a remote confederate design, participants who either perceived themselves as normal-weight or overweight were led to believe they would meet another participant in person, and learnt that the confederate either endorsed risky health behaviours or not. Participants then completed a computer task assessing their endorsement of risky health behaviours, which they believed would be viewed by the confederate. We predicted that participants who perceived themselves as overweight would be more likely to conform to the confederate's risky health behaviours-related attitudes, as they may fear being judged negatively because of their weight.

2.3.2 Methods.

2.3.2.1 Sample.

As this was an exploratory study, we did not base our sample on a formal sample size, and we aimed to recruit 120 participants (N = 30 per condition). Participants completed a pre-screening online questionnaire where they were asked to determine their perceived weight among 'underweight', 'normal weight', and 'overweight', with participants describing themselves as 'underweight' being screened out. However, after starting data collection, we were unable to recruit a sufficient number of participants who perceived themselves as overweight. Our final sample consisted of 56 participants, with 35 perceiving themselves as normal weight and 21 perceiving themselves as overweight.

2.3.2.2 Overview.

The study was advertised as a laboratory-based study titled *"Personality and first impressions"*. Those participants who were not screened out were invited for a single session experiment at the University of Liverpool, and were informed that they would have to interact with another participant (a remote confederate), to make a series of personality judgements about them at three different points during the experiment: after being provided with limited information about them (i.e., demographic information), after learning about their attitudes toward general topics and risky health behaviours, and finally, after meeting in person. There was however no other participant involved, and the information presented to participants about the remote confederate was bogus, presenting the confederate as either endorsing risky health behaviours (e.g., binge drinking, smoking) or not. To enhance weight salience, we measured participants' height and weight at the beginning of the session, and led them to believe that their weight status would have been communicated to the confederate. After being provided with information about the confederate's attitudes, participants completed an identical computer task measuring their attitudes toward risky health behaviours, enabling us to examine conformity to the confederate's attitudes towards risky health behaviours.

2.3.2.3 Design.

The study was a 2 (weight perception: perceived overweight, perceived normal weight) X 2 (confederate's attitudes: risky attitudes, non-risky attitudes) between-subjects design.

2.3.2.4 Measures and materials.

Perceived weight pre-screening. To assess perceived weight, participants completed a brief pre-screening online questionnaire before recruitment into the study. They were asked '*How would you describe your weight?'* responding with either underweight, normal weight, or overweight. Participants who perceived themselves as underweight were excluded from the study, and those who perceived themselves as being of a normal weight or overweight were included in the respective experimental groups. The pre-screening questionnaire included other demographic items (age, gender, profession) to distract from the aim of the study.

Attitudes toward risky health behaviours computer-based task. Attitudes toward risky health behaviours were assessed using a 6-item computer task. The task presented four risky health behaviours-related items: *'Unprotected sex with a casual partner is acceptable*'; *'Occasional use of illicit drugs (e.g. cannabis, LSD, ecstasy) is generally safe*'; *'Smoking only on social occasions is no big deal'*; *'Binge drinking regularly is okay'*. The task also included two filler items assessing lifestyle-related attitudes (*'Having frequent medical checks is mandatory to maintain good health'* and *'It is important to regularly practise exercise'*), to distract from the aim of the study. Responses were made on sliding visual-analogue continuous scales, coded from 1 ('*Strongly disagree'*) to 100 ('*Strongly agree'*). Participants' responses to the health behaviours-related items served as a measure of their level of endorsement toward risky health behaviours. The scores were averaged to form the dependent variable.

Computer-generated response screens for the confederate's answers to the computer-based task. To manipulate participants' perceptions of the confederate's attitude toward risky health behaviours, they were presented with a computer-generated response screen of the confederate's answers to the computer task on

attitudes toward risky health behaviours. In the risky attitudes condition, the confederate's responses to the risky health behaviour-related items fell in the last (75 – 100) quartile, to portray the confederate as a person who endorses risky health behaviours (Figure 2.1); in the non-risky attitudes condition, the confederate's responses fell in the first (0 – 25) quartile (Figure 2.2). In both conditions, the confederate's responses for the filler items fell in the middle, to represent non-controversial attitudes on each item and minimise participant suspicion.

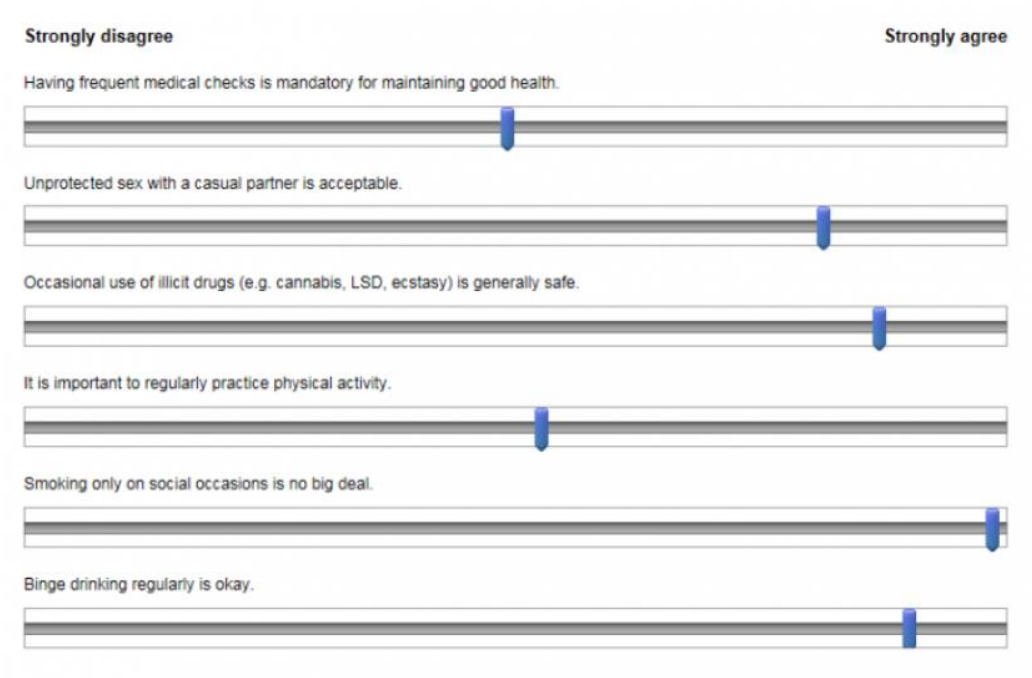

Figure 2.1. Computer-generated response screen for the risky attitudes condition.

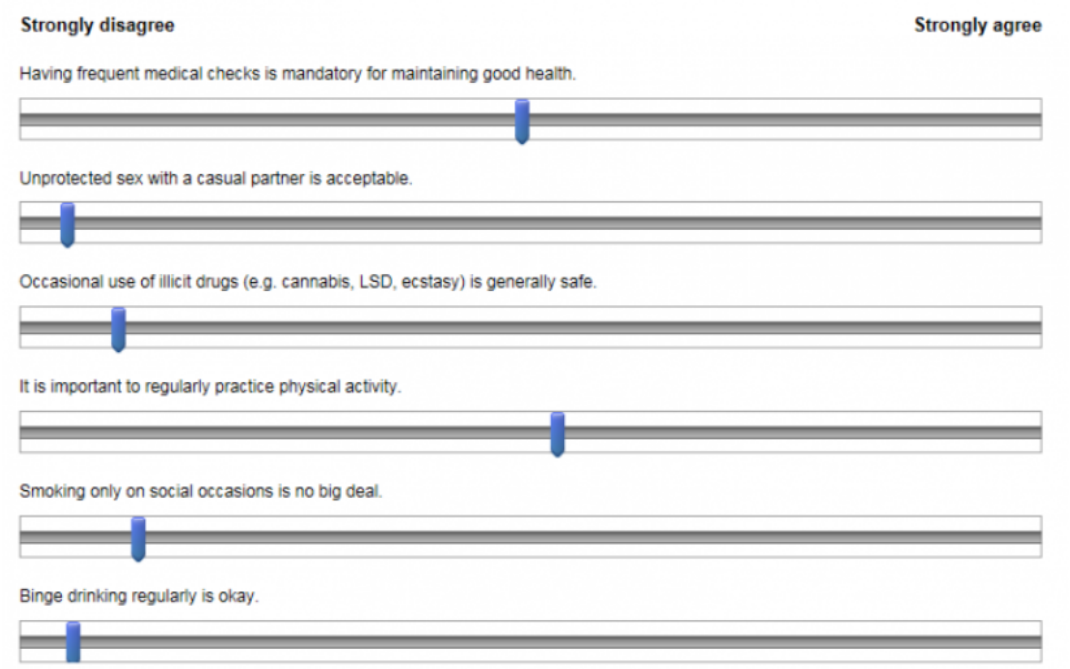

Figure 2.2. Computer-generated response screen for the non-risky attitudes condition.

Confederate evaluation and self-evaluation questionnaire. To support the cover story, participants were told that they would be asked to rate their impression of the personality of the confederate at three different time points: one after being provided with the other participant's demographics, one after reading the other participant's attitudes on risky health behaviours, and finally after meeting them in person (although the latter never occurred). The ratings were performed on three visual analogue scales (e.g., *'Please rate what you think of this person with the information you have so far. We will ask you to rate this person again later in the experiment. Do you think the other participant is…'*) with responses collected on scales ranging from *'Not at all extrovert'* to *'Very Extrovert*', from *'Not at all rational*' to *'Very rational*', and from *'Not at all emotional*' to *'Very emotional*'. To further support the cover story, participants had to rate themselves on the same items used for the confederate evaluation questionnaire immediately after having rated the confederate.

Fear of Negative Evaluation: Fear of Negative Evaluation was assessed using the Brief Fear of Negative Evaluation – Straightforward Items (BFNE-S) (Rodebaugh et al., 2004). It is an 8-item version of the BFNE (Leary, 1983) that is used for measuring fears of negative evaluation. Each item is rated on a 5-point Likert scale, ranging from 0 (‘*Not at all characteristic of me’*) to 5 (‘*Entirely characteristic of me’*). In this study, the items were slightly modified to correspond to fear of negative evaluation of the remote confederate (e.g., *‘I am afraid the other participant will not approve of me’*). Internal consistency for the present study was good ($\alpha = .90$).

Personality questionnaire. The personality questionnaire used for the cover story was the Ten Items Personality Index (TIPI) (Gosling, Rentfrow, & Swann, 2003), a ten-item measure of the Big Five personality dimensions. Each item (e.g. *‘I see myself as extraverted, enthusiastic’*) is rated on a 7-point scale that ranges from 1 (‘*Disagree strongly’*) to 7 (‘*Agree strongly’*).

Aims-awareness check. Aims-awareness was assessed by the open-ended response question *‘What do you think the aim of this study was?’*.

Manipulation check. To confirm that the confederate attitude manipulation was successful, participants were asked to rate their agreement with the statements *‘The other participant has relaxed attitudes toward risky behaviours (such as binge drinking, drug use, smoking, unprotected sex)’* with responses made on a 7-point Likert scale ranging from 1 (*‘Strongly disagree’*) to 7 (*‘Strongly agree’*).

Confederate suspicion check. Suspicion about the remote confederate was assessed by the open-ended response question *‘Did you notice anything suspicious about the other participant so far?*’.

Awareness of conformity. Awareness of conformity was assessed by the item '*My answers to the health-related questions were influenced by the other participant's answers'*, with responses made on a 7-point Likert scale ranging from 1 (*'Strongly disagree'*) to 7 (*'Strongly agree'*).

Two more measures, self-objectification and self-esteem, were included for exploratory moderation analyses. However, since we did not recruit enough participants to perform moderation analyses, the results are not reported. Moreover, for a secondary aim of the study, we also asked participants to complete a computer-based facial recognition task. Details about the additional measures and the facial recognition task procedure and results are reported in the Chapter Appendix (Appendix I, page 222).

2.3.2.5 Procedure.

After successfully completing the pre-screening questionnaire, participants were invited to a single-session experiment at the University of Liverpool. Upon arrival, the participant was told that the other participant had already arrived and was located in another room with a second researcher. After bringing the participant to the lab, the researcher asked them to read the information sheet and complete the consent form while they left to tell the other researcher they were ready to start the experiment. Once back, the researcher read the participant their answers to the pre-screening and asked to take their height and weight to verify it they were correct before sending them to the other participant. After having their measurements taken, the participant was asked to sit at the computer and the researcher entered their demographic information (gender, age, weight status and whether the participant was a student or not) in the

computer task and submitted them, saying they would be sent to the other participant. 'Weight status' information was based on participants' reported weight perception from the pre-screening. The researcher then left the participant to progress through the computer task. To bolster the cover story, the participant was warned that there may be a short delay at some points during the task, as their computer needed to synchronise with the other participant's. The researcher also informed them that they would be in the corridor and they could just knock at the door once they were done, to avoid participants seeing each other before the actual meeting.

The participant was left to complete the first self-evaluation questionnaire, which they were informed would be used to assess the confederate's accuracy in rating their personality. The participant then was presented with a brief statement about the confederate (e.g. *'The person you're going to meet is a* [same gender as participant], *18 years old student, of normal weight'*), and was asked to complete the first confederate evaluation questionnaire. The second step of the computer task involved presenting the participant with the confederate's manipulated answers to the computer task on attitudes towards risky health behaviours, either presenting the confederate's risky attitudes for health behaviours, or presenting the confederate's non-risky attitudes for health behaviours. Afterwards, the participant completed a second confederate personality evaluation. Next, the participant completed their own copy of the computer task on attitudes towards risky health behaviours, being informed that the confederate would have read their answers and rated their personality before they met in person. Afterwards, the participants completed the PANAS, BFNE and the TIPI to further support the cover story, followed by the aims-awareness, manipulation, suspicion about remote confederate and awareness of conformity questions. The researcher then returned to the lab and the participant completed the facial recognition

task. When the participant informed the researcher they had completed the facial recognition task, the researcher returned and informed them that they would not have met another person and that their answers had not been sent to anyone. The participant then completed the self-esteem questionnaire and the self-objectification questionnaire. Finally, the participant was debriefed.

2.3.2.6 Planned analyses.

2.3.2.6.1 Manipulation check.

We ran an independent-samples t-test to compare participants across confederate's attitudes condition on the confederate manipulation check. We expected a significant difference between the two confederate's attitudes conditions, with participants in the risky attitudes condition reporting that the confederate endorsed risky attitudes significantly more than how reported by participants in the non-risky attitudes condition.

2.3.2.6.2 Hypothesis testing.

We ran an independent-samples t-test to compare participants across the two weight perception conditions on fear of negative evaluation. We also ran a 2 (weight perception: perceived overweight, perceived normal weight) X 2 (confederate's attitudes: risky attitudes, non-risky attitudes) ANOVA with participants' average attitudes towards risky health behaviours as a dependant variable. We expected a significant difference between the two weight perception conditions on fear of negative evaluation, such that those in the perceived overweight condition would report higher rates of fear of negative evaluation compared to the perceived normal

weight condition. For the 2X2 ANOVA, we expected to find a main effect of confederate attitude, such that participants in the risky attitudes condition would report greater endorsement of risky health behaviours than those in the non-risky attitudes condition. We also expected to observe an interaction between confederate's attitudes and weight perception, with a stronger effect of confederate's attitudes on endorsement of risky health behaviours in the perceived overweight condition compared to the perceived normal weight condition, indicating greater conformity.

2.3.2.6.3 Sensitivity analyses.

We re-ran the t-tests and 2x2 mixed ANOVA main analyses excluding those participants who guessed the aims or suspected there was no other participant taking part to the experiment. In order to detect participants to exclude, two researchers independently coded the aim-awareness and confederate suspicion checks. For the aim-awareness check, answers such as *"the aim of the experiment was to see whether I would change my mind/attitude on risky behaviours according to the other participant's opinions"*, or *"the aim of the experiment was to see whether I would agree with the other participant's opinion on risky behaviours"* were considered as guessing the aim of the experiment. For the confederate suspicion check, answers such as *"I think there is not another participant"* or *"I think the other participant is a researcher"* were considered as guessing the absence of another participant.

2.3.3 Results.

Fifty-six participants were recruited (71.4% females, $N = 40$), aged between 18 and 63 years, $M = 26.48$, $SD = 9.92$, with BMI ranging from 15.81 to 44.38, $M = 25.57$,

SD = 5.26. Most participants were students, 73.2%, *N* = 41, and of perceived normal weight, 62.5%, *N* = 35. Baseline characteristics of the perceived normal weight and perceived overweight participants are reported in Table 2.1, along with results from independent samples t-tests (for age and BMI) and Chi-square analyses (for gender and student status) when comparing the two groups on demographic variables. Participants in the perceived normal weight condition had a significantly lower BMI, M = 22.71, SD = 2.52, $t(25.75) = -6.29$, $p = <.001$, d = 1.87, were significantly younger, M = 24.26, SD = 8.41, $t(33.38) = -2.09$, $p = .045$, d = .60, and had a higher proportion of students, $\chi^2(1) = 7.44$, $p = .012$, OR = .18, compared to participants in the perceived overweight condition.

Table 2.1

Participants characteristics for weight perception conditions

	Mean (SD)/ %Yes			
	Perceived normal weight	**Perceived overweight**	***t*/χ^2**	**Sig.**
Age	24.26 (8.41)	30.19 (11.29)	-2.09	.045
BMI	22.71(2.52)	30.34 (5.20)	-6.29	< .001
Female	71.40%	71.40%	<.001	> .99
Student	85.70%	52.40%	7.44	.012

Participants reported their age, gender, and whether they were a student in the pre-screening. BMI measures were calculated after measuring their height (in meters) and weight (in kilograms) at the end of the experiment.

2.3.3.1 Manipulation check.

There was a significant difference between the two confederate's attitudes conditions, t (40.68) = 12.20, p < .001, d = 3.29, on the manipulation check.

Participants in the risky attitudes condition reported the confederate endorsing risky health behaviours significantly more, M = 6.07, SD = .84, than participants in the non-risky attitudes condition, M = 2.11, SD = 1.48.

2.3.3.2 Hypothesis testing.

An independent-samples t-test revealed no significant difference between the two weight perception conditions on fear of negative evaluation, $t(54) = -.95$, $p = .346$, $d = .26$. Results from the 2 X 2 ANOVA are illustrated in Figure 2.3. Only a significant main effect of confederate's attitudes, $F(1,52) = 19.94$, $p < .001$, $\eta_p^2 = .28$, was observed, with participants in the risky attitudes condition reporting overall a higher endorsement of risky health behaviours, M = 40.65, SD = 23.01, compared to those in the non-risky attitudes condition, M = 15.81, SD = 17.16. The interaction between weight perception and confederate's attitudes was non-significant, F (1,52) = .22, p = .641, $\eta_p^2 = .004$.

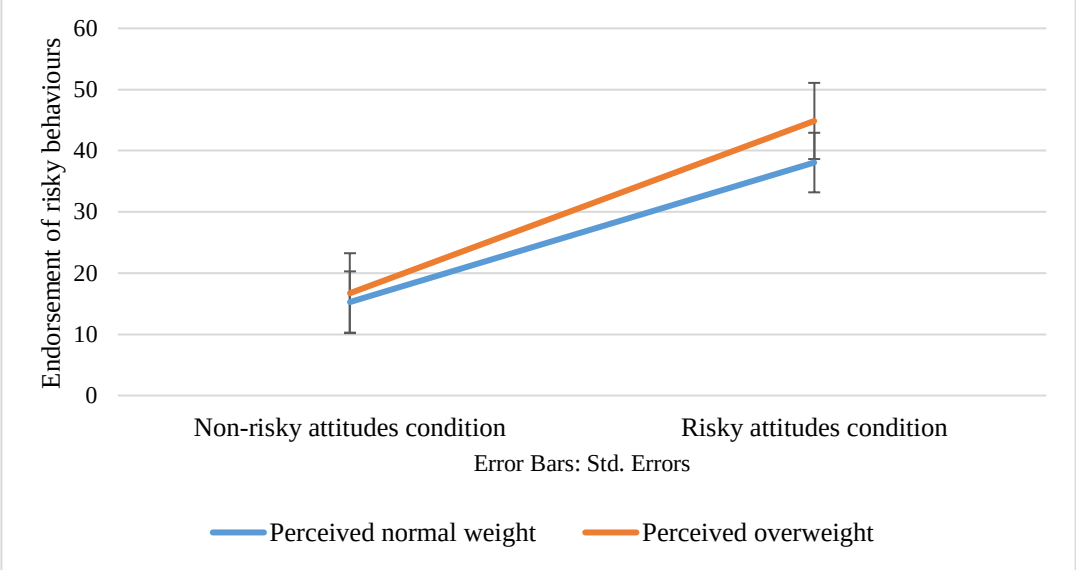

Figure 2.3. Results of the 2 (weight perception) X 2 (confederate's attitudes) ANOVA for risky health behaviours. The graph presents participants' average score of risky health behaviours across conditions.

2.3.3.3 Sensitivity analyses.

Seven participants were excluded because they either guessed the aim of the study or did not believe there was another participant. When excluding them and re-running the analyses for the hypothesis testing, both the t-test to compare participants across weight perception groups on rates of fear of negative evaluation and the 2x2 between-subjects ANOVA did not show a different pattern of results: specifically, no significant result became non-significant and vice-versa.

2.3.4 Discussion.

The present study examined attitudinal conformity to risky health behaviours in participants who perceived themselves as overweight opposed to participants who

perceived themselves as normal weight. As predicted, our results reported a significant main effect of confederate's attitudes, reflecting an overall tendency for participants to report greater endorsement of risky health behaviours when exposed to another person endorsing positive attitudes towards risky health behaviours. This is in line with previous results about social imitation of risky behaviours as a way to socially ingratiate themselves with others (Robinson, Oldham, et al., 2016). However, we did not find any evidence of greater conformity among individuals who perceived their weight status as overweight, compared to those who perceived their weight status as normal.

These results could be due to limitations of the study. First, we had a smaller sample size than intended. Further to that, participants who perceived themselves as overweight were significantly older, in addition to many of them being non-students. These differences might have affected conformity, given that our confederate was described as being 18 years old and a first-year undergraduate student in psychology, and many participants who perceived themselves as overweight might have hence failed to consider them as a peer. We also predicted that participants who perceived themselves as overweight would report higher rates of fear of negative evaluation, but we found no evidence in support of this. The questionnaire we used assessed general fear negative evaluation rather than weight stigma concerns (Hunger & Major, 2015), which may explain a lack of difference between the two groups. Moreover, participants' weight may not have been salient enough during the experiment to invoke self-presentation concerns. For example, previous research reports an impact of stereotype threat on academic performance in girls only when the stereotype threat was heightened (Keller, 2002). Similarly, research on impression management tactics suggests that stigmatised people try to prioritize self-presentation strategies when a

stereotype threat is made salient (Neel et al., 2013). Therefore, from the present study we did not find evidence in support of our hypothesis that perceiving one's own weight status as overweight increases attitudinal conformity for risky health behaviours. However, the lack of evidence may have been due to study limitations. Therefore, these limitations were addressed in Study 2.

2.4 Study 2

2.4.1 Introduction.

Study 2 aimed to assess whether manipulation of weight perception resulted in increased attitudinal conformity towards risky peer behaviours, due to weight stigma concerns. In a remote confederate design, participants were led to believe they would meet another participant in person, and learnt that the confederate endorsed some risky health behaviours, but not others. Participants then completed a computer task assessing their attitudes toward risky health behaviours, which they believed would be viewed by the confederate. We predicted that participants in the manipulated perceived overweight condition would be more likely to conform to the confederate's risky health behaviours-related attitudes than participants in the perceived normal weight condition.

In Study 2 we opted for a mixed design, where the confederate's attitudes toward risky health behaviours (risky attitudes, non-risky attitudes) served as a within-subjects factor. To overcome the recruitment difficulties faced in Study 1, rather than using self-reported perceived weight we based our between-subjects factor on a manipulation of weight perception, with participants being randomly assigned to

either a perceived normal weight condition or a manipulated perceived overweight condition obtained with the use of an overweight bodysuit. Because of this change, we only recruited participants who perceived themselves as normal weight to ensure that the experimental manipulation was not confounded with a pre-existing feeling of being overweight. Moreover, in order to overcome any between-groups age difference, we only recruited participants aged between 18 and 25. Finally, we changed the confederate description so that participants would perceive them as a peer. We thus only reported the confederate's gender, age-range and student status, all of which were identical to recruited participants.

2.4.2 Method.

2.4.2.1 Sample.

We used GPower to calculate our required sample size, running a priori analyses for a repeated measures ANOVA with a within-between interaction ($1 - \beta \geq 0.80$, $\alpha = 0.05$, $f = 0.25$, G*POWER 3.1.3). The recommended sample size to detect a medium sized statistical effect was 46 participants. To account for the exclusion of any participants guessing the aim of the study and the eventuality that the detected effect could be smaller in statistical size, we recruited 80 participants (40 for the manipulated perceived overweight condition and 40 for the perceived normal weight condition). We recruited participants aged 18 to 25 years old, who were students and fluent in English, and who had not previously taken part in a bodysuit study. Moreover, we only recruited those participants who reported they would describe their weight as 'normal weight' in a pre-screening questionnaire. Between-subjects groups were stratified by gender.

2.4.2.2 Overview.

The study was advertised as a laboratory-based study titled *"Social interactions study"*. After completing a pre-screening questionnaire sent online, participants were invited to attend a single session experiment at the University of Liverpool. They were informed that the aim of the study was to examine how people form judgements about others and social interactions. Participants were told that they would interact with another participant electronically through a computer-linked task before meeting in person, and they would also be asked to complete a brief computer task about attitudes and personality. The study, however, had no other participant or confederate involved, and the participants only read pre-arranged computer-generated answers before completing a computer-based task. Moreover, since the study aimed to examine the effect of appearance in these interactions, participants were told that they might be asked to wear clothing during the experiment. Participants were allocated to one of two conditions: a manipulated perceived overweight condition, where they were asked to wear an overweight body prosthetic to manipulate the feeling of being overweight, or a perceived normal weight condition, where they were not asked to modify their apparent weight but would only wear control clothing.

At the beginning of the experiment, after being assigned to one of the two appearance-conditions, participants were led to believe that their apparent weight would be communicated to the (non-existent) confederate. Afterwards, they were told that they would make a series of personality judgements about the other participant at three different points during the experiment: after being provided with limited information about the other participant, after learning about their attitudes toward various topics, and finally, after meeting in person (although the latter did not take

place, as the remote confederate was bogus). The confederate's attitudes toward risky health behaviours were manipulated using a randomised within-subjects design: participants were presented with two response screens of the pre-filled computer task, showing the confederate endorsing two risky health behaviours and not endorsing two other risky health behaviours, with risky health behaviours-related items presented in a counterbalanced order and with equal frequency. Participants saw the confederate's response screen at two different points of the computer-based interaction, and after seeing each response screen, participants completed an identical computer-based task measuring their attitudes toward the same health behaviours, which they expected the confederate to read.

2.4.2.3 Design.

The study was a 2 (between-subjects condition, weight perception: manipulated perceived overweight, perceived normal weight) X 2 (within-subjects condition, confederate's attitudes: risky attitudes, non-risky attitudes) mixed design.

2.4.2.4 Measures and materials.

Pre-screening questionnaire. Potential participants were asked to complete a brief pre-screening questionnaire on their age range, gender, whether they were a student, and how they would describe their weight (*'underweight'*, *'normal weight'* or *'overweight'*).

Attitudes toward risky health behaviours computer-based task. Participants' attitudes toward risky behaviours were measured using a 6-item computer task. The risky health behaviours-related items were: *'Unprotected sex with a casual partner is*

acceptable'; *'Occasional use of illicit drugs (e.g. cannabis, LSD, ecstasy) is generally safe*'; *'Smoking only on social occasions is no big deal'*; *'Binge drinking regularly is okay'*. The task also included two filler items on two different lifestyle attitudes, to distract from the aim of the study (*'It is important to regularly drink water'* and *'Having frequent medical checks is mandatory for maintaining good health'*). Responses to each item were collected on visual-analogue scale (VAS), with anchors of 1 (*'Strongly disagree'*) to 100 (*'Strongly agree'*). Participants' responses to the health behaviours-related items served as a measure of their own endorsement toward risky health behaviours, and these scores were averaged to form the dependent variable.

Computer-generated response screens for the confederate's computer-based task. To manipulate their perceptions of the confederate's attitude toward risky health behaviours, participants were provided with two computer-generated response screens of the confederate's answers on the task about attitudes toward risky health behaviours. One response screen (containing one filler item and two risky health behaviours-related items) showed the confederate endorsing the risky health behaviours-related items (serving as the within-subjects risky attitudes condition, see Figure 2.4), with their responses to the risky health behaviours-related items falling in the last quartile of the VAS (75 – 100). For the item regarding unprotected sex, the confederate's answer presented less relaxed attitudes compared to the one reported in the risky attitudes condition from Study 1, to avoid arousing suspicion from the participants. The other response screen (containing the other filler item and the remaining two risky health behaviours-related items) showed the confederate not endorsing the two risky health behaviours-related items (serving as the within-subjects non-risky attitudes condition, see Figure 2.5), with their responses falling in the first

quartile of the VAS (0 – 25). In both conditions, the confederate's responses for the filler items fell in the middle of the scale.

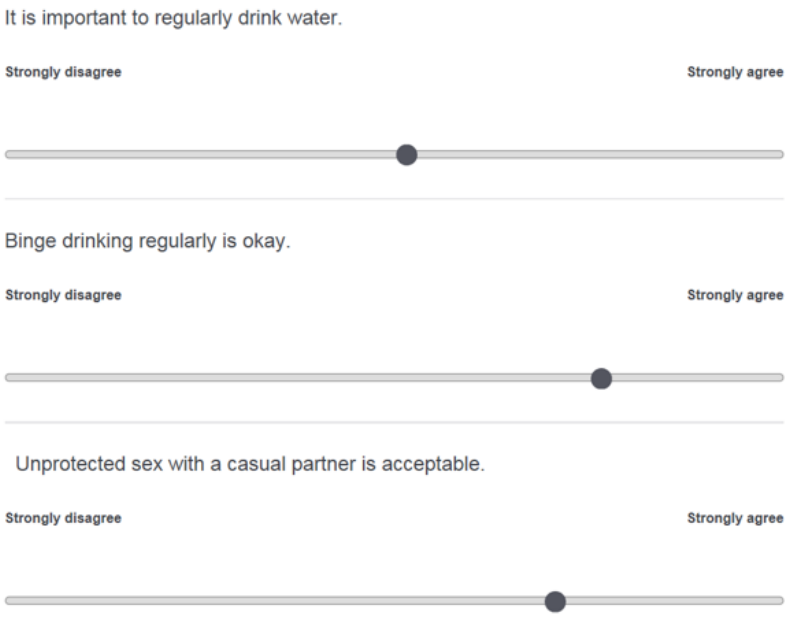

Figure 2.4. Computer-generated response screen for the risky attitudes condition.

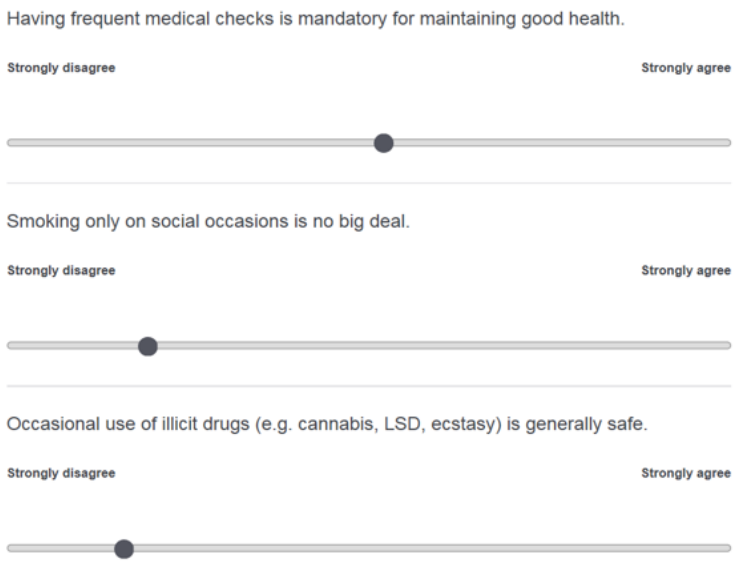

Figure 2.5. Computer-generated response screen for the non-risky attitudes condition.

Each item conveying the confederate's attitudes toward risky health behaviours presented risky and non-risky attitudes with equal frequency. The order of presentation of each individual item was counterbalanced across conditions, and the order of presentation of the confederate's risky and non-risky answers was counterbalanced across participants.

Confederate and self-evaluation computer-based questionnaire. As in Study 1, to support the cover story, participants were told that they would have to rate their impression of the personality of the confederate at three different time points (after being provided with their demographics, after seeing their response on the computer-based task, and after the meeting, although the latter did not happen), on three visual analogue scales (e.g., *'Please rate what you think of this person with the information you have so far. We will ask you to rate this person again later in the experiment. Do you think the other participant is…',* with responses collected on visual analogue scales ranging from *'Introvert'* to *'Extrovert'*). To further corroborate the cover story participants were also asked to rate themselves on the same items right after rating the confederate on them, which they were told it was to evaluate the accuracy of the confederate's perceptions of their personality.

Weight stigma concerns. Weight stigma concerns were assessed using the 5-item weight stigma concerns scale, developed by Hunger and Major (Hunger & Major, 2015). It consists of 5 items to which participant can rate their agreement on a Likert scale ranging from 1 ('*Strongly disagree'*) to 7 ('*Strongly agree'*). The wording was slightly modified so that the items could refer to participants' concerns over whether the confederate would have stigmatised them because of their weight (e.g., *'I am*

concerned that the other participant's opinion of me will be based on how my weight appears'). Internal consistency was excellent for the study (α = .91).

Current mood. To assess the potential effect of wearing a bodysuit on state mood, participants completed the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988). The questionnaire comprises of two mood scales, assessing positive and negative affect. Participants are asked to indicate the extent to which 20 items describe how they are currently feeling on 5-point Likert scales, ranging from 1 ('*Very slightly or not at all*') to 5 ('*Extremely')*. The scales had good internal consistency in the present study (positive affect α = .88, negative affect α = .86).

Aims-awareness check. Aims-awareness was assessed by the open-ended response question *'What do you think the aim of this study is so far?'*.

Confederate suspicion check. Suspicion about the absence of another participant was assessed with the open-ended question *'Did you notice anything suspicious about the other participant so far?*'.

Manipulation checks. To confirm that the confederate's attitudes manipulation was successful, participants were asked to rate their agreement with four statements related to the four different health behaviours items (*e.g. 'The other participant had relaxed attitudes towards binge drinking'*), with answers rated on a 5-point Likert scale ranging from 1 ('*Strongly disagree'*) to 5 ('*Strongly agree*'). Two mean scores were then calculated from the single four confederate manipulation checks according to the confederate's randomised risky and non-risky attitudes which participants were exposed to during the experiment. To confirm that the manipulation of weight perception was successful, participants were asked to rate their agreement with the

statement '*I felt overweight during the study*' on a 5-point Likert scale ranging from 1 ('*Strongly disagree'*) to 5 ('*Strongly* agree').

Awareness of conformity. Awareness of conformity was assessed by the item '*My answers to the health-related questions were influenced by the other participant's* answers', with responses made on a 5-point Likert scale ranging from 1 ('*Strongly disagree'*) to 5 ('*Strongly* agree').

2.4.2.5 Procedure.

Upon arrival to the laboratory, the participant was told that the other participant (remote confederate) had arrived already and was located in another room. The researcher asked the participant to read the information sheet and complete the consent form, while the researcher left the room to *"tell the other participant they are ready to start the experiment"* (to bolster the cover story). The researcher then asked the participant to change into the bodysuit and clothing (in the manipulated perceived overweight condition), or into the control clothing (perceived normal weight condition), using the following instructions.

For participants in the manipulated perceived overweight condition:

"During the study, you will make a series of judgments of the other participant's personality after exchanging information online, and then after meeting them in person. Because we are interested in how physical appearances influence first impressions and social interactions, we are asking some participants to change their physical appearance. You have been allocated to the body prosthetic condition, so we will ask you to wear this bodysuit to modify your appearance. We need you to wear this bodysuit since the beginning of the experiment in order for you to grow used to

have it on and move naturally while wearing it. This is important because we want to make sure the other participant does not realise you are wearing the bodysuit during the meeting, so please do not tell them when you meet. You will wear these clothes over the top, to disguise that you are wearing a body suit. The participant you will meet will be wearing the same clothing over their own clothing, but will not be wearing a bodysuit. This is so that other aspects of appearance are standardised, except that you will be wearing the bodysuit to modify your appearance. After meeting the other participant in person while wearing the bodysuit, we will then ask you to make some final evaluations of each other."

For participants in the perceived normal weight condition:

"During the study, you will make a series of judgments of the other participant's personality after exchanging information online, and then after meeting them in person. Because we are interested in how physical appearances influence first impressions and social interactions, we are asking all participants to wear the same clothes so this is standardised. You will wear these clothes over your own, and the participant you will meet will be wearing the same clothing as you over their own clothing. After meeting the other participant in person, you will then make some final evaluations of each other."

Once the participant had put on the clothing, the researcher asked them to stand in front of the mirror *"to check if the clothing fits properly"*, making sure the participant could see their appearance.

The participant then began the computer task. The researcher entered the participant's demographic information (gender, age range, weight status and whether the participant was a student or not) in the computer and selected "*send to the other*

participant". Weight status information was based on the experimental condition to which the participant was assigned (*'overweight'* for the manipulated perceived overweight condition, *'normal weight'* in the perceived normal weight condition). The researcher then left the participant to progress through the computer task, instructing them to knock on the door once the computer informed them that they had reached the end of the first part of the computer task. To bolster the cover story, the researcher told the participant that they would wait for them in the corridor, so that either participant could inform the researcher that they had finished the computer task without seeing the other participant before the meeting. The participant was also warned that they may experience a short delay at points during the task while their computer 'synchronised' with the other participant's.

The participant was then left to complete a brief computer-based self-evaluation questionnaire, which they were informed would be used to assess the confederate's accuracy in rating their personality. The participant then completed the first step of the computer task. Specifically, they were presented with a brief statement about the confederate (e.g. *'The person you're going to meet is a* [same gender as participant], *18-25 years old student, of normal weight'*), and were asked to complete the first confederate evaluation task. The second step of the computer task involved presenting the participant with the first response screen of the confederate's attitudes responses, which either showed the confederate as endorsing (risky attitudes condition) or non-endorsing (non-risky attitudes condition) risky health behaviours. After viewing the first response screen of the confederate's answers, the participant completed a second confederate personality evaluation. The participant was then asked to answer themselves the same three risky health behaviours-related items they just rated the confederate on, rating their own endorsement of the risky health behaviours, being

reminded that their responses would be forwarded to the confederate to read before they meet in person. The same procedure was repeated for the second block of confederate attitude items, containing the remaining two risky health behaviours related items and filler item. Next, the participant completed the weight stigma concerns scale, the PANAS mood scale, and the aims-awareness, awareness of absence of a fake remote confederate (confederate suspicion), manipulation and awareness of conformity checks. The computer task instructed the participant to knock on the door to inform the researcher that they had finished. The participant was then debriefed and asked to take off the bodysuit (for those in the manipulated perceived overweight condition) and control clothing so the researcher could measure their height and weight.

2.4.2.6 Planned analyses.

2.4.2.6.1 Manipulation checks.

To examine that the manipulation of the confederate's attitudes towards different risky health behaviours was successful, we ran a paired samples t-test to compare participants on the confederate's attitudes manipulation checks. To examine that the manipulation of weight perception using the bodysuit was successful, we ran an independent samples t-tests to compare participants across the two weight perception conditions on the manipulation of weight perception check measure.

2.4.2.6.2 Hypothesis testing.

We ran three independent samples t-tests to compare participants across the between-subjects condition on positive affect, negative affect, and weight stigma

concerns scores. We expected participants in the manipulated perceived overweight condition to score lower on positive affect and higher on negative affect and weight stigma concerns when compared to those in the perceived normal weight group. We conducted a 2 X 2 mixed ANOVA, with weight perception (manipulated perceived overweight, perceived normal weight) as the between-subjects condition and confederate's attitudes (risky attitudes, non-risky attitudes) as the within-subjects condition, and with participant's average scores on attitudes toward risky and non-risky health behaviours as the dependent variable. We expected to find a main effect of confederate's attitudes, such that participants would report a significantly greater endorsement of risky health behaviours in the risky attitudes condition than in the non-risky attitudes condition. We also expected to find a significant interaction effect between weight perception and confederate's attitudes. If a significant interaction was observed, paired samples t-tests with a Bonferroni correction were planned to examine the effect of the confederate's attitudes in the manipulated perceived overweight versus the perceived normal weight condition. We hypothesised that there would be stronger effect of confederate's attitudes on endorsement of risky health behaviours in the manipulated perceived overweight condition than in the perceived normal weight condition, indicating greater conformity.

2.4.2.6.3 Sensitivity analyses.

We ran the t-tests and 2x2 mixed ANOVA main analyses excluding those subjects who guessed the aims or suspected there was no other participant taking part to the experiment. In order to detect participants to exclude, two researchers independently coded the aim-awareness and confederate suspicion checks. For the aim-awareness check, answers such as *"the aim of the experiment was to see whether I would change*

my mind/attitude on risky behaviours according to the other participant's opinions", or *"the aim of the experiment was to see whether I would agree with the other participant's opinion on risky behaviours"* were considered as guessing the aim of the experiment. For the confederate suspicion check, answers such *as "I think there is not another participant"* or *"I think the other participant is a researcher"* were considered as guessing the absence of another participant.

2.4.3 Results.

We recruited 80 participants (85% female, $N = 68$), aged between 18 and 24 ($M = 18.58$, $SD = 1.05$) with BMIs ranging from 15.76 to 33.27 ($M = 22.48$, $SD = 3.18$).

2.4.3.1 Manipulation checks.

A paired samples *t*-test comparing participants on the confederate's attitudes manipulation check revealed a significant difference between conditions, $t\ (79) = 18.03$, $p < .001$, $d = 2.65$. Participants perceived the confederate in the risky attitudes condition to endorse risky health behaviours, $M = 4.04$, $SD = .67$, more so than then in the non-risky attitudes condition, $M = 1.98$, $SD = .86$. As expected, a significant difference was also found between weight perception conditions (manipulated perceived overweight, perceived normal weight) on the perceived weight manipulation check, $t(70.25) = -12.09$, $p < .001$, $d = 2.67$. Participants in the manipulated perceived overweight condition felt significantly more overweight during the study, $M = 3.81$, $SD = 1.02$, compared to participants in the perceived normal weight condition, $M = 1.53$, $SD = .65$.

2.4.3.2 Hypothesis testing.

An independent samples *t*-test revealed a significant difference between weight perception conditions on weight stigma concerns, t (77.28) = -13.41, $p < .001$, $d = 3$, such that participants in the manipulated perceived overweight condition reported higher weight stigma concerns, $M = 22.74$, $SD = 4.29$, than participants in the perceived normal weight condition, $M = 9.89$, $SD = 4.27$. However, contrary to our predictions, no significant difference between the two groups was found on positive, t (76.85) = .64, $p = .525$, $d = .14$, or negative affect scores, t (77.47) = -1.41, $p = .166$, $d = .31$ (Table 2.2).

Table 2.2

Independent samples t-tests (manipulated perceived overweight vs. perceived normal weight) comparing participants on FNE and PANAS scores

		Mean (SD)
Positive	***Manipulated perceived overweight***	35.64 (17.50)
PANAS	***Perceived normal weight***	33.16 (17.14)
Negative	***Manipulated perceived overweight***	9.15 (10.34)
PANAS	***Perceived normal weight***	12.75 (12.44)

Means refer to the averaged sum of items related to each subscale of the PANAS.

We found a significant main effect of confederate's attitudes, F (1, 78) = 71.42, $p < .001$, $\eta_p^2 = .48$, on endorsement of risky health behaviours, such that participants reported stronger endorsement of risky health behaviour in the risky attitudes condition, $M = 48.38$, $SD = 21.89$, than in the non-risky attitudes condition, $M = 24.53$, $SD = 22.25$, as predicted. We also found a significant main effect of weight

perception condition, F (1, 78) = 5.17, p = .026, η_p^2 = .06, such that participants in the perceived normal weight condition reported greater endorsement of risky health behaviours than those in the manipulated perceived overweight condition. However, contrary to our hypothesis, the interaction between weight perception and confederate's attitudes was not significant, F (1, 78) = 1.95, p = .167, η_p^2 = .02 (Figure 2.6).

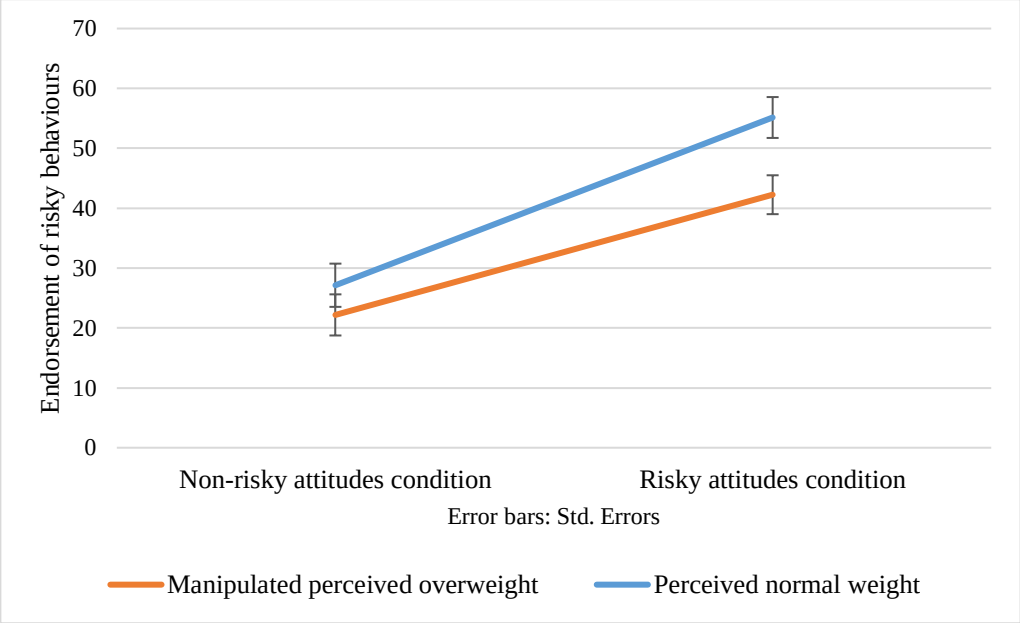

Figure 2.6. Results of the 2 (weight perception) X 2 (confederate's attitudes) mixed ANOVA for risky health behaviours. The graph presents participants' average score of risky health behaviours across conditions.

2.4.3.3 Sensitivity analyses.

Four participants correctly guessed the aims of the study or were aware that there was no other participant and were excluded from the analyses. We re-ran the *t*-tests comparing PANAS and FNE scores between weight perception conditions and the

main 2x2 mixed ANOVA excluding participants who guessed the aim of the experiment or who did not believe that there was another participant taking part in the experiment. The pattern of results did not differ from the main analysis section: specifically, no significant results became non-significant and vice-versa.

2.5 General Discussion

Self-perception of overweight status, as opposed to perception of normal weight status, has been found to be associated with risky health behaviours such as unprotected sexual behaviours, smoking, and marijuana and excessive alcohol consumption (Farhat, 2015; Jiang et al., 2014, 2012). We reasoned that this may be explained by perceived overweight causing a desire to conform and be accepted. More specifically, based on the stigma attached to overweight and obesity (Puhl & Heuer, 2009), we hypothesized that because of an expectation of being rejected because of their weight (Blodorn et al., 2016), individuals who perceive themselves as being of an overweight status may be more likely to conform to the their peers' risky behaviour-related attitudes, in order to present themselves in a more favourable manner.

In Study 1 we found no evidence in support of our predictions, but there were a number of limitations. In Study 2 we manipulated perceived overweight and examined if participants were more likely to display attitudinal conformity about endorsement of risky health behaviour. We hypothesized that participants in the manipulated perceived overweight condition (who were asked to wear an overweight bodysuit and control clothing) would be more likely to conform to a confederate's risky attitudes compared to participants in the perceived normal weight condition (who were only

asked to wear control clothing), as a way to overcome their weight stigma concerns. We found evidence for a main effect of confederate's attitudes, which suggests that participants had a tendency toward conforming to peers' attitudes toward risky health behaviours; this in line with previous literature on conformity and risky health behaviour (Gardner & Steinberg, 2005), and in our study it may have been a way to ingratiate themselves with the confederate (Robinson, Oldham, et al., 2016). Alternatively, the effect we found could be due to informational or normative influence (Deutsch & Gerard, 1955), which have previously reported an impact on young people's attitudes toward risky health behaviours, such as drinking (Borsari & Carey, 2001). However, we found no significant interaction between confederate's attitudes and weight perception. Our study hence did not identify a significant effect of our experimental manipulation of weight perception on conformity, or on informational or normative influences.

The lack of hypothesised effect may be due to limitations of our study design. Participants completed the study alone in the laboratory, and were not seen by anyone other than the researcher while they were wearing the bodysuit, so it is possible that the lack of visual exposure did not make them feel 'judged' enough to conform to the confederate's attitudes. A study by Blodorn and colleagues, for example, found that women high in BMI reported increased expectations of social rejection when their weight was visible (Blodorn et al., 2016). It could also be that the perceived overweight manipulation due to wearing a bodysuit had caused an in-group vs. out-group difference between participants and the confederate (who was described as being of normal weight), which reduced any increased tendency to conform as a result of wearing the body suit. Previous research, in fact, has reported a trend towards

conforming more to in-group norms compared to out-group ones (Berger & Heath, 2007, study 3 and 4; Cruwys et al., 2012; Mackie, 1986). Last, and most importantly, while wearing a bodysuit did result in participants feeling overweight and reporting higher weight stigma concerns, it is important to point out that wearing a bodysuit is not equivalent to experiencing the stigma a person with actual overweight may live with. There is a rising critique on the use of fat bodysuits in research (Meadows, Danielsdottir, Calogero, & O'Reilly, 2017), firstly from a methodological perspective, as a bodysuit can not possibly reproduce the psychological, social, and physiological experience of living with overweight. Further to that, the use of fat bodysuits posits an ethical issue, as "manipulating the experience of obesity" through the use of a bodysuit would indirect minimise the legitimacy of the reported discrimination faced by people with overweight, as if it could only be verified by allowing those who do not live with overweight to experience such discrimination by wearing a suit for a short amount of time (Meadows et al., 2017). Finally, it is important to note that our study measured attitudinal conformity rather than behavioural conformity (Merton, 1959). Therefore, we cannot conclude whether or not perceived overweight would increase behavioural conformity.

There are other potential explanations for the findings reported in literature on the association between weight perception and risky peer behaviours which we did not consider in this study. It could be that people who consider their status as overweight do not engage in risky health behaviours because of conformity. Rather, people who perceive their weight as overweight may turn to risky health behaviours simply as a way to cope with the negative emotions due to being stigmatised. Literature has previously reported how different kind of stigmatisation can lead to coping strategies

involving drinking (Hatzenbuehler et al., 2011; J. K. Martin et al., 2003), smoking (Gruskin et al., 2008; Guthrie et al., 2002; Parker et al., 2016), substance abuse (Reisner et al., 2015), and unprotected sex (Han et al., 2014). Considering the high levels of distress caused by weight stigma (Ashmore et al., 2008; Major et al., 2012), it may be that people who perceive their weight as overweight engage in risky health behaviours as a way of maladaptive coping.

An increased tendency to engage in risky behaviours among individuals who self-perceive their weight as being overweight may also be explained by stigma depleting self-control. There is evidence showing that stigma exposure can deplete self-control (Inzlicht et al., 2006). For example, exposing self-perceived individuals to weight-stigmatising contents can impair self-control for caloric intake (Major et al., 2014). It may hence be plausible that the same mechanisms could be the cause of the high tendency towards risky health behaviours reported among individuals who perceive their weight status as overweight, considering the association of ego-depletion with increased risk taking (Fischer, Kastenmüller, & Asal, 2012) and with heavy drinking (Christiansen, Cole, & Field, 2012). Finally, another potential explanation for our results could be due to a matter of different ingratiation tactics. Rather than being a result of conformity, it is possible that individuals who perceive their weight as overweight choose to endorse risky health behaviours as a direct impression management strategy. Previous research has reported a tendency towards adopting risky health behaviours among adolescents as a way to present themselves in a favourable way to their peers (K. A. Martin & Leary, 2001), and similarly, self-presentation strategies have been found among individuals with overweight as well (Neel et al., 2013). It may hence be possible that individuals who perceive their weight

as overweight would purposefully adopt risky health behaviours to give a better first impression of themselves to other people.

Following the abovementioned explanations, future investigations should focus on the mechanisms explaining the increased rate of risky health behaviours reported among individuals who perceive their weight status as overweight (Farhat, 2015; Jiang et al., 2014, 2012). Considering our limitations, future studies should better examine whether it is an effect of conformity or whether it is more of a case of ingratiation tactics. Alternatively, future research could benefit from considering whether the high tendency towards risky health behaviours among individuals who consider their weight status as overweight is due to the stigma of obesity causing maladaptive coping or depleted self-control.

2.6 Conclusions

Neither perceived overweight (Study 1) nor manipulated perceived overweight (Study 2) resulted in increased attitudinal conformity towards risky peer behaviours.

Chapter 3: Weight perception, weight stigma concerns, and overeating

3.1 Chapter abstract

Perceiving one's own weight status as being overweight is a likely motivation for weight loss. However, self-perceived overweight status has also been found to be associated with overeating and weight gain. In this chapter, we examined whether individuals who perceive their weight status as being overweight are prone to overeating because of concerns of being stigmatised based on their weight.

3.2 Introduction

The failure of individuals with overweight to accurately identify their weight status has been highlighted as a cause for concern, as it is presumed that this failure might lead to ineffective weight management. In support of this idea, studies have demonstrated that self-perception of overweight is associated with attempted weight loss and weight loss intentions among adults and adolescents of overweight status (Duncan et al., 2011; Lebrun et al., 2013; Rancourt et al., 2017). However, recent findings suggest that self-perception of overweight is associated with worse weight management over time; self-perceived overweight is a risk factor for increased weight gain, both for adults and adolescents of 'normal' weight and overweight status (Robinson et al., 2015; Sutin & Terracciano, 2015), while weight status misperception among adolescents of overweight status seems to be protective against weight gain (Rancourt et al., 2017). This may partly be explained by overeating. A study by Saules

and colleagues, for example, found self-perceived overweight to be associated with binge eating among adults of normal and overweight status (Saules et al., 2009) and a recent systematic review found evidence that self-perception of overweight tended to be associated with disordered eating in participants of both normal weight and overweight/obese weight status (Haynes et al., 2018).

One reason why self-perception of overweight may be associated with overeating is because of the widespread stigma attached to larger body sizes (Andreyeva et al., 2008; Puhl & Heuer, 2009), which may lead to concerns over being negatively evaluated, rejected, or avoided because of body weight. In an experimental context, exposing participants to stigmatising information about larger body sizes has been shown to promote increased food intake in women of overweight status (Schvey et al., 2011) and in women who perceived themselves as overweight (Major et al., 2014). In line with research on social anxiety and eating pathology in undergraduate students (Levinson et al., 2013; Menatti, DeBoer, Weeks, & Heimberg, 2015), a potential explanation of these experimental findings is that awareness of weight stigma causes individuals who perceive themselves as overweight to experience a fear of being stigmatised on the basis of their weight (Hunger & Major, 2015), regardless of whether they have actually personally experienced discrimination or mistreatment because of their body weight previously. These weight stigma concerns present a form of social identity threat, which has been shown to increase stress in women of overweight status (Blodorn et al., 2016), and has been hypothesised to encourage overeating (Hunger et al., 2015).

Although self-perception of overweight status has now been shown to be associated with overeating among female adolescents (French et al., 1997) and young adult females of overweight status (Sonneville et al., 2016), we are not aware of research that has attempted to explain the psychological mechanisms underlying this relationship. In the present research, we conducted two studies of US adults to examine whether the cross-sectional relationship between self-perceived overweight and overeating tendencies is explained by heightened weight stigma concerns among individuals who perceive their weight status as being overweight (Figure 3.1). We controlled for other factors that may confound the relationships of interest, including demographic and health variables and additional psychological variables (neuroticism and depression in Study 1 and 2; self-esteem, body dissatisfaction, and physical activity in Study 2). This set of covariates was chosen as each has been demonstrated to be related to either perceived weight status (Hartmann & Siegrist, 2015; Paeratakul et al., 2002; Sutin & Terracciano, 2016), overeating (Sutin et al., 2016), or both (Andrade et al., 2010; Carano et al., 2006; Daly et al., 2017; Ozmen et al., 2007; Roberts & Duong, 2013; Southerland et al., 2013). We additionally controlled for perceived weight discrimination in both studies, as we were interested in isolating the effect of concerns over being stigmatised based on weight, independently of the objective experience of experiencing weight-based discrimination.

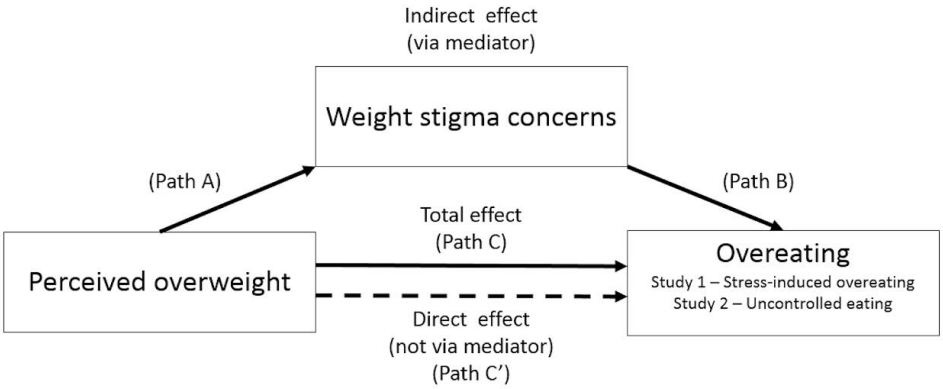

Figure 3.1. Hypothesized test of indirect effect.

3.3 Study 1

3.3.1 Methods.

3.3.1.1 Sample.

Our analytic sample size in Study 1 provided sufficient power to detect small effect sizes ($1 - \beta \geq 0.80$, $\alpha = 0.05$, $f^2 \geq 0.02$) for each pathway of our proposed test of indirect effect using bias-corrected bootstrap models whilst accounting for covariates (Fritz & MacKinnon, 2007). Seven hundred and eighteen US adult participants were recruited via Amazon Mechanical Turk (MTurk) to complete an online questionnaire advertised as *"Weight and personal characteristics"*. We decided a-priori to exclude participants that failed at least one attention check (see Appendix II for full information on attention checks, page 229), self-perceived their weight as being underweight (due to few participants being likely to report this perception) or reported weight and height data that produced an implausible BMI, using criteria as in previous research (Armour et al., 2016). Ninety-eight participants were excluded for not

completing the questionnaire in full, a further 72 were excluded for failing at least one attention check, a further 10 for reporting an implausible BMI, and a further 33 for reporting perceiving themselves as underweight, leaving a final analytic sample of 505. Sample characteristics are reported in Table 3.1.

Table 3.1

Descriptive statistics for analytic sample (N = 505 for Study 1 and N = 642 for Study 2)

Study 1	**Mean (SD)/%**	**Study 2**	**Mean (SD)/%**
Age	36.66 (12.02)	**Age**	38.81 (12.19)
BMI	27.11 (6.09)	**BMI**	26.86 (5.59)
Gender (% female)	57.8	**Gender (% female)**	57.6
Perceived overweight	61.8	**Perceived overweight**	58.7
Long-standing illness (% yes)	24.0	**Long-standing illness (% yes)**	23.1
Ethnicity		**Ethnicity**	
White	78.4	*White*	81.5
Black	7.3	*Black*	6.9
Asian	5.5	*Asian*	4.8
Hispanic	5.3	*Hispanic*	4.0
Mixed	2.8	*Mixed*	2.2
Other	0.6	*Other*	0.6
Annual income		**Annual income**	
Less than $25,000	33.5	*Less than $26,000*	28.5
Between $25,000 and $39,999	20.8	*Between $26,000 and $39,999*	20.4
Between $40,000 and $49,999	14.9	*Between $40,000 and $49,999*	13.4
Between $50,000 and $74,999	19.2	*Between $50,000 and $74,999*	22.7
Between $75,000 and $99,999	6.9	*Between $75,000 and $99,999*	8.7
$100,000 or higher	4.8	*$100,000 or higher*	6.2
Educational attainment		**Educational attainment**	
Never completed High School	0.2	*Never completed High School*	0.3
Completed High School	17.4	*Completed High School*	36.8
College	23.8	*Bachelor's Degree*	48.8
Bachelor's Degree	43.0	*Master's Degree*	10.1
Master's Degree	12.3	*PhD/Professional Degree*	4.0
PhD/Professional Degree	3.4		

3.3.1.2 Measures.

Demographics. Participants reported their age, gender, ethnicity, current annual income and highest education level. Participants also reported their height (feet and inches) and weight (pounds), which were converted to metric measures to calculate BMI (kg/m^2). Presence of chronic illness was assessed with a single yes/no item.

Perceived weight. Consistent with previous research (Robinson et al., 2015) participants were asked to describe their weight on a 6-point scale ('*Very underweight'*, '*Underweight'*, *'About the right weight'*, *'Overweight', 'Very overweight', 'Obese'*). Based on their answers, participants were divided in two categories: perceived normal weight, for those who perceived themselves as *'About the right weight'* (representing the reference category), and perceived overweight, for those whose answers ranged from *'Overweight'* to *'Obese'.*

Weight stigma concerns. Weight stigma concerns were assessed using the Weight Stigma Concerns scale (Hunger & Major, 2015). The scale consists of 5 items (e.g. *"I am concerned that other people's opinion of me will be based on my weight"*) to which participants indicate their agreement on 5-point Likert scales, ranging from 1 ('*Strongly Disagree'*) to 5 (*'Strongly Agree'*). Responses were summed with higher values indicating greater weight stigma concerns. This scale had excellent internal consistency in the present study ($\alpha = .96$).

Overeating tendencies. To assess overeating tendencies participants completed a measure of stress-induced overeating. Participants were asked to indicate the extent to which they typically engage in the following behaviours when stressed: *"eating more than usual to enhance my mood"*, and *"eating more of my favourite foods to enhance my mood"* (Harris et al., 2009; Robinson et al., 2015). Participants responded to each

item on 4-point Likert scales ranging from 1 (‘*Not at all’*) to 4 (‘*A lot’*), and the mean of responses to the two items was calculated with higher scores indicating a greater tendency toward stress-induced eating (α = .86 in present study).

Neuroticism. Participants completed the Neuroticism subscale of the Mini International Personality Item Pool (Mini IPIP) (Donnellan, Oswald, Baird, & Lucas, 2006). This brief measure has been psychometrically validated as a measure of the Big Five personality traits (Donnellan et al., 2006). The Neuroticism subscale had good internal consistency in the present study (α = .83).

Depressive symptoms. Depressive symptoms were assessed using the 10-item Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). Internal consistency for the scale was good in the present study (α = .89).

Perceived weight discrimination. An adapted version of the Perceived Everyday Experiences with Discrimination Scale (Hunger & Major, 2015; D. R. Williams, Yu, Jackson, & Anderson, 1997) measured how frequently participants reported encountering a set of five discriminatory experiences in their daily life because of their weight. In this study, the scale had good internal consistency (α = .87). See Appendix II for additional details on included measures (Appendix II, page 224).

In Study 1 and Study 2 we collected additional self-report questionnaires for the purpose of other research questions and these are reported in full in Appendix II (Appendix II, pages 230 and 234).

3.3.1.3 Procedure.

After providing informed consent, participants completed the demographics and perceived weight measures. Measures of weight stigma concerns, perceived weight

discrimination, neuroticism, depression, and stress-induced eating were then completed on randomised consecutive pages of the online survey. The survey included four attention checks, and participants who failed to answer them properly were screened out of the questionnaire. Participants were provided with a small monetary reward upon completion of the questionnaire. Ethical approval was obtained from the University of Liverpool Ethics Committee.

3.3.1.4 Planned analysis.

The PROCESS macro for SPSS (model 4) with 5,000 bootstrap samples (Hayes, 2012) was used to test whether self-perceived overweight (relative to perceived normal weight) had an indirect effect on stress-induced overeating through weight stigma concerns. In our main analysis all tests of indirect effects were adjusted for demographic and health variables: gender, age, BMI, ethnicity (white or not), income, education and presence of chronic illness. As a test of robustness, we additionally controlled for neuroticism, perceived weight discrimination, and depression in a second analysis.

We also conducted two tests of conditional indirect effects using PROCESS (model 59) to test whether participant gender or the accuracy of perceived overweight (inaccurate perception of overweight [subsample of participants with BMI < 25], accurate perception of overweight [subsample of participants with BMI ≥ 25]) moderated the indirect effect of perceived overweight on stress-induced overeating through weight stigma concerns in the fully adjusted analyses.

3.3.2 Results.

Correlations between the variables are presented in the Chapter Appendix (Appendix II, Table II.1, page 232). In our first model (Table 3.2, Model 1), weight perception was a significant predictor of weight stigma concerns, $B = 3.71$, SE = .59, $p < .001$, and in turn, weight stigma concerns were a significant predictor of stress-induced overeating, $B = .04$, SE = .01, $p < .001$. Perceived overweight (relative to perceived normal weight) had a significant indirect effect on stress-induced overeating via weight stigma concerns, bootstrap estimate = .14, SE = .03, 95% CI [.08, .22], with weight stigma concerns explaining 31.7% of the variance in the relationship between perceived overweight and stress-induced overeating. In the fully adjusted model (Table 3.2, Model 2), perceived overweight relative to perceived normal weight had a significant indirect effect on stress-induced overeating via weight stigma concerns, bootstrap estimate = .08, SE = .03, 95% CI [.04, .14], and weight stigma concerns explained 22.9% of the variance in the relationship between perceived overweight and stress-induced overeating.

For gender the index of moderated mediation was not significant, bootstrap estimate = .06, SE = .04, CI [-.03, .15], suggesting that gender did not moderate the indirect effect of perceived overweight on stress-induced overeating via weight stigma concerns. For weight perception accuracy the index of moderated mediation was not significant, bootstrap estimate = -.02, SE = .07, CI [-.18, .11], indicating that weight perception accuracy did not moderate the indirect effect of perceived overweight on stress-induced overeating via weight stigma concerns.

Table 3.2

Indirect effect of perceived overweight on stress-induced overeating via weight stigma concerns (Study 1)

		Unstandard. Coeff.	SE	*p*	Bootstrap 95% CI	Model R^2 / Proportion mediated (%)	Stand. Coeff.[a]	SE	95% CI
Model 1[b]	**Path A**	3.71	.59	<.001	[2.56, 4.87]	--	.57	.09	[.39, .75]
	Path B	.04	.01	<.001	[.02, .05]	--	.27	.05	[.17, .38]
	Indirect effect	.14	.03	--	[.08, .22]	31.7%	.16	.04	[.09, .24]
	Path C (total effect)	.44	.09	<.001	[.27, .61]	.166	.49	.10	[.30, .69]
	Path C' (direct effect)	.30	.09	<.001	[.13, .48]	.215	.34	.10	[.14, .53]
Model 2[c]	**Path A**	2.82	.57	<.001	[1.70, 3.94]	--	.43	.09	[.26, .60]
	Path B	.03	.01	<.001	[.01, .04]	--	.21	.06	[.10, .32]
	Indirect effect	.08	.03	--	[.04, .14]	22.9%	.09	.03	[.04, .16]
	Path C (total effect)	.35	.09	<.001	[.18, .53]	.229	.40	.10	[.20, .59]
	Path C' (direct effect)	.27	.09	.003	[.10, .45]	.252	.30	.10	[.11, .50]

NOTE: Path A = correlation between perceived overweight and weight stigma concerns; Path B = correlation between weight stigma concerns and stress-induced overeating; Indirect effect = effect of perceived overweight on stress-induced overeating through weight stigma concerns; Path C = effect of perceived overweight on stress-induced overeating when weight stigma concerns is not present in the model; Path C' = correlation between perceived overweight and stress-induced overeating after taking weight stigma concerns into account.

[a] Calculated by repeating the analysis of indirect effects on z-scores for any continuous variables (e.g. age, BMI, weight stigma concerns, stress-induced overeating, neuroticism, perceived weight discrimination, and depression).

[b] Adjusted for age, gender, ethnicity (white, non-white), income, education, chronic illness and BMI.

[c] Adjusted for variables listed for Model 1, plus neuroticism, perceived weight discrimination, and depression.

Discussion

Weight stigma concerns partially explained the relationship between perceived overweight status and overeating. A limitation of Study 1 was that although our measure of overeating has been shown to prospectively predict increased weight gain (Robinson et al., 2015), it is a short form measure that has not been formally validated. We addressed this in Study 2 by using a validated measure of overeating that has been shown to be associated with increased energy intake (de Lauzon et al., 2004; Jaakkola, Hakala, Isolauri, Poussa, & Laitinen, 2013); the uncontrolled eating subscale of the Three Factor Eating Questionnaire – R18 (Karlsson, Persson, Sjöström, & Sullivan, 2000). Moreover, in Study 2 we controlled for further variables that we reasoned may be confounders of our proposed indirect pathway; body dissatisfaction, self-esteem and physical activity.

3.4 Study 2

3.4.1 Methods.

3.4.1.1 Sample.

We powered Study 2 to be able to detect the effects observed in Study 1 ($1 - \beta \geq 0.80$, $\alpha = 0.05$, $f^2 \geq 0.03$), oversampling for participant exclusions. We recruited 804 US adults via MTurk to complete a study on *"The relationship between weight, personal characteristics, and wellbeing"*. One hundred and four participants were excluded because they failed an attention check, a further four participants were excluded because they reported an age of <18 years, a further 40 perceived their weight as being underweight, and a further 14 reported implausible BMIs, leaving an analytic sample of 642.

3.4.1.2 Measures.

Demographics, perceived weight, perceived weight discrimination, weight stigma concerns, neuroticism, and depressive symptoms were measured as in Study 1 with a few minor differences (see Appendix II, page 233).

Overeating tendencies. The uncontrolled eating subscale of the Three Factor Eating Questionnaire – Revised 18 (TFEQ-R18) (Karlsson et al., 2000) was administered to assess the tendency to overeat. The subscale consists of 9 items (e.g. *"Sometimes when I start eating, I just can't seem to stop"*) answered on 4-point Likert scales, ranging from 1 (*'Definitely false'*) to 4 ('*Definitely true*'). The uncontrolled eating subscale has been validated against self-reported food intake in a general population (de Lauzon et al., 2004). Internal consistency was excellent in the present study (α = .92).

Physical activity. Physical activity was assessed using a single item measure (*"In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate. This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job")* which has been validated against other widely used physical activity questionnaires, showing moderate positive correlations (r = .53) and a good test-retest reliability (r = .72) (Milton, Bull, & Bauman, 2011).

Self-esteem. Self-esteem was assessed using Rosenberg's Self-Esteem Scale (Rosenberg, 1965). Internal consistency was excellent in the present study (α = .94).

Body dissatisfaction. Body dissatisfaction was assessed using the Body Dissatisfaction subscale of the Eating Disorder Inventory (EDI-BD) (Garner, Olmstead, & Polivy, 1983). The scale had excellent internal consistency in the present study (α = .92). See Chapter Appendix for additional details on included measures (Appendix II, page 234).

3.4.1.3 Procedure.

The additional measures were presented in randomized order alongside the other randomized measures as in Study 1. Participants were provided with a small monetary reward upon completion of the questionnaire. Ethical approval was obtained from the University of Liverpool Ethics Committee.

3.4.1.4 Planned analysis.

Data analysis was identical to Study 1. However, in the second test of indirect effects, we controlled for neuroticism, perceived weight discrimination, depression, self-esteem, body dissatisfaction, and physical activity.

3.4.2 Results.

Correlations between the variables are presented in the Chapter Appendix (Appendix II, Table II.2, page 235). Results from our main analyses and relative standardised effects are presented in Table 3.3. In our first model (Table 3.3, Model 1), weight perception (perceived overweight relative to perceived normal weight) was a significant predictor of weight stigma concerns, B = 6.62, SE = .77, $p < .001$, and

weight stigma concerns significantly predicted uncontrolled eating, B = 1.03, SE = .11, $p < .001$. There was a significant indirect effect of perceived weight on uncontrolled eating via weight stigma concerns, bootstrap estimate = 6.80, SE = 1.07, 95% CI [4.85, 9.06], and weight stigma concerns explained 60.3% of the variance in the relationship between perceived overweight and uncontrolled eating. In the fully adjusted model (Table 3.3, Model 2), perceived overweight, relative to perceived normal weight, had a significant indirect effect on uncontrolled eating via weight stigma concerns, bootstrap estimate = 1.49, SE = .55, 95% CI [.65, 2.84], and weight stigma concerns explained 47.1% of the variance in the relationship between perceived overweight and uncontrolled eating.

For gender the index of moderated mediation was non-significant, bootstrap estimate = -1.07, SE = .84, CI [-2.94, .40], suggesting that gender did not moderate the indirect effect of perceived overweight on uncontrolled eating via weight stigma concerns. For weight perception accuracy the index of moderated mediation was not significant, bootstrap estimate = -.01, SE = 1.19, CI [-2.94, 1.91], indicating that weight perception accuracy did not moderated the indirect effect of perceived overweight on uncontrolled eating via weight stigma concerns.

Table 3.3

Indirect effect of perceived overweight on uncontrolled eating via weight stigma concerns (Study 2)

		Unstandard. Coeff.	SE	*p*	Bootstrap 95% CI	Model R^2 / Proportion mediated (%)	Stand. Coeff.[a]	SE	95% CI
Model 1[b]	**Path A**	6.62	.77	<.001	[5.10, 8.13]	--	.73	.08	[.56, .89]
	Path B	1.03	.11	<.001	[.82, 1.24]	--	.41	.04	[.33, .49]
	Indirect effect	6.80	1.07	--	[4.85, 9.06]	60.3%	.30	.05	[.22, .40]
	Path C (total effect)	11.27	2.21	<.001	[6.93, 15.61]	.133	.49	.10	[.30, .69]
	Path C' (direct effect)	4.47	2.16	.039	[.23, 8.71]	.249	.20	.09	[.01, .38]
Model 2[c]	**Path A**	2.91	.72	<.001	[1.50, 4.33]	--	.32	.08	[.16, .48]
	Path B	.51	.14	<.001	[.23, .79]	--	.20	.06	[.09, .31]
	Indirect effect	1.49	.55	--	[.65, 2.84]	47.1%	.07	.02	[.03, .13]
	Path C (total effect)	3.16	2.20	.152	[-1.16, 7.49]	.295	.14	.10	[-.05, .33]
	Path C' (direct effect)	1.67	2.19	.445	[-2.63, 5.98]	.312	.07	.10	[-.12, .26]

NOTE: Path A = correlation between perceived overweight and weight stigma concerns; Path B = correlation between weight stigma concerns and uncontrolled eating; Indirect effect = effect of perceived overweight on uncontrolled eating through weight stigma concerns; Path C = effect of perceived overweight on uncontrolled eating when weight stigma concerns is not present in the model; Path C' = correlation between perceived overweight and uncontrolled eating after taking weight stigma concerns into account.

[a] Calculated by repeating the analysis of indirect effects on z-scores for any continuous variables (e.g. age, BMI, weight stigma concerns, uncontrolled eating, neuroticism, perceived weight discrimination, depression, self-esteem, body dissatisfaction, and physical activity).

[b] Adjusted for variables listed for Study 1, Model 1.

[c] Adjusted for variables listed for Study 1, Model 2, plus self-esteem, body dissatisfaction, and physical activity.

3.5 Discussion

Individuals who perceive their weight status as being overweight are more likely to overeat and gain more weight than those who do not perceive their weight status as being overweight (Haynes et al., 2018; Robinson et al., 2015). We hypothesised that heightened weight stigma concerns due to the widespread stigma associated with larger body sizes (Andreyeva et al., 2008; Puhl & Heuer, 2009) could explain why individuals who perceive their weight status as being overweight are at an increased risk of overeating relative to those who perceive their weight as 'about right'. Across two studies of US adults we found that weight stigma concerns in part explained the cross-sectional relationship between self-perceived overweight (relative to perceiving one's weight as 'about right') and self-reported overeating tendencies. In both studies weight stigma concerns explained a substantial proportion of the cross-sectional association between weight perception and overeating in both our main analyses (32-60% of variance) and in analyses that accounted for a range of other related psychological variables, including previous experience of weight discrimination (23-47% of variance). This pattern of results was observed regardless of gender and whether self-perception of overweight was accurate or inaccurate.

In line with Hunger and colleagues (Hunger & Major, 2015), our proposed explanation of these findings is that the awareness of the stigma attached to larger body sizes results in individuals who perceive their weight status as being overweight experiencing greater concern over being negatively evaluated, rejected, or avoided by others because of their weight. Given the nature of the present research we cannot infer why weight stigma concerns are associated with overeating tendencies, but there are plausible mechanisms. In Study 1 we measured stress-induced overeating and based

on previous research it is plausible that the stress associated with weight stigma concerns directly stimulates overeating (Groesz et al., 2012). Alternatively, experiencing stress hampers self-regulatory ability which in turn results in unintended overeating (Major et al., 2014). In Study 2 we measured uncontrolled eating and there is evidence that episodes of uncontrolled eating may occur in response to negative emotions (Henderson & Huon, 2002). Thus, individuals who self-identify as being of overweight status may overeat as a way of coping with their concerns of being stigmatised by others because of their perceived body size. A better understanding of why weight stigma concerns are associated with overeating tendencies among individuals who self-identify as overweight would now be valuable. Given that self-perception of overweight has been shown to be associated with a range of negative health outcomes, including depressive symptoms (Roberts & Duong, 2013) and suicidal ideation (Eaton, Lowry, Brener, Galuska, & Crosby, 2005), examination of whether weight stigma concerns also in part explain these other findings would now be informative.

In both studies, weight stigma concerns only partially explained the cross-sectional association between self-perception of overweight and overeating. Therefore, there are likely to be other factors explaining this relationship. Internalised weight stigma may be an important factor to consider in future research. Individuals who perceive their weight status as overweight may internalise negative stereotypes about larger body sizes and this negative self-perception may lead to emotional overeating (Puhl, Moss-Racusin, & Schwartz, 2007). There are also plausible physiological mechanisms by which the stigma of obesity could result in increased energy intake among individuals who self-perceive their weight status as being

overweight (Tomiyama, 2014). We also did not find that our main results were moderated by participant gender or accuracy of weight perception. However, previous research has shown women to be more likely to expect social rejection because of their weight (Blodorn et al., 2016).

In the present research we replicated our findings across two studies using different measures of overeating tendencies and found consistent results across analyses that controlled for a range of potentially confounding psychological variables. A limitation of the present studies is that they were cross-sectional, which precludes causal inference. For example, we cannot rule out reverse causality in the relationships we tested, and it is possible that a third unmeasured variable may explain the observed pattern of findings. The measures of overeating tendencies used in Study 1 have been shown to prospectively predict weight gain (Robinson et al., 2015) and the measure we used in Study 2 has been formally validated against an objective measurement of food intake (de Lauzon et al., 2004). However, the measures were self-reported which may have introduced measurement bias. Moreover, differences between the two measures of overeating used may explain why weight stigma concerns explained a greater proportion of the association between weight perception and overeating in Study 2 than in Study 1. Finally, while depression was controlled for in the model, it may be another step of the path model we did not consider, such that a higher perceived weight would lead to weight stigma concerns, causing more depression, which, in turn, would lead to overeating tendencies; previous results, in fact, have reported depression to be bidirectionally associated with overeating (Skinner, Haines, Austin, & Field, 2012). Replication of our findings using longitudinal or experimental designs that rely on objective measurements of eating

behaviour, or including other potential mediators in the path we analysed, would now be valuable.

3.6 Conclusions

The results of these two cross-sectional survey studies suggest that weight stigma concerns may explain why perceiving one's own weight status as being overweight is associated with an increased tendency to overeat.

Chapter 4: Weight stigma concerns, internalised weight bias, and post-bariatric surgery grazing

4.1 Chapter abstract

Bariatric surgery has become a popular treatment for obesity. However, postoperative weight regain often occurs, and 'grazing' (an eating behaviour characterized by the repetitive eating of small/modest amounts of food in an unplanned manner) is a likely cause. Research has identified some predictive factors of postoperative overeating. However, no study has yet assessed the role of weight stigma concerns in postoperative grazing. In this chapter an online study was used to test whether weight stigma concerns predicts grazing tendencies in postoperative bariatric surgery patients

4.2 Introduction

Bariatric surgery is now used widely to treat obesity (Angrisani et al., 2017). In America, for example, the annual number of operations between 2009 and 2012 ranged between 81,005 and 114,780 cases (Nguyen, Vu, Kim, Bodunova, & Phelan, 2016). This might be due to the benefits provided for weight-loss and obesity-related comorbidities, and to the higher effectiveness of bariatric surgery procedures in reducing BMI compared to non-surgical interventions (Padwal et al., 2011; Picot, Jones, Colquitt, Loveman, & Clegg, 2012). Patients with class II obesity for example, or those with class I obesity and type 2 diabetes, seem to particularly benefit from these procedures (Picot et al., 2012). However, weight regain may occur after surgery (Christou, Look, & MacLean, 2006; Hsu et al., 1998; Magro et al., 2008), usually two

years after the intervention (Magro et al., 2008), with people showing a 15% increase in weight from the post-operative nadir of weight loss (Odom et al., 2010).

Overeating is a common cause for weight regain after bariatric surgery. Several studies show that various maladaptive eating patterns, such as binge eating and loss of control over eating, are associated with post-operative weight regain in bariatric surgery patients (Hsu et al., 1998; Kofman, Lent, & Swencionis, 2010; Nicolau et al., 2015). This is concerning considering that, other than through malabsorptive procedures involving intervention on the gastrointestinal tract, bariatric surgery is meant to restrict the amount of food patients can eat after the operation (Choban, Jackson, Poplawski, & Bistolarides, 2002). However, patients may still be able to eat small portions of food in a repetitive manner (Conceição et al., 2014), and this eating pattern, defined as "grazing", has been found to be a cause for significant weight regain after bariatric surgery (Kofman et al., 2010; Nicolau et al., 2015). Therefore, understanding the potential causes of post-bariatric grazing specifically will be important to explaining weight regain in bariatric surgery populations.

Literature indicates that grazing might be a manifestation of a precedent eating disorder characterized by a loss of control over eating. Some studies have found that patients who develop grazing or uncontrolled eating after surgery reported binge eating symptoms prior to their operation (Colles, Dixon, & O'Brien, 2008; R. Saunders, 2004), as well as an association between post-surgery grazing tendencies and pre-surgical weight (Conceição et al., 2017). Further to previous disordered eating patterns, research has examined other potential factors explaining overeating

tendencies post-bariatric surgery. Patients who report a greater time since surgery are more likely to report difficulties following dietary recommendations after the operation (Raves et al., 2016), and time since surgery has also been found to be associated with amount of weight regain after bariatric interventions (Cooper, Simmons, Webb, Burns, & Kushner, 2015). Moreover depression, which is the most common lifetime disorder reported among bariatric surgery candidates (Malik, Mitchell, Engel, Crosby, & Wonderlich, 2014), has been found to mediate the relationship between impulsivity and disordered eating patterns in post-bariatric surgery participants (Schag et al., 2016). This association could in turn explain the relationship between depressive symptoms and a poor post-operative outcome observed in other studies (De Zwaan et al., 2011; Scholtz et al., 2007). Finally, some results have also highlighted the role of weigh stigma in explaining overeating tendencies after bariatric surgery. Internalised weight bias, also known as self-directed weight stigma, has been found to be positively associated with disordered eating in post-bariatric surgery participants, and experiences of weight-related stigma are also predictive of worse dietary adherence after surgery (Raves et al., 2016). Moreover, both internalised weight bias and experiences of weight-based discrimination have reported associations with disordered eating before bariatric surgery. A study on pre-bariatric patients, for example, has found an association between internalised weight bias and emotional eating, mediated by emotion dysregulation (Baldofski et al., 2016). Similarly, stigmatising experiences have been found to be positively associated with emotional eating in the pre-bariatric surgery population (K. E. Friedman et al., 2008).

The association between stigmatizing experiences and disordered eating has been theorized by Hunger and colleagues as a consequence of a social identity threat

(Hunger et al., 2015). Hunger et al. suggest that people with overweight who are aware of the widespread stigma placed on weight would in turn be concerned of being judged for their own weight, and such concern might affect food intake by undermining self-regulation (Hunger et al., 2015). Literature has already reported evidence on the influence of weight stigma on disordered eating (Puhl & Suh, 2015). Studies have found how, among women with overweight (Schvey et al., 2011), or who perceive themselves as such (Major et al., 2014), an experimental exposure to stigmatizing content regarding weight is associated with greater food intake. A study on female college students, for example, found that fear of negative evaluation mediates the relationship between social anxiety and disordered eating symptoms (Menatti et al., 2015), while another study of college students found that fear of negative evaluation is predictive of the development of bulimic symptoms (Gilbert & Meyer, 2005). Concerning the specific fear of being negatively judged because of one's own weight, a study on non-treatment seeking population found that weight stigma concerns mediate the relationship between weight perception and overeating tendencies (Romano, Haynes, & Robinson, 2018).

Weight stigma seems to linger even after weight loss. Latner and colleagues found that people tend to stigmatise lean individuals who used to have overweight even after considerable weight loss, and to the same extent as people who consistently report being overweight (Latner, Ebneter, & O'Brien, 2012). Similarly, people who underwent bariatric surgery are not perceived as less lazy after losing weight (Fardouly & Vartanian, 2012). Post-operative bariatric surgery patients are therefore likely to still experience the stigma of obesity. This would in turn explain the high levels of internalised weight bias, as it has been found that a history of weight-based teasing is

associated with high levels of shame in bariatric surgery patients (Rosenberger, Henderson, Bell, & Grilo, 2007). Following this logic, the worry of still being stigmatised for their former weight might explain the association between a poor dietary adherence experienced post-surgically and the stigmatizing experiences reported among bariatric surgery participants (Raves et al., 2016).

While there is published evidence on the relationship between weight stigma and overeating post-bariatric surgery (Raves et al., 2016), and on the association between weight stigma concerns and overeating tendencies in the non-treatment seeking population (Romano et al., 2018), we are not aware of research that has attempted to examine the association between weight stigma concerns or internalised weight bias and grazing tendencies after bariatric surgery. In the present research, we conducted an online study to examine the association between weight stigma concerns and grazing tendencies in a population of post-bariatric surgery participants. We measured and controlled for factors that have been reported to be associated with overeating after bariatric surgery (Colles et al., 2008; Conceição et al., 2017; Kofman et al., 2010; Nicolau et al., 2015; Raves et al., 2016; R. Saunders, 2004; Schag et al., 2016) in order to attempt to isolate the independent association between weight stigma concerns and grazing. We also measured and controlled for demographic variables, as well as for type of surgery, as post-surgical occurrences of disordered eating may differ dependent on bariatric procedure (Opozda, Chur-Hansen, & Wittert, 2016). We hypothesised that, after controlling for demographic variables and significant psychological confounders, weight stigma concerns would result as a significant predictor of grazing tendencies in post-bariatric surgery participants.

4.3 Methods

4.3.1 Sample.

Participants were recruited from an online support groups for bariatric surgery patients. The size of our analytic sample was determined to grant enough power to detect a small to moderate effect size ($1 - \beta \geq 0.80$, $\alpha = 0.05$, $f^2 = .085$) for the association between weight stigma concerns and overeating whilst accounting for potential confounders, based on results obtained from a previous study examining weight stigma concerns and overeating (Romano et al., 2018). Following recommendations for sample size estimation accounting for covariates in linear regression analysis (Green, 1991), we recruited 458 participants. The study was advertised as a study on *"Psychological factors and well-being after bariatric surgery"*, and participants were entered in a shopping voucher prize draw (a £100 first prize and two £50 second prizes). Participants were provided with full informed consent prior to completion of the survey, and at the end of the study they were invited to only share the questionnaire among people who underwent bariatric surgery and live in the UK, and who were taking part in a relative support group, either online or in person.

We decided a priori to exclude participants that failed at least an attention check (see Appendix III, page 236), reported being younger than 18, had not received surgery, or reported implausible biological values based on criteria from literature (Noël et al., 2010). A hundred and ninety participants did not complete the study, 6 failed at least one attention check, 5 reported a date of surgery later than the date on which they completed the questionnaire, and 4 had implausible biological values for weight, which resulted in a final sample consisting of 253 participants. Sample characteristics are reported in Table 4.1.

4.3.2 Measures.

Standardised questionnaires for demographics. Participants reported their age in years, gender, ethnicity, education level, and annual income as measures of socio-economic status (Galobardes, 2006). Participants also reported their current height (in feet/meters) and weight (in pounds/kilograms). Non-metrical measures were converted in order to calculate current BMI (kg/m²).

Weight perception. Consistently with previous research (Dorsey, Eberhardt, & Ogden, 2009), weight perception was measured on a 3-points Likert scale asking participants *"Would you describe yourself as a person with"*, with answers ranging from 1 (*'Underweight'*) to 3 (*'Overweight'*).

Months since surgery. Participants were asked to report the date they underwent surgery to calculate the amount of time passed since the operation.

Type of surgery. Participants were asked to report the type of surgery they underwent (*'gastric bypass'*, *'gastric band'*, *'gastric sleeve'* or *'other'*). Answers to 'other' were subsequently recoded based on the information reported (free text) by participants (e.g. *"Anastomosis bypass"* was recoded as *'bypass'*).

Weight before surgery and amount of weight regained after surgery. Participants were asked for their last recorded weight prior to surgery, as well as for the lowest weight recorded after surgery, to calculate the amount of weight regained after surgery.

Diagnosis of eating disorder. Participants were asked on a yes/no item whether they had been previously diagnosed with an eating disorder and to report which one

('anorexia nervosa', 'bulimia nervosa', 'binge eating disorder', or *'eating disorder not otherwise specified'*).

Weight stigma concerns. Weight stigma concerns were assessed with the Weight Stigma Concerns scale (Hunger & Major, 2015), which consists of 5 items (e.g. *"I am concerned that other people's opinion of me will be based on my weight"*) to which participants indicated their agreement on 7-point Likert scales, ranging from 1 (*'Strongly disagree'*) to 7 (*'Strongly agree'*). Responses were summed to provide a measure of weight stigma concerns, with higher values indicating greater concerns. Internal consistency was excellent in this study (α = .97).

Grazing (dependent variable). Grazing was assessed with the Repetitive Eating Questionnaire – Rep(EAT)-Q (Conceição et al., 2017), which consists of 12 items aimed to assess compulsive and non-compulsive grazing. Respondents rated the frequency of the behaviour (e.g. *"Snacked on food repeatedly throughout the day between meals"*) in the previous month on Likert scales ranging from 0 (*'Never'*) to 6 (*'Every day'*). Scores were calculated as the mean of the scale items. The scale has been previously validated in a community sample and in a sample of bariatric surgery patients and candidates (Conceição et al., 2017). Internal consistency was excellent in this study (α = .96).

Perceived weight discrimination. Perceived weight discrimination was assessed with an adapted version of the Perceived Everyday Experiences with Discrimination Scale (Hunger & Major, 2015; D. R. Williams et al., 1997). The scale is composed by 6 items that ask participants to indicate how frequently they experienced discrimination or prejudice based upon their weight (e.g. *"You are treated with less courtesy or respect than others"*). Responses are reported on 6-point scales ranging

from 1 (*'Never'*) to 6 (*'Almost Every day'*). Internal consistency was good in this study (α = .88).

Depressive symptoms. Depressive symptoms were assessed with the 10-item Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). For each item, participants indicated how often they felt or behaved in a particular way over the past week on Likert scales ranging from 1 (*'Rarely or none of the time'*) to 4 (*'All of the times'*). The scale has demonstrated validity against self-report measures and clinical depression ratings (Radloff, 1977) and has been validated in a population of older adults and in HIV-positive participants (Zhang et al., 2012). Internal consistency was excellent in this study (α = .91).

Internalised weight bias. Internalised weight bias was assessed with the Weight Bias Internalisation Scale (WBIS) (Durso & Latner, 2008), an 11-items measure used to assess internalised weight bias among people with overweight and obesity. All items were scored on 1 (*'Strongly disagree'*) to 7 (*'Strongly agree'*) Likert scales, with higher scores indicating more internalization of weight bias. The scale has been validated in treatment-seeking adults with overweight (Durso, Latner, & Ciao, 2016). To avoid using stigmatising language, we reworded some of the items (e.g. using *"as a person with overweight"* instead of *"as an overweight person"*). Internal consistency was excellent in this study (α = .93).

The questionnaire also included three attention checks to ensure data quality, and other measures that served the purpose of a different study (see Appendix III, page 236).

4.3.3 Procedure.

After providing their informed consent, participants completed demographic questions (age, gender, socio-economic status, height and weight, and perceived weight) and questions related to the bariatric surgery intervention (whether they underwent surgery, which type of surgery they received, their last recorded weight before surgery, their lowest recorded weight after surgery, and whether they had been previously diagnosed with an eating disorder). Afterwards, they completed measures assessing depressive symptoms, perceived weight discrimination, internalised weight bias, weight stigma concerns, and grazing tendencies, all presented in a randomized order. The survey included 3 attention checks, and participants failing to answer them properly were screened out of the questionnaire.

The average time to complete the full battery of questionnaires was 32 minutes. At the end of the questionnaire, all participants were asked to share their personal considerations on topics they would like to be considered for future research, as well as their positive achievements from undergoing bariatric surgery, before being fully debriefed. Participants were also asked for their email address if they wanted to be considered for the prize draw. Ethical approval was obtained by the University of Liverpool Committee.

4.3.4 Planned analyses.

4.3.4.1 Hypothesis testing.

In order to study the adjusted association between weight stigma concerns, internalized weight bias and grazing, single linear regressions were planned to check for unadjusted correlations between each of the predictors and the dependent variable

to exclude unnecessary covariates and minimize the number of potential confounders. The confounders considered were demographic variables (gender and ethnicity as categorical variable, level of education and income as ordinal variables, and age and BMI, continuous), and measured variables linked to overeating in post-bariatric surgery. These factors were: time since surgery (in days, continuous) (Raves et al., 2016), previous diagnosis of eating disorder (categorical) (Colles et al., 2008; R. Saunders, 2004), type of surgery (categorical) (Opozda et al., 2016), weight prior to surgery (Conceição et al., 2017) and amount of weight regained since surgery (Kofman et al., 2010; Nicolau et al., 2015), depressive symptoms (Schag et al., 2016), perceived weight discrimination (Raves et al., 2016), and internalised weight bias (Raves et al., 2016). In total, fourteen confounders were considered for the association between weight stigma concerns and grazing. Only predictors correlated with the dependent variable (grazing), conservatively determined by a cut-off of $p \leq .25$ as suggested by previous research (Mickey & Greenland, 1989), were included in a hierarchical multiple regression (forced entry) with 1000 bootstrap samples. We controlled for demographic variables at step 1 of the regression model, and accounted for all identified potential confounders alongside weight stigma concerns in step 2 of the model.

4.3.4.2 Exploratory analyses.

As an exploratory analysis, we examined whether weight perception was a significant predictor of grazing as well, and if it explained additional variance in grazing tendencies. We planned to recode the variable into a different, dummy-coded one (*'perceived normal weight'* vs *'perceived overweight'*), excluding participants who reported perceiving themselves as underweight. The variable was entered in a

single linear regression, with grazing as the dependent variable, to check if it reported an unadjusted association with grazing at $p \leq .25$ and if it could be then included in the full regression model.

4.4 Results

4.4.1 Hypothesis testing.

Most of our participants were females (94.5%, *N* = 239), and perceived themselves as overweight (80.2%, *N* = 203). Most of them reported being either Scottish, English, Welsh or Northern Irish (90.1%, N = 228), earning between £15,600 and £20,799 per year (17%, *N* = 43), and having a university or college qualification below a degree (27.7%, *N* = 70). Participants' mean age was 45.37 (*SD* = 9.91), and mean current BMI was 34.06 (*SD* = 7.92). The mean last recorded weight before surgery reported by participants was 135.31 kilograms (*SD* = 25.61), with a mean of 38.08 (*SD* = 44.99) months passed since the surgery date. The mean lowest recorded weight after surgery was 88.74 kilograms (*SD* = 22.80), and the mean amount of weight lost after surgery was 46.57 kilograms (*SD* =24.17). The mean amount of weight regained after surgery was only 5.57 kilograms (*SD* = 11.16). One hundred and thirty five participants (53.4%) had regained weight, 103 participants (40.7%) had reported that their current weight was the same as the lowest weight recorded after surgery, and 15 participants (5.9%) had lost further weight. Most participants received gastric bypass (56.9%, *N* = 144), and of those who had received a diagnosis of eating disorder (11.1%, *N* = 28), most had received a diagnosis of binge eating disorder (60.7%, *N* = 17) (Table 4.1).

Table 4.1

Descriptive statistics for analytic sample (N = 253)

	Mean/%Yes (N)	SD	Min	Max
Age	45.37	9.91	23	69
Female	94.5% (239)			
Current BMI	34.06	7.92	19.46	62.00
Perceived overweight	80.2% (203)			
Ethnicity				
Scottish/English/Welsh/Northern Irish	90.1% (228)			
Irish	2.4% (6)			
White (other)	3.6% (9)			
White and black Caribbean	1.6% (4)			
Other mixed background	0.8% (2)			
Caribbean	0.4% (1)			
African	0.4% (1)			
Bangladeshi	0.4% (1)			
Black/African/Caribbean (other)	0.4% (1)			
Income				
Up to £5,199	4.3% (11)			
Between £5,200 and £10,399	8.7% (22)			
Between £10,400 and £15,599	14.6% (37)			
Between £15,600 and £20,799	17% (43)			
Between £20,800 and £25,999	15% (38)			
Between £26,000 and £31,199	14.6% (37)			
Between £31,200 and £36,399	6.3% (16)			
Between £36,400 and £41,599	4.7% (12)			
Between £41,600 and £46,799	4.3% (11)			
Between £46,800 and £51,999	4.7% (12)			
£52,000 and above	5.5% (14)			
Education				
Lower secondary school qualification	19.4% (49)			
Upper secondary school qualification	16.2% (41)			
University or college qualification below a degree	27.7% (70)			
University or college degree, undergraduate	17.8% (45)			
University degree, postgraduate	19% (48)			
Weight before surgery (in kg)	135.31	25.61	77.60	218.40
Weight after surgery (in kg)	88.74	22.80	52	156.49
Weight lost after surgery (in kg)	46.57	24.17	.60	126.39
Weight regained after surgery (in kg)	5.57	11.16	-11.34	69.85
Months since surgery	38.08	44.99	0	189
Type of Bariatric Surgery				
Gastric Band	9.9% (25)			
Gastric Bypass	56.9% (144)			
Gastric Sleeve	29.6% (75)			
Duodenal Switch	3.6% (9)			
Eating disorder diagnosis	11.1% (28)			
Of which Anorexia nervosa	3.6% (1)			
Of which Bulimia nervosa	21.4% (6)			
Of which Binge eating disorder	60.7% (17)			
Of which Eating disorder not otherwise specified (EDNOS)	14.3% (4)			

Correlations between variables are reported in Table 4.2. We performed single regressions analyses to examine unadjusted correlations between each predictor and grazing (values reported in Table 4.3). Only education (B = .10, SE = .07, t = 1.41, p = .159), months since surgery (B = .01, SE = .002, t = 3.26, p = .001), having received gastric band (B = .70, SE = .33, t = 2.15, p = .033) or gastric bypass (B = -.30, SE = .20, t = -1.51, p = .132), amount of weight regained after surgery (B = .06, SE = .01, t = 7.17, p < .001), depressive symptoms (B = .07, SE = .01, t = 5.75, p < .001), internalised weight bias (B = .03, SE = .01, t = 5.90, p < .001), and weight stigma concerns (B = .04, SE = .01, t = 3.39, p = .001), were associated with grazing at p < .25.

Table 4.2

Correlation matrix for the variables analysed

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.Age	--																	
2. Gender[1]	-.002																	
3. Ethnicity[1]	.129*	.049																
4. Income	-.018	.200**	.043															
5. Education	.053	.014	.043	-.293***														
6. BMI	-.088	-.091	-.065	-.117	.073													
7. ED diagnosis[1]	.021	-.085	.007	-.045	-.053	-.003												
8. Months since surgery	.332***	-.031	.099	-.036	-.069	-.065	-.027											
9. Gastric Band[1]	.041	-.080	-.001	-.008	-.056	.100	.010	.347***										
10. Gastric Bypass[1]	.007	.036	-.013	-.066	.100	-.059	.052	-.079	-.381***									
11. Gastric Sleeve[1]	-.078	-.006	.043	.110	-.053	.042	-.091	-.319***	-.215**	-.746***								
12. Duodenal Switch[1]	.105	.047	-.071	-.084	-.046	-.109	.068	.438***	-.064	-.221***	-.125*							
13. Weight before surgery	-.027	.231***	.027	-.006	.023	.439***	-.009	.182**	-.108	.076	-.053	.104						
14. Weight regained after surgery	.161*	-.043	.034	-.059	.090	.317***	.005	.564***	.280***	-.025	-.172**	.039	.156*					
15. Depressive symptoms	.004	-.003	-.072	-.113	.034	.077	.073	.137*	.029	-.068	-.002	.139*	.040	.198**				
16. Perceived weight discrimination	-.214**	.101	-.067	.054	-.093	.028	.050	-.112	-.099	.031	.027	.009	.178**	-.018	.200**			
17. Internalised weight bias	-.155	.047	-.019	-.005	.081	.298***	.141*	-.156*	.054	-.045	.073	-.148*	.035	.164**	.395***	.314***		
18. Wight stigma concerns	-.130*	.045	.059	-.039	.038	.354***	.086	-.115	.030	-.023	.058	-.131*	.166**	.059	.305***	.351***	.686***	
19. Grazing	.052	-.047	-.054	-.051	.089	.021	.064	.201**	.134*	-.095	.009	.015	.001	.412***	.341***	.060	.349***	.209**

[1] = Dummy coded; * p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

Table 4.3

Single regression analyses for individual predictors (grazing as the dependent variable)

	Unstandardized B (Standard Error)	t	Sig.
Age	.01 (.01)	.83	.408
Gender[1]	-.32 (.43)	-.75	.454
Ethnicity[2]	-.43 (.50)	-.86	.388
Income	-.03 (.04)	-.80	.423
Education	.10 (.07)	1.41	.159
BMI	.004 (.01)	.34	.737
Diagnosis of Eating Disorder[3]	.32 (.31)	1.02	.308
Months since surgery	.01 (.002)	3.26	.001
Gastric Band[3]	.70 (.33)	2.15	.033
Gastric Bypass[3]	-.30 (.20)	-1.51	.132
Gastric Sleeve[3]	.03 (.22)	.14	.887
Duodenal Switch[3]	.13 (.53)	.24	.813
Weight before surgery	8.20E-5 (.004)	.02	.983
Weight regained after surgery	.06 (.01)	7.17	<.001
Depressive symptoms	.07 (.01)	5.75	< .001
Perceived weight discrimination	.01 (.01)	.96	.339
Internalised weight bias	.03 (.01)	5.90	<.001
Weight stigma concerns	.04 (.01)	3.39	.001

[1]Dummy coded (1 = male, 0 = female).

[2]Dummy coded (1 = white, 0 = other).

[3]Dummy coded (1 = yes, 0 = no).

Table 4.4 reports the results of the hierarchical multiple regression analysis with 95% confidence intervals and standard errors based on 1000 bootstrap samples. The overall model explained 33% of the variance in grazing, R^2 = .331, F(13, 239) = 9.11,

$p < .001$. After controlling for demographic variables (age, gender, ethnicity, income, and BMI) the predictors we identified and included the second step predicted 32% of the variance in grazing (R^2 Change = .321). There was no evidence of multi-collinearity, as all variance inflation factors (VIF) were below 10 and tolerance values were all above .20 (Field, Miles, & Field, 2013). In the final model (controlling for age, gender, ethnicity, income, BMI, education, gastric band, gastric bypass, months since surgery, weight regained after surgery, depressive symptoms, internalised weight bias, and weight stigma concerns), only weight regained after surgery (*B* = .06, *SE* = .01, *95% CI* = .04 to .08, *p* = .001), depressive symptoms (*B* = .03, *SE* = .01, *95% CI* = .01 to .06, *p* = .021), and internalised weight bias (*B* = .02, *SE* = .01, *95% CI* = .01 to .04, *p* = .006) predicted grazing. Weight stigma concerns was not a significant predictor of grazing (*B* = .01, *SE* = .01, *95% CI* = -.02 to .03, *p* = .474).

4.4.2 Exploratory analyses.

Only one participant reported perceiving themselves as underweight (0.4%). Forty-nine participants reported perceiving themselves as normal-weight (19.4%) and 203 reported perceiving themselves as overweight (80.2%). Weight perception was not associated with grazing (*B* = .24, *SE* = .25, *t* = .96, *p* = .337) and therefore was not included in the model for further exploratory analysis.

Table 4.4

Multiple regression analysis with 95% confidence intervals and standard errors based on 1000 bootstrap samples (grazing as the dependent variable)

Variable	Cumulative		Simultaneous			
	R^2 Change	*F* Change	*B [95% CI]*	*SE*	*β*	*p*
Step 1						
Age	.01	$F(5,247) = .51$	.01 [-.01; .03]	.01	.06	.322
Gender[1]			-.24 [-1.01, .62]	.42	-.04	.559
Ethnicity[1]			-.46 [-1.62, .82]	.62	-.06	.424
Income			-.02 [-.10, .05]	.04	-.04	.561
BMI			.003 [-.02, .03]	.01	.02	.834
Step 2						
Education	.32	$F(8,239) = 14.35^{***}$	.05 [-.07, .17]	.06	.05	.387
Gastric Band[1]			-.02 [-.73, .65]	.34	-.003	.964
Gastric Bypass[1]			-.26 [-.62, .13]	.19	-.08	.156
Months since surgery			-.001 [-.01, .004]	.003	-.03	.673
Weight regained after surgery			.06 [.04, .08]	.01	.42	.001
Depressive symptoms			.03 [.01, .06]	.01	.15	.021
Internalised weight bias			.02 [.01, .04]	.01	.24	.006
Weight stigma concerns			.01 [-.02, .03]	.01	.06	.474

[1] = Dummy coded.

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

4.5 Discussion

Weight regain often occurs after bariatric surgery (Christou et al., 2006; Hsu et al., 1998; Magro et al., 2008) and grazing, an eating pattern characterised by consuming small portions of food in a repetitive manner (Conceição et al., 2014), has been found to be a likely cause of weight regain (Kofman et al., 2010; Nicolau et al., 2015). The experience of weight stigma has been linked to disordered eating after bariatric surgery (Raves et al., 2016), and literature also reports that even after losing

weight, bariatric surgery participants are still a target of residual weight stigma (Fardouly & Vartanian, 2012). We hence reasoned that weight stigma concerns would be a significant predictor of grazing tendencies in people who underwent bariatric surgery, given its association with overeating in the general population (Romano et al., 2018). We assessed the relationship between weight stigma concerns and grazing tendencies in post-bariatric participants, while controlling for factors associated with disordered eating in the bariatric surgery population reported in literature. We found that, although in an unadjusted analysis weight stigma concerns was associated with more frequent grazing, in adjusted analyses weight stigma concerns was not a significant risk factor for grazing in post-surgery participants. However, internalised weight bias, depression, and weight regained were associated with grazing.

Our results on the association between depression and grazing tendencies are consistent with previously published studies. Depression is common among bariatric surgery candidates (Malik et al., 2014), and it has been found to be negatively associated with the magnitude of weight loss and BMI change 2 years after surgery (Thonney, Pataky, Badel, Bobbioni-Harsch, & Golay, 2010), as well as being positively associated with both pre and post-surgery grazing tendencies in bariatric participants (Colles et al., 2008). Our results confirm that depressive symptoms are a risk factor for grazing tendencies in the post-bariatric population, which could be explained by depression making self-regulation around food more difficult (Macht, 2008) or grazing being a coping mechanism for depression (Ward & Hay, 2015). However, given the cross-sectional nature of our study, we cannot exclude that the tendency of falling back into an unhealthy eating pattern may be associated with higher depressive symptoms instead. In fact, literature reports depressive symptom and eating

pathologies to be longitudinally correlated with each other (Puccio, Fuller-Tyszkiewicz, Ong, & Krug, 2016).

Regarding weight regain, previous studies have found an association with grazing in bariatric surgery outpatients (Nicolau et al., 2015). Specifically, some authors reported that a fear of gaining weight is an emotional trigger for eating both in pre and post-surgery grazers (Colles et al., 2008), so an actual weight regain might serve as a self-fulfilling prophecy and trigger grazing tendencies, as our study suggests. This could also be due to a tendency towards reaching perfectionist ideals, which has been found to be associated with disordered eating tendencies after bariatric surgery (Leombruni et al., 2007). Given that bariatric surgery participants tend to evaluate their worth on the basis of shape and weight (Masheb, Grilo, Burke-Martindale, & Rothschild, 2006), weight regain could be translated as a feeling of failure and shame, as reported in previous studies (Natvik, Gjengedal, & Råheim, 2013). In turn, its stressful effect could lead to falling back to grazing tendencies, which have been found to be associated with anxiety as well (Goodpaster et al., 2016). However, given that our results are cross-sectional, it may also be that grazing tendencies would lead to weight regain after surgery instead, as previously reported by other studies (Kofman et al., 2010; Nicolau et al., 2015).

The findings suggest that internalisation of weight stigma may have a more significant impact than weight stigma concerns on eating behaviour after bariatric surgery. In fact, previous research on the association between internalised weight bias and binge eating has reported that the degree to which people internalise weight stigma

is independent of the amount of objective discriminatory experiences reported (Puhl et al., 2007). Similarly, a study by Durso and colleagues on people with overweight found that the association between experiences of discrimination and disordered eating is mediated by internalised weight bias (Durso, Latner, & Hayashi, 2012). There is evidence that the effects of stigma can still linger after losing weight (Mustillo, Hendrix, & Schafer, 2012), which could explain the reason why internalised weight bias reported a significant effect on grazing, as found in previous research (Raves et al., 2016). This could also explain the significant effect of depressive symptoms on grazing tendencies found in our model. Despite not belonging to a stigmatised group anymore, post-bariatric patients might still carry the psychological effects of having been stigmatised for a long time. In line with this, it has been found that people with former overweight report the same levels of depression as people with current overweight (Levy & Pilver, 2012). This, along with the internalised self-stigma and a significant effect of weight regained after surgery on grazing tendencies, could reflect a "why try" effect that would diminish self-efficacy (Corrigan, Larson, & Rüsch, 2009) and could lead participants to fall back into unhealthy eating habits, potentially as a way to deal with their negative affect (Ward & Hay, 2015). Alternatively, the association of internalised weight bias with grazing may be due to the stress of weight stigma compromising regulatory processes (Tomiyama, 2014), as internalised weight bias is associated with anxiety (Wu & Berry, 2018).

Another potential hypothesis explaining why weight stigma concerns did not predict grazing could be due to methodological reasons. It may be that rather than the concern over being stigmatised for their weight status, post-bariatric participants might be worried about the specific stigma related to having undergone bariatric

surgery, which our model did not account for. There is a growing bias focussing on bariatric procedures, such that participants who lose weight through surgery are perceived more negatively than people who diet or exercise (Mattingly, Stambush, & Hill, 2009). Post-surgery participants are considered lazy for choosing an "easy way out" compared to other weight-loss methods (Drew, 2011; Fardouly & Vartanian, 2012), and judged as less responsible for their weight loss (Vartanian & Fardouly, 2013).

Nevertheless, our study presents evidence on how stigma is associated with grazing after bariatric surgery not when it is perceived as coming from others (weight stigma concerns), but rather if participants have internalised weight bias. These results highlight once more the importance of addressing weight stigma not only in the general population (Puhl & Brownell, 2001), but also in the clinical setting (Phelan et al., 2015). For example, sometimes prevention programs can implicitly blame people for their responsibility over their weight (Täuber, Mulder, & Flint, 2018) and the present study findings suggest that bariatric surgery patients may benefit from psychological intervention to reduce internalisation of weight bias and depression.

This study also comes with limitations. For instance, it relies on self-reported measures that can often be prone to bias (Paulhus & Vazire, 2007), and while the measure we used to assess grazing has been validated in a sample of bariatric surgery patients and candidates (Conceição et al., 2017), some of the measures we used were not (e.g. weight stigma concerns, perceived weight discrimination). Furthermore, the cross-sectional design does not allow assuming causality between our variables, and a

different analysis strategy might have clarified which of the variables analysed took away significance from the single association between weight stigma concerns and grazing tendencies; thus, entering significant predictors in separate steps of a regression model, rather than in a single one, may be a methodological recommendation to consider in the future. Moreover, the sample we used might not be fully representative of the post-bariatric population, as we only included those participants who took part to bariatric surgery support groups; similarly, our sample might be biased towards participants who did not regain weight after surgery, posing another representation issue regarding the population we analysed. However, our model did account for several predictors of overeating after bariatric surgery identified by literature (Colles et al., 2008; Conceição et al., 2017; Kofman et al., 2010; Nicolau et al., 2015; Opozda et al., 2016; Raves et al., 2016; R. Saunders, 2004; Schag et al., 2016). In addition, our questionnaire was approved by participants from a bariatric surgery support charity before being distributed for data collection, to ensure its language was understandable and respectful toward the participants, and would not cause distress or embarrassment due to the nature of the variables included. Future research should thus aim at investigating weight stigma in the post-bariatric population with a longitudinal design, taking into account the role of different types of weight stigma and how they may impact on overeating and weight regain in the post-bariatric population.

4.6 Conclusion

While there was no association between weight stigma concerns and grazing tendencies after adjusting for potential confounders, internalised weight bias was a predictor of grazing among postoperative bariatric surgery participants.

Chapter 5: Weight perception, perceived weight discrimination, and weight loss: An analysis of secondary data from the SWITCH weight-loss trial

5.1 Chapter abstract

Despite a recorded increase from 1997 to 2015 in weight-loss attempts among adults (Lim, Kang, & Lee, 2018; Piernas, Aveyard, & Jebb, 2016), people often fail to achieve a significant amount of weight loss and/or experience weight regain (Dulloo & Montani, 2015). The stigma of overweight and obesity is a factor that may contribute to poor weight-loss outcomes, but has received limited attention to date. For example, both perceived weight status and perceived weight discrimination have been linked to weight gain and worse weight-loss maintenance (Haynes et al., 2018; Hübner et al., 2016; Wott & Carels, 2010). Hence, the aim of this chapter is to examine the impact of weight perception and perceived weight discrimination on weight loss during a 12-week weight-loss program. Specifically, this study aimed to examine if a heavier perceived weight status and a history of experiencing weight-based discrimination predicts amount of weight loss at the end of a 12-week weight-loss program.

5.2 Introduction

Due to the scale of the obesity epidemic (Finucane et al., 2011; Kelly et al., 2008), governments and public health bodies are actively encouraging populations to reduce their body weight (Margetts, 2004). In the US, there is now an aim to reduce child

obesity rates from 17% to 5% by 2030 (Whelan, Russell, & Sekha, 2010) and government strategies in the UK also aim to reverse obesity prevalence (Cavendish, 2008). In line with this, the proportion of people attempting weight loss has increased from 1997 to 2015, particularly among people with overweight (Lim et al., 2018; Piernas et al., 2016). However, it has been found that people often do not lose as much weight as desired, or end up regaining weight (Dulloo & Montani, 2015).

Some authors have openly encouraged weight stigma as a way to fight the obesity epidemic and motivate people to lose weight (Callahan, 2013) and there is also a small amount of evidence that experiencing weight stigma could be beneficial for obesity treatment. A study by Latner and colleagues, for example, found that among participants from a weight-loss treatment program for obesity, a higher frequency of stigmatizing experiences was associated with a greater maintenance of percentage of weight loss after six months in treatment (Latner, Wilson, Jackson, & Stunkard, 2009). Moreover, a study by Carels found a positive association between weight loss after an 18-week intervention and post-treatment implicit weight bias, indicating that greater internalisation of weight stigma was associated with increased weight loss (Carels et al., 2014). Counter to these findings are studies that suggest weight stigma may hinder weight management among people with overweight trying to lose weight. Among participants with overweight taking part in a 14-week behavioural weight-loss intervention, experiencing overt weight stigma was found to be significantly associated with greater binge eating and poorer weight-loss treatment outcomes (Wott & Carels, 2010). Further to that, a longitudinal study found that more retrospective experiences of weight discrimination over childhood and adolescence were associated with a less successful weight-loss maintenance over two years among adults

attempting to actively lose weight (Hübner et al., 2016). Finally, a recent study by Puhl and colleagues examining weight changes among US participants over a year, reported that people who tend to regain weight are more likely to report experiencing weight discrimination compared to weight maintainers (Puhl, Quinn, Weisz, & Suh, 2017).

Considering the abovementioned results, it is possible that poor success in weight-loss programs could be in part due to the stigma of overweight and obesity. Weight stigma is widespread (Puhl & Heuer, 2009) and there is evidence that people who tend to perceive themselves as having an overweight or obese status report higher concerns about being stigmatised because of their weight (Romano et al., 2018). Likewise, a sizeable proportion of adults with obesity, and those who perceive their weight as overweight, report experiencing discrimination because of their body weight (Blodorn et al., 2016; Dutton et al., 2014; Scott-Johnson et al., 2010). Therefore, both a heavier perceived weight and experiences of weight discrimination may negatively affect weight-loss efforts.

Previous studies on weight-loss trials have identified some of the factors associated with weight loss, such as barriers to healthy eating (Zheng et al., 2017), dietary restraint and healthy lifestyle ratings (James, Roe, Loken, & Rolls, 2017) and eating and exercise self-efficacy (Linde, Rothman, Baldwin, & Jeffery, 2006). However, no study to our knowledge has explored the association between perceived weight and perceived weight discrimination, and their effect on amount weight lost after a weight-loss intervention. In the present study, we analysed secondary data from the *'EffectS of non-nutritive sWeetened beverages on appetITe during aCtive weigHt*

loss' trial (SWITCH). Previous research has suggested weight perception and perceived weight discrimination may negatively impact on effortful health behaviour (e.g. overeating and physical inactivity) in non-treatment seeking samples (Haynes et al., 2018; Sutin et al., 2016; Vartanian & Shaprow, 2008). Hence, in this study we examined whether weight perception and perceived weight discrimination measured before the start of the 12-week weight-loss program predicted the amount of recorded weight lost at the end of the intervention.

5.3 Methods

5.3.1 The SWITCH trial.

For this study, we made use of secondary data from the SWITCH trial (Masic et al., 2017). The SWITCH trial aimed to assess the effect of non-nutritive sweetened (NNS) beverages on weight loss and long-term weight maintenance and to explore the possible mechanisms through which NNS may promote better weight loss outcomes than water. It relied on a randomized parallel groups design with two arms, a NNS beverages consumption condition (active), and a water consumption condition (control). Participants first took part in a weight-loss phase (lasting 12 weeks, with weekly sessions), followed by a supported weight-maintenance phase (lasting 40 weeks, with monthly sessions) and finally concluding with an independent weight-maintenance phase (lasting 52 week). The study aimed to enrol 432 participants, for a total study duration of 2 years (Masic et al., 2017). For the purpose of the present research, this study will focus on currently available data from the 12-week weight-loss phase.

5.3.2 Sample.

We made use of data from 184 participants who had completed the 12-week weight-loss program from the SWITCH trial. The study is exploratory and based on data available. However, the sample size is comparable to previous studies that have examined the association between weight stigma variables and weight loss (Carels et al., 2014; James et al., 2017). In order to take part in the SWITCH weight-loss trial, participants had to have overweight or obesity (BMI of 27-35 kg/m^2), but no other major medical, psychiatric, or psychological conditions. The trial included non-smoking participants, older than 18, who were not in their first year of University studies, and willing to consume chilled non-nutritive sweetened beverages or water for a 2-year period. For this study, we decided a-priori to exclude participants who reported a self-perception of being underweight.

From an available sample of 184 participants, twelve participants were excluded due to incorrect timing of weight measurements, two were excluded for not reporting their weight perception at the beginning of the weight-loss intervention, and one for reporting a self-perception of underweight. The final sample consisted of 169 participants.

5.3.3 Measures.

Demographic factors and baseline weight. At the screening for taking part in the study, participants were asked for their age and gender, while height (in centimetres) and weight (in kilograms) were measured by a researcher to calculate initial BMI. Baseline weight (in kilograms) was measured again at the beginning of the weight-loss program.

Arm of the trial. Participants were coded according to which arm of the trial they were randomized to (either the NNS beverage condition or the water condition).

Amount of weight lost. The amount of weight lost (in kilograms) was calculated as the difference between weight recorded before the beginning of the 12-week weight-loss program and at programme end.

Perceived weight. During their pre-weight-loss-program assessment, participants were asked to describe their weight on a 6-point scale ranging from 1 (‘*Underweight’*) to 6 (*‘Extremely overweight’*), recoded as 1 (*‘About right’*) to 5 (*‘Extremely overweight’*) for the purpose of this analysis.

Perceived weight discrimination. During their pre-weight-loss-program assessment, participants completed an adapted version of the Everyday Experiences with Discrimination Scale (Hunger & Major, 2015; D. R. Williams et al., 1997). They indicated how frequently they encounter five discriminatory experiences because of their weight (e.g., *“You are threatened or harassed”*) on 5-point Likert scales ranging from 1 (‘*Almost every day’*) to 5 (‘*Less than once a year*). Responses were inversely recoded to calculate a total score, with higher values indicating higher perceived weight discrimination.

Eating self-efficacy questionnaire. During their pre-weight-loss-program assessment, participants completed the Eating self-efficacy questionnaire (Glynn & Ruderman, 1986). The scale has 25 items indicating how difficult it is to control eating in different situations (e.g. *“Overeating after work or school”*) with scores ranging from 1 (*‘No difficulty controlling eating’*) to 7 (*‘Most difficulty controlling eating’*). The total score was calculated as the sum of the items. High scores on the ESES indicate less eating self-efficacy.

Exercise-Avoidance Motivation Scale. During their pre-weight-loss-program assessment, participants completed a measure of exercise avoidance. The scale contains eight items identifying people's reactions to experiencing negative situations related to their weight, in particular related to exercise (e.g. *"I avoid going to the gym when I know there will be a lot of thin people there"*). Items were rated on Likert scales ranging from 1 (*'Not at all true'*) to 7 (*'Completely true'*). Higher scores indicate greater avoidance motivation (Vartanian & Shaprow, 2008).

It was not possible to calculate internal consistency scores, as only the total scores for all measures were reported in the database for the study.

5.3.4 Procedure.

After an initial screening during which their demographic variables were taken, and once they were randomised to one of the two conditions (either the NNS beverage or the water condition), participants attended a pre-weight-loss meeting on a morning after an overnight fast. During the visit, they were asked to have a sample of their blood taken (if willing) and to consume a snack before being asked to complete a set of questionnaires (among which weight perception, perceived weight discrimination, exercise avoidance and eating self-efficacy were included). The visit lasted about 90-120 minutes. The weight-loss program began within 10 weeks after the pre-intervention meeting. Over the 12-week intevention, participants attended weekly visits to receive nutritional advice whilst additionally incorporating the NSS beverage or bottled water products into their daily diet. Initial body weight measure was taken at the start of the weight-loss program. An exercise component was also included over the weight-loss period, as well as weekly support sessions on weight loss and nutrition.

Within the same week of the end of the weight-loss program, a post-weight-loss-intervention assessment was attended, again on a morning after an overnight fast. During the visit, participants were once again asked for a sample of their blood (if willing), and to consume a snack before completing the same set of questionnaire from the pre-weight-loss-program visit. Participants' weight after the intervention was measured within the same week of the post-weight-loss assessment. The University of Liverpool sponsored the trial (version 2 dated December 16th 2015), which was also registered at Clinical Trials (NCT02591134) on October 23rd of 2015. Ethical approval was received from the NRES Ethics Committee North West - Liverpool East (date May 19th 2016, Ethics Ref: 16/NW/0347). See Figure 5.1 for the timeline of the study.

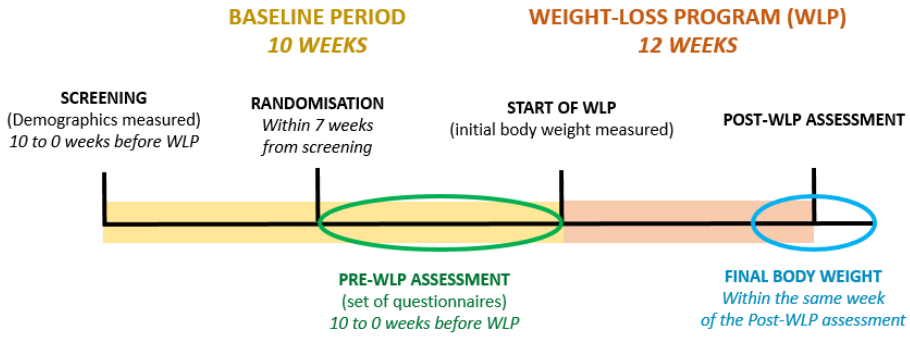

Figure 5.1. Timeline for the study.

5.3.5 Planned analysis.

5.3.5.1 Hypothesis testing.

A hierarchical regression with forced entry and 1000 bootstraps was performed to evaluate the effect of perceived weight and perceived weight discrimination recorded before the weight-loss program on amount of weight lost at the end of the weight-loss program. Demographic factors (age, gender and BMI), baseline weight, and trial arm,

were controlled for by entering them in step 1. Weight perception and perceived weight discrimination measured before the weight-loss program were entered in the second step. We reasoned that any effect of weight perception or perceived weight discrimination may impact on weight loss by affecting eating self-efficacy or exercise avoidance. We therefore planned to repeat the same analysis as above whilst controlling for eating self-efficacy and exercise avoidance measured before the beginning of the weight-loss program by entering them in the second step of the hierarchical regression model. The set of covariates was chosen based on previous studies on weight-loss trials examining trajectories of weight loss (James et al., 2017) and/or factors shown to be associated with weight loss (Linde et al., 2006).

5.3.5.2 Exploratory analyses.

If inclusion of eating self-efficacy and exercise avoidance reduced the associations between weight perception or perceived weight discrimination and weight loss, we planned two further exploratory tests of indirect effect with two parallel mediators (PROCESS, Model 4). Specifically, we aimed to test the mediating effect of exercise avoidance and eating self-efficacy in the relationship between perceived weight/perceived weight discrimination and amount of weight lost (see Figure 5.2).

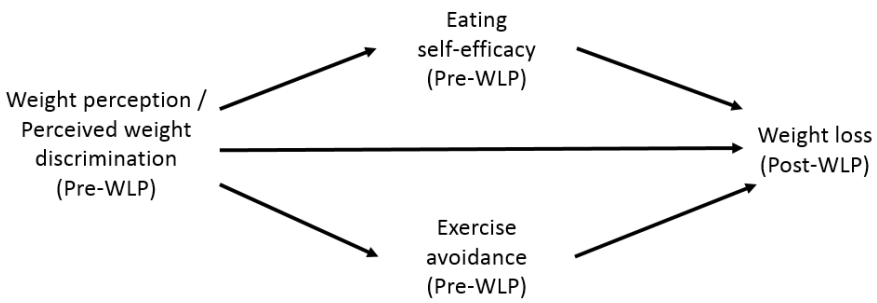

Figure 5.2 Hypothesized tests of indirect effects.

5.4 Results

Most participants were females (N = 123, 72.80%). The mean age was 45.70 years (*SD* = 12.11) and the mean BMI at the beginning of the trial was 31.30 (*SD* = 2.51). The most common weight perception before the weight-loss program was a self-perception of overweight (N = 87, 51.50%). Participants' average initial weight was 88.76 Kg (*SD* = 11.41) and the average weight at the end of the 12-week intervention was 83.16 Kg (*SD* = 10.81), with a mean weight loss of 5.60 Kg (*SD* = 3.27). See Table 5.1 for participant demographics.

Table 5.1

Descriptive statistics for analytic sample (N = 169)

	Mean/%	**SD**	**Min**	**Max**
Age	45.70	12.11	19	65
Female	72.80 (123)			
BMI	31.30	2.51	23.89	35.87
Arm of trial				
Water	46.70 (79)			
Non-nutritive sweetened beverages	53.30 (90)			
Weight perception				
Slightly overweight	3.60 (6)			
Overweight	51.50 (87)			
Very overweight	39.60 (67)			
Extremely overweight	5.30 (9)			
Weight before intervention (in kg)	88.76	11.41	65.80	123.70
Weight after intervention (in kg)	83.16	10.81	62.10	120.20
Weight lost (in kg)	5.60	3.27	-1.70	16.30

Pearson correlations (Table 5.2) show that weight perception and perceived weight discrimination measured before the intervention were not associated, $r(167) = .038$, $p = .626$. Weight perception was positively associated with eating self-efficacy, $r(167) = .201$, $p = .009$, and exercise avoidance, $r(167) = .286$, $p < .001$, both measured before the intervention, as well as with weight measured at the end of the intervention, $r(167) = .195$, $p = .011$, and amount of weight lost, $r(167) = .183$, $p = .017$. The heavier the participants perceived themselves before the weight-loss program, the more they reported difficulties in controlling their eating and a tendency to avoid exercising because of their weight. Perceived weight discrimination was only positively associated with exercise avoidance, $r(167) = .334$, $p < .001$; the more participants had experienced weight discrimination in the past, the more likely they were to avoid exercising because of their weight.

Table 5.2

Correlation matrix for the variables analysed

	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1. Age	-.050	.063	-.201**	-.031	.047	-.067	.065	-.243**	-.229**	.056
2. Gender		.209**	.295***	.013	-.051	.000	-.055	-.045	.251**	.199*
3. BMI Pre-WLP			.596***	.100	.509***	.075	.205**	.145	.568***	.202**
4. Weight Pre-WLP				-.045	.238**	.032	.044	.097	.958***	.320***
5. Arm					.180*	-.097	.024	.064	-.048	.003
6. Weight perception Pre-WLP						.038	.201**	.286***	.195*	.183*
7. Perceived weight discrimination Pre-WLP							.121	.334***	.020	.047
8. Eating self-efficacy Pre-WLP								.295***	.014	.106
9. Exercise avoidance Pre-WLP									.094	.026
10. Weight Post-WLP										.034
11. Weight lost										--

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

5.4.1 Hypothesis testing.

Table 5.3 shows results from the regression model. The overall model explained 15% of the variance in amount of weight lost after the 12-week intervention, $R^2 = .151$, $F(7, 161) = 4.09$, $p < .001$. After controlling for participants' demographics, weight perception and perceived weight discrimination only predicted 2% of the variance in amount of weight lost (R^2 change = .021). There was no evidence of multi-collinearity, as all variance inflation factors (VIF) were below 10 and tolerance values were all above .20 (Field et al., 2013). Neither perceived weight (*B* = .82, *SE* = .50, *95% CI* = -.27 to 1.71, $p = .102$), nor perceived weight discrimination (*B* = .07, *SE* = .12, *95% CI* = -.17 to .30, $p = .562$) were significantly associated with amount of weight lost after the 12-week intervention. As planned, we re-ran the model by including eating self-efficacy and exercise avoidance in step 2 and the results remained the same.

5.4.2 Exploratory analyses

Due to the lack of a significant association between the variables of interest and the dependent variable, no further exploratory analyses were performed.

Table 5.3

Multiple regression analysis with 95% confidence intervals and standard errors based on 1000 bootstrap samples (amount of weight lost at the end of the trial as the dependent variable)

Variable	Cumulative		Simultaneous			
	R^2 Change	*F* Change	*B [95% CI]*	*SE*	*β*	*p*
Step 1						
Age	.13	$F(5,163) = 4.87^{***}$	.04 [-.01, .08]	.02	.13	.115
Gender[1]			.83 [-.37, 2.10]	.63	.11	.191
BMI (Pre-WLP)			-.04 [-.36, .25]	.15	-.03	.791
Weight (Pre-WLP)			.10 [.03, .17]	.04	.33	.012
Arm of trial[1]			.15 [-.77, 1.05]	.47	.02	.761
Step 2						
Weight perception (Pre-WLP)	.02	$F(2,161) = 2.004$	.82 [-.27, 1.71]	.50	.16	.102
Perceived weight discrimination (Pre-WLP)			.07 [-.17, .30]	.12	.05	.562

[1] = Dummy coded (0 = female, 1 = male).

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

5.5 Discussion

We analysed secondary data from a weight-loss trial to examine if weight perception and perceived weight discrimination measured at the beginning of a 12-week weight-loss intervention were associated with the amount of weight lost at the end of the trial. We found that neither weight perception nor perceived weight discrimination were associated with amount of weight lost.

While there is evidence on the positive association between weight perception and weight gain in the general population (Haynes et al., 2018), our study found no association between weight perception and amount of weight loss among participants in the SWITCH trial. The lack of a negative association between perceived weight and amount of weight lost in our study but previously found in the general population may reflect that all participants were actively attempting weight loss. While being a risk factor for weight gain in the general population (Haynes et al., 2018), a heavier body weight perception may instead act as a motivating factor among some people actively attempting to lose weight. For example, in a study of participants receiving weight-loss therapy, feelings of being an excessive body size were associated with larger reduction in weight at the end of therapy (Bak-Sosnowska & Zahorska-Markiewicz, 2009).

Alternatively, being part of a group of people with overweight could represent a source of social support that we did not account for. There is evidence on the reinforcing effect of social support during weight-management programs (Verheijden, Bakx, van Weel, Koelen, & van Staveren, 2005). For example, a study on a weight-loss competition-based intervention for people with overweight found that the amount of weight loss reported by participants positively correlated with experiencing social influence on weight loss (Leahey, Kumar, Weinberg, & Wing, 2012). In the present study participants who self-identified as being overweight may have felt socially connected with others because of their shared identity (Deforche, Haerens, & De Bourdeaudhuij, 2011) and this may have mitigated any negative effects of the stigma associated with perceiving one's own weight as being heavier.

Finally, demographic factors might have accounted for the lack of a negative association between perceived weight and amount of weight lost. Most of our participants perceived themselves as either ‘overweight’ (51.5%) or ‘very overweight’ (39.6%). So, it may be that the lack of participants in the other weight perception categories (e.g. only 6 perceiving themselves as ‘slightly overweight’ and none perceiving themselves as 'about the right weight’) may have resulted in limited variability in our independent variable of weight perception and impacted on our ability to test whether a heavier perceived weight impacted on weight loss. Treating the variable as a continuous one could have also affected the results, although when we re-ran the model including perception as a categorical variable in exploratory analysis, the results did not change. Moreover, our sample consisted mostly of middle-aged adults who were motivated to take part to a weight-loss program. Sample characteristics similar to ours were reported in a study by Wang and colleagues (M. L. Wang et al., 2017). In line with the present results, Wang et al. found that baseline weight did predict weight change in a 2-year intervention to prevent weight-gain and perceived weight status did not. On the other hand, many results on the association between weight perception and weight change come from cohort studies with participants reporting younger ages, and who are assessed for a longer time. An example is a study on UK and US population by Robinson and colleagues, which assessed weight change over the course of several years, and found an association between weight perception and weight change (Robinson et al., 2015). These differences could also suggest that 12 weeks might not be enough time to assess the impact of perceived weight on weight change after a weight-loss intervention. A

longer follow-up may be needed to analyse whether a heavier perceived weight is associated with poorer weight-loss.

Evidence on the association between weight stigma and weight loss in participants from weight-loss programs is mixed, with studies reporting a positive association between weight stigma and weight-loss outcomes (Carels et al., 2014; Latner et al., 2009) and others showing that weight stigma can be damaging for weight-loss outcomes (Hübner et al., 2016; Wott & Carels, 2010). We found no association between perceived weight discrimination and amount of weight lost. Once again, this result could be due to the short follow-up. The majority of participants in the present trial lost weight. Therefore, 12 weeks may not be long enough to observed significant variability in weight loss between participants. One of the studies by Carels identifying a positive association between internalised stigma and amount of weight lost, for example, relied on participants who took part in an 18-week program (Carels et al., 2014). Similarly, a study identifying a positive association between stigmatising experiences and weight-loss maintenance followed participants for 6 months (Latner et al., 2009). Further to that, a study found that more retrospectively reported weight-based teasing from childhood and adolescence predicts less successful weight-loss management over the course of 2 years in a sample of adults from the general German population (Hübner et al., 2016). This might also suggest that experiences of weight stigma do not hold the same effect on weight management during weight-loss interventions as they do in daily life. Past stigmatising experiences could act as a motivating factor for weight loss while participants are professionally supported through the weight-loss process, and subsequently become a risk factor for weight-maintenance when this support is over. This may happen because weight-loss trials

represent a protective and less judgemental setting for participants. However, once people return to their everyday life with reduced social support, weight stigma experiences may be a risk factor for weight maintenance due to their stressful effect (Tomiyama, 2014). Examining the effect of weight stigma on weight-loss maintenance may shed more light on the mixed findings reported on the association between weight discrimination and weight management.

Another reason why our null findings on the association between perceived weight discrimination and amount of weight lost are in contradiction with published results could also be due to the different measures used to assess weight discrimination. Some of the studies on the association between weight stigma and amount of weight lost (Latner et al., 2009; Wott & Carels, 2010) rely on a scale developed and validated to assess frequency of stigmatising situations among people with overweight (The Stigmatizing Situations Inventory, SSI, Myers and Rosen, 1999). However, the measure we used to assess perceived weight discrimination was an adapted version of a scale designed to assess everyday experiences of discrimination in a study analysing racial differences in physical and mental health (Hunger & Major, 2015; D. R. Williams et al., 1997). Although previously found to be directly associated with several psychological and physical health outcomes among community members (Hunger & Major, 2015), the scale we used may be less sensitive in detecting the frequency of discriminatory experiences specifically related to weight among participants from weight-loss trials.

A further consideration is that the amount of discriminatory experiences and a heavier self-perceived weight may cause people to be concerned about being stigmatised because of their weight, a measure that was not included in this weight-loss trial. Hunger and colleagues (Hunger et al., 2015) define "weight-based social identity threat" a situationally-triggered psychological state in which an individual is concerned that they will be discriminated because of their weight. Such a threat is hypothesised to affect several health and behavioural outcomes, such as weight management, due to its stressful effect (Hunger et al., 2015). A study by Hunger and Major, for example, has reported that after controlling for weight stigma concerns, perceived weight discrimination is not a significant mediator of the association between higher BMI and poorer physical and psychological health (Hunger & Major, 2015). Therefore, weight stigma concerns may be a more important predictor of weight-loss outcomes than perceived weight or perceived weight discrimination. Weight bias internalization is a further relevant variable we did not account for (Puhl et al., 2017). In Puhl et al. the authors recruited a sample of participants from the general population who indicated that they had intentionally lost weight over the previous year. Afterwards, the sample was further divided between those who were able to keep their weight loss over the next year (weight maintainers) and those who were not (weight regainers). When analysing variables predicting the likelihood of being a weight maintainer, Puhl et al. found that a higher internalized weight stigma was associated with a lower likelihood to maintain the weight lost over the previous year (Puhl et al., 2017). Interestingly, among individuals with overweight, the degree to which people internalise negative weight bias has been shown to be unrelated to the amount of discrimination they report experiencing (Puhl et al., 2007). Therefore, rather than self-perception of body size or objective experiences of weight

discrimination, it may be that the fear of being negatively judged because of one's weight and/or the degree to which people internalise stigmatising messages related to obesity are key to predict weight-loss outcomes.

The present study has limitations. For example, some variables (e.g. perceived weight discrimination) are self-reported, and could be prone to bias (Paulhus & Vazire, 2007). Further to that, the sample was limited to the number of participants who completed the 12-week weight-loss program from the SWITCH trial and was therefore relatively small (N= 169), although similar studies on weight stigma and weight-loss outcomes have relied on similar or smaller sample sizes (Carels et al., 2014; James et al., 2017). However, strengths include that our study relied on longitudinal data and is one of the first assessing both the effect of weight perception and perceived weight discrimination on outcomes of weight-loss trials. Future studies should aim to integrate these findings by examining the role of weight stigma concerns and internalised weight bias on weight-loss trials outcomes, expanding their research criteria to consider younger participants taking part in weight-loss programs, and assessing participants for a longer time after the intervention.

5.6 Conclusions

In the present study, perceived weight and perceived weight discrimination were not associated with amount of weight lost at the end of a 12-week weight-loss intervention.

Chapter 6: Weight perception, weight stigma concerns, and the relationship between BMI and depressive symptoms

6.1 Abstract

Overweight and obesity are associated with an increased risk of depression, however there is a need to understand the mechanisms responsible for this relationship. It may be that a self-perception of a heavier weight status leads to heightened concerns of being stigmatised due to body weight, which in turn increases risk of developing depressive symptoms. This chapter examines whether the association between a higher body mass index and depressive symptoms is explained by perceived weight status and weight stigma concerns.

6.2 Introduction

Individuals with overweight or obesity are at an increased risk of depression (Luppino et al., 2010). While there is some evidence that the relationship is bidirectional (Luppino et al., 2010), recent findings suggest that a higher body mass index may be causally related to depression (Van Den Broek et al., 2018). However, there is a less clear understanding of why a higher BMI is a risk factor for developing depression. A variety of mechanisms may account for the association between higher body weight and depressive symptoms. From a genetic point of view, a study on female participants has reported a phenotypic association between depression and obesity (Afari et al., 2010). On a physiological level, obesity is associated with dysregulated cortisol secretion (Pasquali & Vicennati, 2000) which is also implicated in the development of depression (Holsboer, 2000). Inflammation could be another key mechanism, as

weight gain can lead to inflammation (Shoelson, Herrero, & Naaz, 2007), and inflammation has been hypothesised to be involved in the pathogenesis of depression (Raison, Capuron, & Miller, 2006). Physical health difficulties and chronic illness are also associated with depressive symptoms (Hilderink, Burger, Deeg, Beekman, & Oude Voshaar, 2012; Turvey, Schultz, Beglinger, & Klein, 2009) and with higher BMI (Doll, Petersen, & Stewart-Brown, 2000; Hitt, McMillen, Thornton-Neaves, Koch, & Cosby, 2007), and may also play a role in the association between higher body weight and depressive symptoms. Finally, another explanation could be given by dieting, such that people with obesity who fail to maintain a dieting regime may relapse into overeating habits (Grilo, Shiffman, & Wing, 1989), gaining further weight (Hays & Roberts, 2008; Tomiyama, 2014), and thus experiencing to shame and depression (Orth, Berking, & Burkhardt, 2006); previous results have in fact reported a bidirectional association between overeating and depression in female participants (Skinner et al., 2012).

There are also psychosocial contributors to the development of depression among people with obesity. Overweight and obesity are widely stigmatised (Puhl & Brownell, 2001). The experience of weight-based discrimination has been linked with poor mental health outcomes, and is one factor that has been shown to partially explain the relationship between higher BMI and depression (Robinson, Sutin, & Daly, 2016). Yet, regardless of an individuals' objective experience of discrimination, there is evidence suggesting that the mere *concern* over experiencing stigmatisation based on one's weight may be detrimental to the psychological and physical health of individuals with overweight or obesity (Hunger & Major, 2015; Hunger et al., 2015). Similarly, irrespectively of actual body weight, a self-perceived overweight status has

been found to be associated with an increased risk for developing depressive symptoms (Haynes et al., 2019). There is evidence for the association of weight perception with weight stigma concerns (Romano et al., 2018), of weight stigma concerns with psychological health (Hunger & Major, 2015), and of weight perception with depression (Haynes et al., 2019). However, to our knowledge, no previous study has examined the combined role of weight perception and weight stigma concerns in the relationship between BMI and depression. Following the results from literature reported above, we propose that weight perception and weight stigma concerns may be important factors explaining the relationship between BMI and mental health. We reason that experiencing concern over being susceptible to weight stigma may be dependent on an individual perceiving themselves as part of a stigmatised group (overweight), and therefore perceived overweight and weight stigma concerns may be key constructs explaining the relationship between BMI and depressive symptoms.

In the present research, we analysed data from two cross-sectional online questionnaires administered to US adults to examine whether the relationship between a higher BMI and depressive symptoms was explained by perceived weight status and subsequently, weight stigma concerns. We controlled in our analyses for factors that have been previously reported to be associated with weight perception, weight stigma concerns, and/or depression, such as demographic and health variables (e.g. income, education, presence of chronic illness) (Paeratakul et al., 2002), psychological variables (neuroticism) (Hartmann & Siegrist, 2015; Lewis, Bates, Posthuma, & Polderman, 2014), and health behaviours (overeating) (Romano et al., 2018). We also controlled for perceived weight discrimination in order to isolate the effect of weight stigma concerns independently of history of experiencing discrimination.

6.3 Method

6.3.1 Sample.

Our sample (N = 1,522) consisted of participants combined across two previous online studies (Romano et al., 2018) recruited via Amazon Mechanical Turk (MTurk). We decided *a priori* to exclude participants who did not complete the full questionnaire or who failed attention checks (N = 274), perceived their weight as underweight (due to few participants being likely to report this perception, N = 74), reported an implausible BMI according to criteria used in previous research (Armour et al., 2016) (BMI < 15 or > 50, N = 24), or were aged <18 (N = 3), resulting in an analytic sample of 1,147 participants.

Using the web-based software "Monte Carlo Power Analysis for Indirect Effects" (Schoemann, Boulton, & Short, 2017) we estimated correlations between model variables from existing literature: path A1, r = .11 (original value OR = 1.50, Paeratakul, White, Williamson, Ryan, & Bray, 2002); path B1, r = .096 (original value OR = 1.42, Haynes, Kersbergen, Sutin, Daly, & Robinson, 2019); paths A2 and B2, each r = .30 (rounded down from r = .40 and r = .47 to avoid overestimation due to limited research on the construct of weight stigma concerns, Hunger & Major, 2015); path C', r = .12 (original value OR = 1.57, Luppino et al., 2010); and path D, r = .21 (Puhl et al., 2017). Following recommendations by Schoemann et al. (2017), standard deviations were set at 1, and we used a random seed of 1,234 and 5,000 replications with 20,000 Monte Carlo draws per replication. With a confidence level of 95%, the power analysis revealed that our sample of 1,147 provided sufficient power ($1 - \beta \geq 0.96$) to detect a serial mediation effect of BMI on depressive symptoms via perceived weight status and weight stigma concerns (Figure 6.1). Ethical approval for both

studies was obtained from the University Ethics Committee. See Appendix II for additional details on measures, attention checks, BMI and cut-offs (Appendix II, pages 228 and 233).

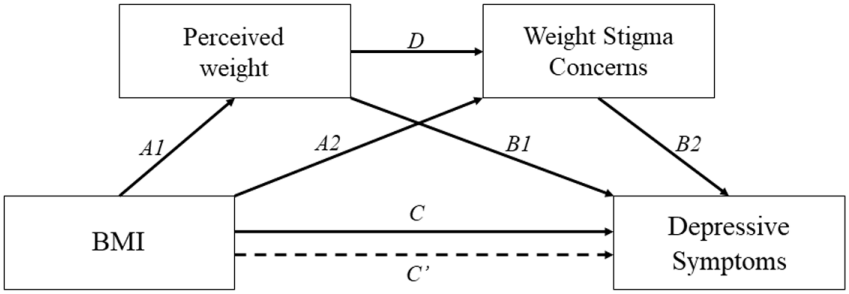

Figure 6.1 Hypothesized test of indirect effects.

6.3.2 Measures.

Demographic and health variables. Participants reported their age, gender, ethnicity, current annual income, and highest education level. Height (feet and inches) and weight (pounds) were converted to metric measures to calculate BMI (kg/m²). Presence of chronic illness was assessed by a single yes/no item.

Perceived weight. Consistent with previous research (Robinson, Hunger, & Daly, 2015) participants described their weight on a 6-point Likert scale (‘*Very underweight’,* ‘*Underweight’*, *‘About the right weight’*, *‘Overweight’, ‘Very overweight’, ‘Obese’*). Instead of being treated as a dichotomous variable as in previous testing of indirect effect (Romano et al., 2018), for the purpose of our analyses the measure was treated as an ordinal variable ranging from *‘About the right weight’* to *‘Obese’*, as the macro used for the test of indirect effects (PROCESS macro for SPSS, model 6, Hayes, 2012) does not allow to test for a dichotomous mediator.

Weight stigma concerns. The Weight Stigma Concerns scale (Hunger & Major, 2015) consists of 5 items (e.g. *"I am afraid that other people will reject me because of my weight"*) rated on Likert scales ranging from 1 (*'Strongly Disagree'*) to 5 (*'Strongly Agree'*) in Study 1 and 1 (*'Strongly Disagree'*) to 7 (*'Strongly Agree'*) in Study 2. Responses were summed, with higher values indicating greater weight stigma concerns. Reliability was excellent in both studies (respectively $\alpha = .96$ and $\alpha = .97$ for Study 1 and 2).

Depressive symptoms. The Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977) consists of 10 items rated on 4-point scales ranging from 1 (*'Rarely'*) to 4 (*'All of the time'*). Responses were summed to obtain a measure of depressive symptoms, with higher scores indicating higher levels of depressive symptoms. Reliability for the scale was good in both studies ($\alpha = .89$ and $\alpha = .90$ for Study 1 and 2).

Overeating tendencies. In Study 1, participants completed a measure of 2 stress-induced overeating behaviours (e.g. *"eating more than usual to enhance my mood"*) rated on 4 point Likert scales ranging from 1 (*'Not at all'*) to 4 (*'A lot'*) (Robinson et al., 2015). Reponses to the items were averaged and had good reliability ($\alpha = .86$). In Study 2, participants completed the uncontrolled eating subscale of the Three Factor Eating Questionnaire – Revised 18 (TFEQ-R18) (Karlsson et al., 2000), with 9 items answered on 4 point Likert scales ranging from 1 (*'Definitely false'*) to 4 (*'Definitely true'*). Reliability was excellent ($\alpha = .92$). In both scales, higher scores indicated stronger tendencies toward overeating.

Neuroticism. Participants completed the Neuroticism subscale of the Mini International Personality Item Pool (Mini IPIP), consisting of 4 items (e.g. "*I get upset easily*") rated on 5 point Likert scales ranging from 1 (*'Very Inaccurate'*) to 5 (*'Very*

Accurate') (Donnellan, Oswald, Baird, & Lucas, 2006), which has been validated as a measure of the Big Five personality traits (Donnellan et al., 2006). Responses were summed to provide a neuroticism score, with higher values indicating higher neuroticism. Reliability was good in both studies (α = .83 and α = .84 for Study 1 and 2).

Perceived weight discrimination. To measure frequency of experienced weight discrimination we used an adapted version of the Perceived Everyday Experiences with Discrimination Scale (Hunger & Major, 2015) describing five discriminatory experiences (six in Study 2) related to overweight (e.g. *"You are threatened or harassed"*) rated on 6 point Likert scales ranging from 1 (*'Never'*) to 6 (*'Almost every day'*). Responses were summed, and higher values indicated more frequent experiences of weight-based discrimination. Reliability was good in Study 1 (α = .87) and excellent in Study 2 (α = .91).

Both studies also included additional self-report measures unrelated to the research question of the present study (Diener, Emmons, Larsen, & Griffin, 1985; Felitti et al., 1998; Fraley, Waller, & Brennan, 2000; Garner, Olmstead, & Polivy, 1983; Gratz & Roemer, 2004; Milton, Bull, & Bauman, 2011; Noll & Fredrickson, 1998; Rosenberg, 1965; Tangney, Baumeister, & Boone, 2004). See Appendix II for additional details on measures (Appendix II, pages 228, 230, 233, and 234).

6.3.3 Procedure.

Participants first provided informed consent, then completed demographic and perceived weight questions before completing the remaining measures on randomised consecutive pages of an online questionnaire (Qualtrics). Each online questionnaire included attention checks, and additional self-report measures unrelated to the present

research question (see Appendix II, pages 229, 230, and 234). Upon completion, participants were debriefed and provided with a small monetary reward via MTurk.

6.3.4 Planned analysis.

The PROCESS macro for SPSS (model 6) with 5,000 bootstrap samples (Hayes, 2012) was used to test whether BMI had an indirect effect on depressive symptoms through perceived weight and weight stigma concerns. All tests of indirect effects were adjusted for demographic and health variables (gender, age, ethnicity [White, Other], income, education, presence of chronic illness), and study of origin. In a second analysis, we additionally controlled for neuroticism, perceived weight discrimination, and overeating. To standardise variable scales across studies, all continuous variables were converted to Z-scores for each study before combining the datasets.

6.4 Results

The analytic sample had a mean BMI of 26.97, *SD* = 5.81 and a mean age of 37.86, *SD* = 12.16 (N = 1,147, 57.7% female). The majority perceived themselves as overweight (60.1%). Descriptive statistics for demographic and health variables are presented in Table 6.1.

Table 6.1

Descriptive statistics for analytic sample (N = 1,147)

	Mean (SD) / % (N)
Age	37.86 (12.16)
BMI	26.97 (5.81)
Gender	
Male	42.3% (485)
Female	57.7% (662)

Perceived weight[a]	
Perceived overweight	60.1% (689)
Perceived normal weight	39.9% (458)
Presence of chronic illness	
Yes	23.5% (269)
No	76.5% (878)
Ethnicity	
White	80.1% (919)
Other[b]	19.9% (228)
Annual income	
< $26,000	30.7% (352)
$26,000 - $39,999	20.6% (236)
$40,000 - $49,999	14% (161)
$50,000 - $74,999	21.2% (243)
$75,000 - $99,999	7.9% (91)
≥$100,000	5.6% (64)
Educational attainment	
Never completed High School	0.3% (3)
Completed High School	28.2% (324)
Bachelor's Degree	56.7% (650)
Master's Degree	11.1% (127)
PhD/Professional Degree	3.7% (43)

[a] Perceived normal weight values were obtained from participants who indicated perceiving themselves as 'About the right weight'. Perceived overweight values were obtained collapsing participants who indicated perceiving themselves as either 'Slightly Overweight' (38.3%, N = 439), 'Very Overweight' (14.7%, N = 169) or 'Obese' (7.1%, N = 81).

[b] Collapsed from categories Black (7.1%, N = 81), Asian (5.1%, N = 59), Hispanic (4.6%, N = 53), Mixed (2.4%, N = 28) and Other (0.6%, N = 7).

Correlations between variables are presented in table 6.2. Controlling for demographic and health variables only (Table 6.3, Model 1), BMI was a significant predictor of higher perceived weight status (path A1), perceived weight status was a significant predictor of higher weight stigma concerns (path D), and weight stigma concerns was a significant predictor of depressive symptoms (path B2). The indirect effect of BMI on depressive symptoms through higher perceived weight and weight stigma concerns was significant, bootstrap estimate = .16, *SE* = .02, *95% CI* [.13, .21], meaning that BMI predicted depressive symptoms via the indirect effect of BMI on

weight perception, of weight perception on weight stigma concerns, and of weight stigma concerns on depressive symptoms. In the fully adjusted model (additionally controlling for neuroticism, perceived weight discrimination, and overeating, Table 6.3, Model 2), BMI remained a significant predictor of higher perceived weight status (path A1), which in turn significantly predicted greater weight stigma concerns (path D), and weight stigma concerns was a significant predictor of depressive symptoms (path B2). After controlling for potential confounders, the indirect effect of BMI on depressive symptoms via higher perceived weight and weight stigma concerns remained significant, bootstrap estimate = .03, *SE* = .01, *95% CI* [.02, .06], explaining the relationship between BMI and depressive symptoms.

Table 6.2

Correlations between the variables (all continuous variables were Z-scored)

		2	3	4	5	6	7	8	9	10	11	12	13	14
1	**BMI**	.775***	.435***	.136***	.101**	-.091**	.064*	-.029	-.112***	-.183***	<.001	.065*	.261***	.243***
2	**Perceived weight**		.557***	.222***	.117***	.102**	.053	-.042	-.072*	-.193***	-.041	.157***	.295***	.373***
3	**Weight stigma concerns**			.416***	-.089**	.157***	.054	-.039	-.070*	-.146***	<.001	.342***	.503***	.444***
4	**Depressive symptoms**				-.101**	.039	.004	-.191***	-.051	-.252***	< .001	.673***	.336***	.351***
5	**Age**					.009	.162***	.061*	.063*	-.169***	<.001	-.143***	-.082**	-.129***
6	**Gender**						.069*	-.092**	-.051	-.103***	-.002	.148***	.018	.082**
7	**Ethnicity**							.027	-.013	-.059*	.038	-.002	-.048	.029
8	**Income**								.289***	.186***	.070*	-.138***	-.009	-.050
9	**Education**									.096**	-.137***	-.042	-.064*	.005
10	**Presence of Chronic Illness**										.011	-.149***	-.069*	-.089**
11	**Study of origin**											<.001	<.001	<.001
12	**Neuroticism**												.226***	.330***
13	**Perceived Weight Discrimination**													.274***
14	**Overeating**													--

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

Table 6.3

Indirect effect of BMI on depressive symptoms via perceived weight and weight stigma concerns

		Standardised Coefficients[a]	SE	*p*	Bootstrap 95% CI	Model R^2 / Proportion mediated (%)
Model 1[b]	**Path A1**	.71	.02	< .001	[.67, .75]	--
	Path A2	.05	.05	.311	[-.04, .14]	--
	Path D	.57	.05	< .001	[.48, .67]	--
	Path B1	.09	.06	.115	[-.02, .20]	--
	Path B2	.40	.03	< .001	[.34, .47]	--
	Path A1DB2 (indirect effect)	.16	.02	--	[.13, .21]	149%[d]
	Path C (total effect)	.11	.03	<.001	[.05, .17]	.115
	Path C' (direct effect)	-.14	.05	.003	[-.22, -.05]	.250
Model 2[c]	**Path A1**	.65	.02	< .001	[.62, .69]	--
	Path A2	.05	.04	.170	[-.02, .13]	--
	Path D	.38	.04	< .001	[.29, .46]	--
	Path B1	.03	.05	.472	[-.06, .12]	--
	Path B2	.14	.03	< .001	[.08, .20]	--
	Path A1DB2 (indirect effect)	.03	.01	--	[.02, .06]	1221%[d]
	Path C (total effect)	-.003	.02	.902	[-.05, .04]	.532
	Path C' (direct effect)	-.07	.04	.068	[-.14, .005]	.543

NOTE: Path A1 = BMI to perceived weight; Path A2 = BMI to weight stigma concerns; Path D = perceived weight to weight stigma concerns; Path B1 = perceived weight to depressive symptoms; Path B2 = weight stigma concerns to depressive symptoms; Path A1DB2 = indirect effect of BMI on depressive symptoms through perceived weight and weight stigma concerns; Path C = relationship between BMI and depressive symptoms when perceived weight and weight stigma concerns are not present in the model; Path C' = relationship between BMI and depressive symptoms when perceived weight and weight stigma concerns are included in the model.

[a] Analyses of indirect effect calculated on Z-scores for all continuous variables (age, BMI, weight stigma concerns, depressive symptoms, perceived weight discrimination, neuroticism, and overeating).

[b] Adjusted for age (Z-scored), gender, ethnicity (white, other), income, education, presence of chronic illness, and study of origin.

[c] Adjusted for variables listed for Model 1, plus neuroticism, perceived weight discrimination, and overeating (Z-scored).

[d] In both analyses > 100% of the direct effect was explained because when controlling for all variables the association between BMI and depression became negative in direction.

6.5 Discussion

Based on the present study, the cross-sectional relationship between BMI and depressive symptoms is explained by self-perceived weight and weight stigma concerns. The results of the present study emphasise the role of the mere *concern* over being susceptible to stigmatisation or discrimination by others because of one's body weight. Previous research has linked self-perceived overweight to depressive symptoms (Daly et al., 2017), and the present study suggests that weight stigma concerns may explain this link. More generally, we propose that the link between BMI and depression may be explained by people of heavier body weight being more likely to self-identify themselves as being 'overweight', which in turn causes them to fear stigma from others because of their body size, a line of reasoning fitting in with existing theoretical models of weight stigma (Hunger et al., 2015; Tomiyama, 2014). This highlights the need for challenging stigma in various settings to change societal attitudes and improve wellbeing of individuals with overweight and obesity. Among healthcare providers, for example, weight bias is frequent, and can impact patients' well-being by causing distress, poor adherence and mistrust in healthcare providers (Phelan et al., 2015). Our results suggest that mental health care and medical professionals should pay attention to psychological aspects of stigma and body image in individuals with overweight and obesity, as these factors are associated with depressive symptoms.

A strength of the present study is that the findings relied on a large sample and were robust when controlling for a range of psychological and behavioural confounders. However, there are some limits to address. Ethnicity had to be reduced to a dichotomous variable ('White' Vs. 'Other') in order to be controlled for in our

analyses, however there is evidence in the literature of how weight perception can vary across different races/ethnicities (Dorsey et al., 2009; Fletcher, 2014; Paeratakul et al., 2002). Testing our model in diverse ethnic groups of individuals would be beneficial. Another limitation of the present study is the use of self-reported data that is prone to bias (Paulhus & Vazire, 2007). Further, the cross-sectional design does not allow reverse or bidirectional relationships between the variables of interest to be ruled out, and examining evidence for our proposed model using longitudinal data would now be valuable to evaluate the proposed temporal interpretation. Moreover, while the relationship between BMI and depressive symptoms was positive and significant as expected, this relationship was unexpectedly negative when accounting for our explanatory variables. This may suggest that after accounting for self-perceived overweight and weight stigma concerns that are common among people of heavier body weight, very slim individuals may be more likely to experience depressive symptoms than those of heavier body weight. There is evidence of a U-shaped association of BMI with depression (De Wit, Van Straten, Van Herten, Penninx, & Cuijpers, 2009). Furthermore, previous literature has reported an inverse association between BMI and depression, known as the "Jolly fat phenomenon" (Crisp & McGuiness, 1976), which occurs among older people (Jasienska, Ziomkiewicz, Górkiewicz, & Pająk, 2005; Li et al., 2004). However, we were not powered enough to test for potential mediators in our analyses. Alternatively, there are methodological explanations that could account for the significant small negative relationship between BMI and depression. One is that, considering the small sizes of the effects we found (e.g. in Model 1, path C' β = -.14, p = .003, and path C β = .11, p < .001), the significance reached in the negative association between BMI and depression may be a statistical artefact (Levine, Weber, Hullett, Park, & Lindsey, 2008). Another possible

explanation, as suggested by Zhao and colleagues, may be that while our mediators are consistent with the theoretical model tested, another mediator may have been omitted from the direct path (Zhao, Lynch, & Chen, 2010), and might hence account for a suppression effect causing the negative relationship between BMI and depression. One example could be healthy coping strategies, a variable we did not control for, but which has been found to be a mediator in the negative relationship between weight stigma experiences and depression (Himmelstein, Puhl, & Quinn, 2018).

Finally, while there is published evidence on the importance of weight stigma concerns for psychological health (Hunger & Major, 2015), other stigma-related variables may also explain the association of BMI with depression. One might be internalised weight bias, which has been reported to be associated with depression (Carels et al., 2010; Pearl, White, & Grilo, 2014) and BMI (Carels et al., 2010). Overeating is another potential mediator to be included in the path analysis rather than as a control variable, as it has reported a bidirectional association with depression (Skinner et al., 2012); the stressful effect of weight stigma concerns might hence lead to overeating, which in turn would lead to more depressive symptoms. Examination of plausible moderators (such as age, ethnicity, and gender) or other plausible mediators (such as internalised weight bias, overeating, and coping strategies) of the relationships tested in this study will be a useful direction for potential future research.

6.7 Conclusions

Perceptions of weight status and concerns over experiencing weight-based stigma may be responsible for the poorer mental health associated with heavier body weight.

Chapter 7: General discussion

7.1 Introduction

The main aim of this thesis was to explore how weight perception and weight stigma concerns are associated with health behaviours and psychological well-being. The interplay between weight perception and weight stigma concerns has been assessed across seven studies, examining their associations with attitudes towards risky health behaviours among young adults (Chapter 2), eating behaviours (Chapter 3 and 4), weight loss outcomes (Chapter 5), and depressive symptoms (Chapter 6).

7.2 Overview of the studies

Chapter 2 examined the role of weight perception and weight stigma concerns on the endorsement of risky health behaviours among young adults in two laboratory-based studies. Through the use of a remote confederate design involving a computer task, the chapter assessed whether participants with self-perceived overweight (Study 1) or manipulated perceived overweight (Study 2) exhibited heightened attitudinal conformity towards risky peer behaviours due to concerns of being stigmatised because of their weight. Study 1 was a pilot study and found that participants exhibited a tendency to report a greater endorsement of risky health behaviours when exposed to a person endorsing positive attitudes towards risky health behaviours. However, there was no evidence of greater attitudinal conformity to risky health behaviours among individuals who perceived their weight status as overweight, compared to those who perceived their weight status as normal weight.

The results and limitations from Study 1 informed Study 2. Study 2 included a more specific measure of weight stigma concerns, and the use of a bodysuit to experimentally manipulate weight perception. The hypothesis was that participants in the manipulated perceived overweight condition would be more likely to conform to a confederate's risky attitudes compared to participants in the perceived normal weight condition. Once again, there was evidence for a tendency towards conforming to peers' attitudes toward risky health behaviours. There was also evidence that a manipulated self-perception of overweight was associated with higher weight stigma concerns compared to a self-perception of normal weight. However, Study 2 also did not find evidence that weight perception affected conformity to risky health behaviours. Chapter 2 indicates that a self-perception of overweight does not result in heightened attitudinal conformity towards risky peer health-related behaviours due to a concern of being stigmatised because of one's own perceived weight.

Chapter 3 examined data from two online studies to assess the indirect effect of weight stigma concerns in the relationship between weight perception and overeating in the general population. The results showed that perceived overweight was associated with heightened weight stigma concerns, which in turn was associated with overeating tendencies. The association was tested controlling for demographic and psychological variables that could theoretically confound the relationship studied, as well as for experiences of perceived weight discrimination, in order to isolate the effect of weight stigma concerns independently from experiencing discrimination. In all analyses, weight stigma concerns was a significant mediator in the relationship between perceived overweight and overeating tendencies, regardless of gender and weight perception accuracy.

After assessing the role of weight stigma concerns and overeating tendencies in the general population in Chapter 3, Chapter 4 explored whether weight stigma concerns are associated with overeating among bariatric surgery patients. In this specific population, overeating was measured as grazing, which is a tendency for consuming small portions of food in a repetitive manner (Conceição et al., 2014). The results showed that weight stigma concerns was not a significant predictor for grazing tendencies when controlling for other factors. Weight perception was also not a significant predictor of grazing tendencies. However, internalised weight bias was found to be a significant predictor of grazing tendencies in this post-bariatric population, along with depression, and amount of weight regained after bariatric surgery.

Chapter 5 examined the impact of weight perception and perceived weight discrimination on weight-loss outcomes through the analysis of secondary data from a 12-week weight-loss trial. The hypothesis tested was that a higher perceived weight and more experiences of perceived weight discrimination measured before the start of the weight-loss program would predict the amount of weight lost at the end of the intervention. The results did not support the hypotheses; a higher perceived weight and perceived weight discrimination were not associated with the amount of weight lost after a 12-week weight-loss intervention.

Finally, using an analysis of secondary data from Chapter 3, Chapter 6 explored and found support for the hypothesis that a heavier perceived weight and weight stigma concerns may fully explain the well-established relationship between BMI and depressive symptoms. Both when controlling for demographic variables and for significant psychological and behavioural factors, Chapter 6 showed that individuals

with a higher BMI report a higher self-perceived weight, which is in turn associated with greater weight stigma concerns and more depressive symptoms.

7.3 Theoretical implications

The findings from the studies reported in this thesis have several implications. There has been a growing emphasis placed on a correct perception of the overweight status in order to support a healthy lifestyle (Duncan et al., 2011; Edwards et al., 2010; Lebrun et al., 2013; Yaemsiri et al., 2011). However, self-perception of overweight is actually associated with several negative outcomes such as overeating, poor weight management, and weight gain (Haynes et al., 2018), depression (Haynes et al., 2019), and risky health behaviours among adolescents (Jiang et al., 2014, 2012). The reason for these counter-intuitive findings could be the growing stigma placed on people with overweight (Puhl & Heuer, 2009). It has been theorised that the stressful experience of weight stigma could trigger a series of behavioural, physiological, and emotional responses that would lead to overeating and weight gain (Tomiyama, 2014). Further to that, it has been hypothesized that a perceived identity threat due to one's own weight can also be activated when stigma is suspected, and could therefore be a consequence of a self-categorization as 'overweight' (Hunger et al., 2015). Together, these two factors could explain the negative health and psychological outcomes that have been found to be associated with perceived overweight (Haynes et al., 2018, 2019, Jiang et al., 2014, 2012), as well as with weight stigma (Hatzenbuehler et al., 2009; Jackson et al., 2014; Papadopoulos & Brennan, 2015; Robinson, Sutin, et al., 2016; Schvey et al., 2014; Sutin & Terracciano, 2013). The findings from this thesis provide some evidence that self-perceived overweight and weight stigma concerns may contribute to poorer health outcomes.

Results from Chapter 3 and 6 are in line with the weight-based identity threat model theorised by Hunger and colleagues (Hunger et al., 2015), presenting novel evidence on how the awareness of weight-based stigma may cause people who perceive themselves as 'overweight' to experience increased concern over being stigmatised due to their weight, which in turn may negatively impact their behaviours and psychological health. Chapter 3 challenges the previously published literature on the use of weight stigma as a way to motivate weight management (Bayer, 2008; Callahan, 2013) by highlighting the potentially damaging association between overweight perception and weight stigma concerns with overeating tendencies. More specifically, Chapter 3 makes a novel contribution by showing that the association found in literature between perceived overweight and disordered eating (Haynes et al., 2018; Saules et al., 2009), as well as between weight stigma and disordered eating (Major et al., 2014; Puhl & Luedicke, 2012; Puhl & Suh, 2015; Schvey et al., 2011) may be explained by the mediating effect of weight stigma concerns. Likewise, Chapter 6 provides the first evidence on the mediating role of perceived weight and weight stigma concerns in explaining the association between BMI and depressive symptoms previously reported in literature (De Wit et al., 2010; Luppino et al., 2010).

Taken together, results from Chapters 3 and 6 expand the evidence on the mediating role of weight stigma concerns in the association between BMI and psychological and physical health reported by Hunger and Major (Hunger & Major, 2015) by introducing the role of perceived overweight. This thesis argues that people of heavier body weight are more likely to perceive their weight as overweight, which in turn leads them to expect social rejection (weight stigma concerns) from others, which in turn impacts on their physical and psychological well-being (Hunger & Major, 2015). This mechanism also fits with the Cyclic Obesity/Weight-Based Stigma

model theorised by Tomiyama (Tomiyama, 2014) by giving further evidence on the stressful effect of weight stigma and, more specifically, of weight stigma concerns.

The potential effect of weight stigma concerns on overeating tendencies, however, are only partially supported by findings from Chapters 4. While there is evidence on how bariatric surgery participants can still be discriminated because of their former weight (Fardouly & Vartanian, 2012), in this study weight stigma concerns was not a significant predictor of overeating tendencies. Instead, Chapter 4 shows how internalised weight bias was associated with grazing tendencies after surgery, a result supported by previous research (Raves et al., 2016). Similarly, Chapter 5 found no evidence on the hypothesized effect of perceived weight and perceived weight discrimination on amount of weight lost after a weight-loss program, in discordance with some previous studies (Carels et al., 2014; Haynes et al., 2018; Hübner et al., 2016; Latner et al., 2009; Robinson et al., 2015; Wott & Carels, 2010). Chapter 4 suggests that weight stigma concerns play a role in predicting negative consequences of weight discrimination only when a person believes the negative stereotypes associated with the overweight status to be true about themselves (internalized weight stigma). There is a small amount of evidence on the mediating role of internalized weight stigma in the association between weight stigma and disordered eating (Durso et al., 2012). These findings, along with results from Chapter 4 and 5, could indicate that the weight-based identity threat model theorised by Hunger and colleagues (Hunger et al., 2015) may need to be revised in order to incorporate internalised weight bias as a key pathway linking heavier body weight to worse health outcomes.

Finally, despite some previous studies reporting an association between endorsement of risky behaviours and perceived overweight among young people (Jiang et al., 2014, 2012), as well as with weight stigma (Hatzenbuehler et al., 2009;

Papadopoulos & Brennan, 2015), Chapter 2 did not find support for the hypothesis that self-perception of overweight is associated with a heightened attitudinal conformity towards risky peer behaviours due to weight stigma concerns. These findings may suggest that weight stigma concerns are associated with risky behaviours through mechanisms that are not related to conformity. Considering how drinking (Hatzenbuehler et al., 2011), smoking (Parker et al., 2016), substance abuse (Reisner et al., 2015), and unprotected sex (Han et al., 2014), are common coping mechanisms among people belonging to different stigmatised groups, it could be that people who perceive their weight status as overweight engage in these risky health behaviours as a coping mechanism. Alternatively, the increased likelihood of risky behaviours among people who perceive themselves as 'overweight' could be due to ego-depletion. In fact, it has been previously shown that when exposed to stigma, people report poorer physical self-regulation (Inzlicht et al., 2006). Furthermore, a study from Major and colleagues reported that exposure to weight stigma leads people who perceive their weight status as overweight to consume more calories and feel less capable of controlling their food intake (Major et al., 2014). The self-control model proposes that exerting self-control for a long time can strain one's own ability to regulate their behaviours in the long term (Baumeister, Vohs, & Tice, 2007). Furthermore, ego-depletion increases risk taking (Fischer et al., 2012) and unhealthy habits such as heavy drinking among social drinkers (Christiansen et al., 2012). So, ego depletion could cause people who perceive themselves as 'overweight' to be less able to regulate health behaviours.

7.4 Applied relevance

Results from this thesis have several implications on weight management, well-being, and weight stigma in modern society, and support the idea that the psychosocial experience of overweight may be a contributor to the obesity epidemic. Chapter 2 showed how manipulating a self-perception of overweight can result in heightened weight stigma concerns. Further to that, despite individuals with overweight and an accurate weight perception being more willing to attempt weight loss (Lebrun et al., 2013; Yaemsiri et al., 2011), studies find a consistent association between overweight perception and increased weight gain (Haynes et al., 2018). Findings from Chapter 3 explain this association by showing how self-perceived overweight is associated with overeating tendencies due to weight stigma concerns, suggesting that a self-perception of overweight may not be beneficial for weight management. Findings from this thesis also contradict the idea that weight stigma could be beneficial for weight management (Bayer, 2008; Callahan, 2013). Chapters 3 and 4 highlight how, both in general and clinical populations, weight stigma is associated with overeating tendencies, as well as with poorer psychological well-being (Chapter 6). Although Chapter 5 did not find support the positive association between perceived weight discrimination and amount of weight loss after a 12-week intervention, the association between weight stigma and overeating found in Chapters 3 and 4 suggests that patients from weight-loss interventions could face the risk of regaining excess weight due to weight stigma.

Several preventive programs focus on correct monitoring and communication of patients' weight status in healthcare practice (Stegenga, Haines, Jones, & Professor, 2014). Even in schools, children's weight status are regularly monitored (Ruggieri & Bass, 2015), despite some authors suggesting that monitoring child BMI might put them at a higher risk of being stigmatised because of their weight (Nihiser et al., 2007).

Given that a self-perception of overweight is likely to come with feelings of shame (Garip & Yardley, 2011), and considering how weight-related shame is linked to avoidance and social withdrawal (Conradt et al., 2008), interventions aimed at addressing the obesity epidemics should consider alternative strategies. Furthermore, current public health approaches may reinforce the idea that overweight is a consequence of personal responsibility (Saguy, Frederick, & Gruys, 2014; Täuber et al., 2018). This itself may cause weight stigma concerns among people of heavier body weight and affect psychological well-being, as suggested by the results from Chapter 6.

On a public level, putting an end to the stigmatising depiction of people with overweight in the media (Ata & Thompson, 2010) is needed. There is a reported need among people with overweight for a better understanding over the struggle of weight loss both from society and from friends and relatives (Puhl, Moss-Racusin, Schwartz, & Brownell, 2008). Providing more consensus on the causes of obesity that are beyond a person's control has been shown to improve attitudes towards people with overweight, and to reduce weight bias (Puhl, Schwartz, & Brownell, 2005; Vartanian & Fardouly, 2014). Some educational interventions have also been shown to reduce anti-fat bias among health professionals (Rukavina, Li, & Rowell, 2008). Moreover, healthcare professionals could be mindful to use non-stigmatising language when addressing the issue of overweight, as it has been found to have an impact on patients' motivations for weight loss (Puhl, Peterson, & Luedicke, 2013). A key issue remains the communication of weight status, as this thesis provides evidence that identifying oneself as overweight might be detrimental to physical (Robinson et al., 2015; Romano et al., 2018) and psychological health (Haynes et al., 2019). A rising suggestion in medical practice is to rely on different health markers rather than BMI:

a recent study by Tomiyama and colleagues, for example, reported how using BMI as the main indicator of health comes with a high risk of misclassifying adult patients as cardiometabolically healthy or unhealthy (Tomiyama, Hunger, Nguyen-Cuu, & Wells, 2016). On the contrary, health markers such as fitness and body fat percentage (Ortega et al., 2013), or cardiometabolic risk factors or waist circumference (Plourde & Karelis, 2014), seem more reliable than BMI, which has proved low sensitivity when it comes to predict actual adiposity (Okorodudu et al., 2010). The results of this thesis hence further confirms the importance of using alternative health markers to body weight in healthcare practice.

In terms of health interventions, promoting healthier behaviours could be more beneficial than highlighting the importance of weight loss and perceived overweight. Specifically, an approach known as "Health at Every Size", which emphasizes self-acceptance and healthy day-to-day practices rather than focussing on weight change (Burgard, 2009), has reported to have several beneficial effects. This approach has been found to come improvements in eating patterns such as disinhibition and hunger (Provencher et al., 2009). Furthermore, a study on women with overweight and obesity found that, in the long term, participants who took part in the "Health at Every Size" intervention were more likely to maintain their weight loss, as well as to keep reporting improvements in terms of binge eating, quality of life, and body esteem, compared to participants in control conditions (Gagnon-Girouard et al., 2010).

On an individual level, people with overweight (or who perceive themselves as such) could also benefit from coping strategies to avoid falling into disordered eating habits or risky health behaviours. Literature suggests that overeating can be a coping mechanism to deal with negative emotions (Ward & Hay, 2015), and stigma (Puhl & Brownell, 2006). Given how stress-induced overeating partially explains the

association between overweight perception and weight gain in the general population (Robinson et al., 2015), and considering the mediating role of emotion dysregulation on the association between internalised weight bias and emotional eating (Baldofski et al., 2016), people with overweight perception could also benefit from learning alternative coping strategies to deal with stress. Furthermore, programs that help reducing the internalization of unattainable body ideals promoted by modern society may be beneficial. The Body Project, for example, is a dissonance-based program aimed at criticizing the thin ideal among women, and the intervention has been found to be associated with reductions in thin-ideal internalization, body dissatisfaction, and eating disorder symptoms (Stice, Rohde, Gau, & Shaw, 2009).

7.5 Limitations

There are some shared limitations across the studies reported in this thesis. Despite the efforts to use validated measures, such as the scale used to assess grazing tendencies in Chapter 4, there were not validated versions of some measures used (e.g. the weight stigma concerns scale). Further to that, all studies relied on self-reported measures, which are known to be prone to bias (Paulhus & Vazire, 2007). Concerning the samples used, most participants were Caucasian and despite controlling for ethnicity in analyses, results are not representative of the general population. Finally, all studies except for Chapter 5 rely on cross-sectional results, hence making reverse causality a possibility in our findings. Longitudinal research to examine temporal order of relationships between stigma and health outcomes is now warranted.

The limits reported in Chapter 2 are mainly related to the laboratory studies design. First, the use of a bodysuit may be considered as an unrealistic way to

manipulate a self-perception of overweight, as it is incapable of fully mirroring the psychological effects of living with obesity and poses some ethical issues on its use in the research around weight stigma (Meadows et al., 2017). Moreover, although participants expected to meet another person at the end of the study, the whole experiment came with the lack of visual exposure to other people. Previous studies, have found an effect for increased concerns of social rejection when participants' weight was actually visible during the experiment (Blodorn et al., 2016). Further to that, while the computer-based tasks asked for participants' attitudes towards risky behaviours, it did not assess their actual behavioural conformity (Merton, 1959) nor informational or normative influence (Deutsch & Gerard, 1955). Creating a more ecological setting to assess behavioural conformity, could provide a more solid base to test role of conformity as an explanation for the associations of risky behaviours with perceived overweight (Hatzenbuehler et al., 2009; Jiang et al., 2014, 2012; Papadopoulos & Brennan, 2015).

The statistical models tested in Chapters 3 and 6 linking weight perception to health outcomes through stigma concerns considered several demographic, psychological, and behavioural confounders, relied on large sample sizes, and results from Chapter 3 were replicated across two different studies while also testing for the moderating roles of gender and weight perception accuracy. However, the variables did not include other factors that have found to be associated with overeating tendencies, such as internalised weight bias (Puhl et al., 2007), and could not account for physiological mechanisms which could explain the effect of weight stigma concerns on overeating (Tomiyama, 2014). Finally, given the bidirectional association of overeating with depression (Skinner et al., 2012), including both of them in the path analysis for Chapters 3 and 6, rather than controlling for them, would have provided a

better narrative through the chapters, offering a better overview of the co-occurring of behavioural and emotional correlates of weight stigma concerns reported in this thesis.

In Chapter 4 the sample was relatively large, but only included participants who underwent weight-loss surgery and were members of support groups. This means that the results cannot be generalised to the clinical population of all bariatric surgery patients and might be biased towards those patients who did not regain weight. Furthermore, the fact that participants were involved in support groups accounts for a source of social support that could not be assessed in the study, but which has been found to be associated with weight loss after bariatric interventions (Livhits et al., 2011). Furthermore, the lack of a follow-up does not allow us to test whether internalised weight bias and weight stigma concerns might hold a different effect on grazing tendencies among post-bariatric surgery participants once they are not part of a support group anymore (i.e. these variables may start to have a more influential effect once social support is removed).

Finally, it is important to address the limitations and implications of investigating weight stigma concerns in a group of participants with normative weight (Chapter 2) or of different weight categories (Chapters 3 and 6). While results from this thesis suggest that the impact of a self-perception of overweight on health behaviours via weight stigma concerns is valid when controlling for BMI (Romano et al., 2018), it is important to point out that previous research has reported manipulated stigmatization to cause stress and self-consciousness in participants of higher weight, but not among those of normal weight (Blodorn et al., 2016). Taken together, this suggests that weight stigma might affect both people of higher and normative weight, however in different ways. This posits a strong limit to the generalization of some of our findings, and should be further addressed in future research.

7.6 Future directions

The studies presented in this thesis provide evidence on the association between overweight perception and weight stigma concerns theorised by Hunger and colleagues (Hunger et al., 2015), suggesting mechanisms by which perceived overweight can lead to weight gain (Haynes et al., 2018) and poor psychological well-being (Haynes et al., 2019), and by which weight stigma may promote obesity (Tomiyama, 2014). However, there are further areas where more research is needed in order to better understanding the associations between weight perception, weight stigma concerns, and their consequences on psychological and physical well-being.

Future studies with longitudinal designs could build on the findings on the consequences of weight stigma concerns reported in Chapters 3, 4, and 6, which rely on cross-sectional designs. A study design involving several, longer follow-ups might also shed light on the null results on the effect of weight perception and weight stigma on weight-loss outcomes reported in Chapter 5. Studies reporting a positive association between weight perception and weight gain in the general population rely on follow-ups of several years (Robinson et al., 2015), which could also be needed to examine the role of weight perception on weight change and weight loss maintenance among participants from weight-loss trials. Furthermore, there are inconsistent findings on the association between weight stigma and weight loss after a weight-loss intervention, with some studies reporting a positive association (Carels et al., 2014; Latner et al., 2009) and other reporting a negative one (Hübner et al., 2016; Wott & Carels, 2010). A longitudinal study could therefore examine whether experiences of weight discrimination have different effects on weight change during different stages of weight management. Specifically, whether weight stigma concerns may act as a

motivator for losing weight initially and/or whether they are detrimental to weight management after initial weight loss.

Moreover, while results from this thesis report evidence on the associations between weight stigma concerns and weight perception, future research could investigate the *mechanisms* by which these variables may affect psychological and physical health. One example could be coping strategies. The association between perceived overweight and weight stigma concerns with overeating found in Chapter 3 might be the result of a coping strategy to deal with the negative affect associated with weight stigma concerns. Likewise, since Chapter 2 did not report increased attitudinal conformity towards risky behaviours as a way to avoid weight discrimination among people with overweight, coping strategies may also explain the association of risky behaviours with perceived overweight (Jiang et al., 2014, 2012) and weight stigma (Hatzenbuehler et al., 2009; Papadopoulos & Brennan, 2015). Alternatively, another mechanism that the studies in this thesis did not investigate are the physiological processes caused by the stress of weight stigma concerns, which could lead to the depressive symptoms associated with it, as suggested in Chapter 6. There is evidence on how high levels of cortisol can stimulate appetite and drive people to consume highly caloric food (Epel et al., 2001), which would explain the association of weight stigma with overeating tendencies reported in Chapters 3 and 4. Similarly, physiological mechanism could explain the risky behaviours which have been found to be associated with weight perception and weight stigma (Hatzenbuehler et al., 2009; Jiang et al., 2014, 2012; Papadopoulos & Brennan, 2015). Because weight perception (Himmelstein, Incollingo Belsky, & Janet Tomiyama, 2015) and weight stigma (Janet Tomiyama et al., 2014) are positively associated with biochemical stress, and since physiological processes mediate the relationship between exposure to stressors and

responsiveness to drugs of abuse (Der-Avakian et al., 2006), it may be that the stress of weight stigma increases responsiveness to addictive substances, as well as the likelihood of engaging in risky health behaviours such as drinking, smoking and substance use.

Finally, the role of weight stigma concerns could be further investigated as related to other psychological behaviours linked to weight gain. For example, some studies have found an association between overweight perception and exercise avoidance, but the results are mixed (Shamaley-Kornatz, Smith, & Tomaka, 2007; Southerland et al., 2013; Yancey et al., 2006). The inconsistency may be explained by differing levels of weight stigma concerns. Furthermore, considering how this thesis examined the damaging consequences of weight stigma concerns, further research on potential solutions or barriers to such consequences is needed. For example, social support and positive self-talk are coping strategies that have been found to be used to deal with weight-based discrimination, and to be associated with lower levels of depression and enhanced self-esteem (Puhl & Brownell, 2006).

Finally, while Chapter 3 and 6 provided evidence on the association of overweight perception with weight stigma concerns, and of weight stigma concerns with negative outcomes such as overeating and depressive symptoms, Chapter 4 indicates that internalised weight bias may also play an important role. Future studies may benefit from exploring how internalised weight bias may interact with or explain the associations between overweight perception, weight stigma concerns, and negative psychological and physical consequences. Research has already found evidence for an association between being labelled as ‘overweight’ and internalised stigma, such that people labelled as ‘overweight’ report higher internalised weight bias (Essayli, Murakami, Wilson, & Latner, 2016). Moreover, previous studies have reported that

internalised weight bias moderates the association between BMI and health-related quality of life (Latner, Barile, Durso, & O'Brien, 2014). Internalised weight bias could hence moderate the association between overweight perception and weight stigma concerns too, so that people with overweight may be most likely to report an increased concern over being stigmatised because of their (perceived) weight if they have internalised the negative stereotypes associated with overweight. Understanding the extent to which people with overweight believe in or have internalised the negative stereotypes associated with obesity may also help in explaining whether weight perception is detrimental to health for some people or a motivator for healthy change in others.

7.7 Conclusions

Findings from this thesis provide several original contributions to the existing literature on weight perception, weight stigma, health behaviours, and psychological and physical well-being. One of the main contributions made is the examination of the role that weight stigma concerns appear to have in linking weight perception to health behaviours (overeating tendencies) and psychological health (depressive symptoms). Furthermore, this thesis suggests how in certain populations (e.g. post-bariatric surgery patients), other constructs related to the psychosocial experience of living with overweight (e.g. internalised weight bias) might be more important determinants of health outcomes compared to weight stigma concerns and weight perception. Therefore, this thesis highlights the need to consider different aspects related to the experience of carrying excess weight, in order to understand how the stigma placed on obesity may negatively impact health. Finally, this thesis provides consistent support for the need to tackle the pervasive weight bias in our society.

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APPENDICES

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Appendix I: Supplementary material for Chapter 2

Study 1

Additional measures.

Self-esteem. Self-esteem was assessed using Rosenberg's Self-Esteem Scale (Rosenberg, 1965) (Rosenberg, 1965), a 10-item scale (e.g. *'I feel that I am a person of worth, at least on an equal plane with* others') with a 4-point Likert-type ranging from *'Strongly Agree*' to *'Strongly Disagree'*. Responses were summed to provide a self-esteem score ranging from 0 to 30. Internal consistency for the present study was good ($\alpha = .83$).

Self-Objectification. Self-Objectification was assessed using the Self-Objectification Questionnaire (SOQ) (Noll & Fredrickson, 1998). The SOQ aims to measure concern with one's appearance without an evaluative or judgmental component. It contains ten items, five of which are appearance-based (i.e., weight, sex appeal, physical attractiveness, firm/sculpted muscles, and measurements) and five of which are competence-based (i.e., physical coordination, health, strength, energy level/stamina, and physical fitness level). Individuals completed the questionnaire by ranking the importance of each attribute to their physical self-concept, where the attribute with the greatest importance receives a score of nine and the attribute with the least importance receives a score of 0. A total self-objectification score was calculated by subtracting the sum of the competence-based items from the sum of the appearance-based items, with possible total scores ranging from -25 to +25. Positive scores reflect greater emphasis on one's physical appearance (Noll & Fredrickson, 1998).

Computer-based facial recognition task.

The correct interpretation of facial expression is a core component of social interactions. However, it has been found that judgement of facial expressions can be altered under certain conditions. People with depression, for example, seem more prone to misinterpret neutral faces as sad and happy faces as neutral (Gur et al., 1992), while participants with social anxiety have reported poor sensitivity for the negative facial expressions of anger and disgust (Montagne et al., 2006). We hypothesized that, due to an expectation of social rejection (Blodorn et al., 2016), participants who perceived themselves as overweight would also present an evaluation bias when presented with neutral faces, and be more likely to interpret them as signalling social rejection (such as anger or disgust) when compared to perceived normal weight participants. To test whether self-perception of overweight induces a bias toward interpreting facial expressions, participants completed a computer task on emotional judgement, where they were asked to evaluate the emotion (anger or disgust) portrayed by different faces presented on the screen, with emotions being displayed at different levels of intensity. The task was run at the end of the experiment, after participants completed the aim-awareness check, manipulation check, confederate suspicion check, and awareness of conformity check related to the study on endorsement of risky behaviours.

Methods.

Materials.

Participants completed two 2-alternative forced choice emotional judgment tasks which were programmed in PsychoPy (Peirce, 2007). The tasks were used to assess participants' perceptual biases in the interpretation of facial expressions as 'angry' and 'disgusted', respectively. In each task, participants were presented with a series of facial expression images at varying levels of emotional expression. Facial stimuli were selected from the NimStim database (Tottenham et al., 2009) and were made of up four angry faces, four disgusted faces, and 8 neutral faces of the same identity (8 different individuals in total: 2 males and 2 females for each emotion). The neutral and emotional expression faces from the same individual were morphed using Fantamorph software (Abrasoft, Lincoln, NE, USA) to create a systematic gradient of 6 emotional intensities. Emotions ranged from 0% (neutral) to 100% extreme affect separated by 20% intervals of increasingly disgusted or angry facial expressions. Procedurally, the tasks were identical except that in one task, participants judged whether the series of disgusted-neutral morphed facial expressions displayed *"neutral"* or *"disgust"* expressions, and the other, whether the series of angry-neutral morphed facial expressions displayed a *"neutral"* or *"angry"* facial expression. To each facial expression, participants were asked to respond as quickly and as accurately as possible with the left (*'z'*) or right (*'m'*) key marked on the keyboard, corresponding to the position of the category label (*"neutral"* and *"angry"* in the anger task, and *"neutral"* or *"disgust"* in the disgust task). Each trial began with a black background with a white fixation-cross shown in the middle, with two category labels (one in the top left, and one in the top right corners of the screen, neutral and emotion category label positions counterbalanced across participants). After a 500ms fixation period, a facial

image (400 x 513 pixels) was presented in the centre of the screen for 100ms. Participants were asked to respond to each face by indicating which category it belonged to, by pressing the key corresponding to the appropriate emotion label. After a response was recorded, the next trial began. The order of presentation of each of the faces was randomised. Each task consisted of 240 trials (4 identities x 6 emotional intensities x 10 repeats), and took approximately 6 minutes to complete.

Planned analysis.

We ran a 2 (between-subjects factor, weight perception: perceived overweight, perceived normal weight) X 6 (within-subjects factors, levels of emotion intensity in the pictures: 0%, 20%, 40%, 60%, 80%, and 100% intensity) mixed ANOVA with the ratio of positive answers (faces perceived as either *'anger'* or *'disgust'*) on total of answers to the task. We expected participants in the perceived overweight condition to score significantly higher on fear of negative evaluation when compared to perceived normal weight people, and to be more likely to report a face as either signalling anger or disgust when compared to perceived normal weight participants.

Results.

Results for the 2 X 6 mixed ANOVA for the facial recognition task are shown in Figures I.1 and I.2. Our analyses violated the assumption of sphericity for the main effect of intensity, as reported by Mauchly's test both for evaluation of angry faces, χ^2 (14) = 142.25, p <.001, and of disgusted faces, χ^2 (14) = 203.56, p <.001. Degrees of freedom were therefore corrected using Greenhouse-Geisser estimates of sphericity, ε = .48 for both anger and disgust. There was only a significant main effect of intensity

both for anger, F (2.40, 129.39) = 927.97, p <.001, η_p^2 = .95, and disgust, F (2.43, 128.91) = 737.27, p <.001, η_p^2 = .93. We found no evidence of between-subjects effect. There was a constant and significant increment in the responses for emotion intensity for both anger and disgust (see Figures I.1 and I.2). All pairwise comparisons between intensity levels were significant ($p \leq .001$) with the exception of the contrast for disgust between 0% and 20% emotion intensity (mean difference = -.03, *SE* = .01, p = .055, d = .41) and between 80% and 100% emotion intensity (mean difference = -.01, *SE* = .01, p > .999, d = .19).

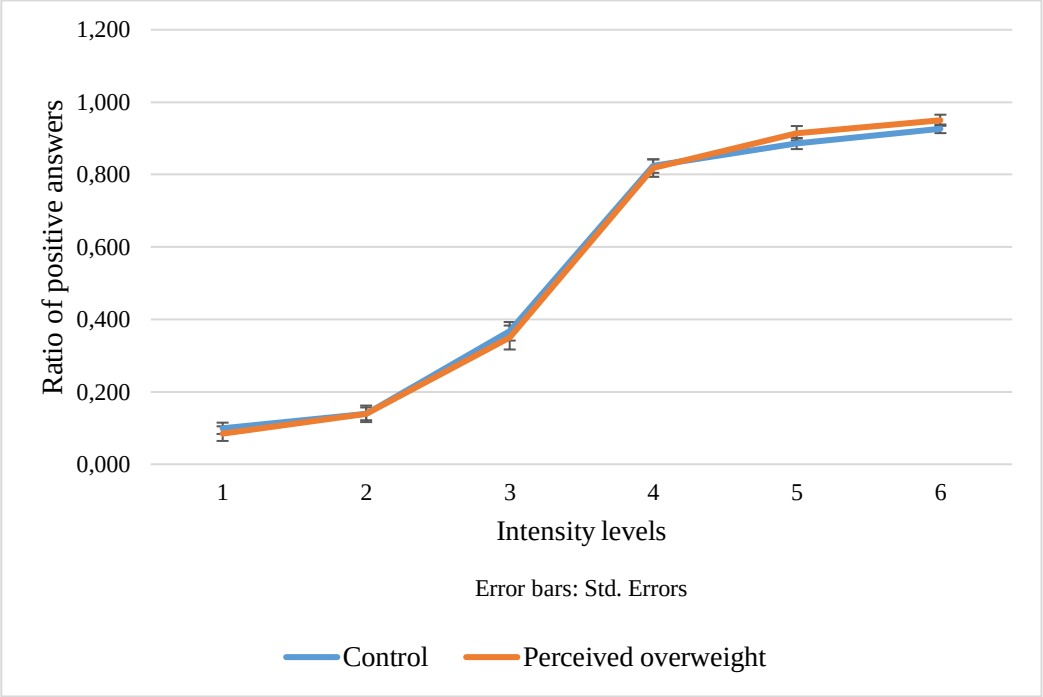

Figure I.1. Results for the 2 X 6 Mixed ANOVA for Anger. Results indicate the ratio of positive answers (Anger over Neutral) as the emotional intensity of the faces presented increases.

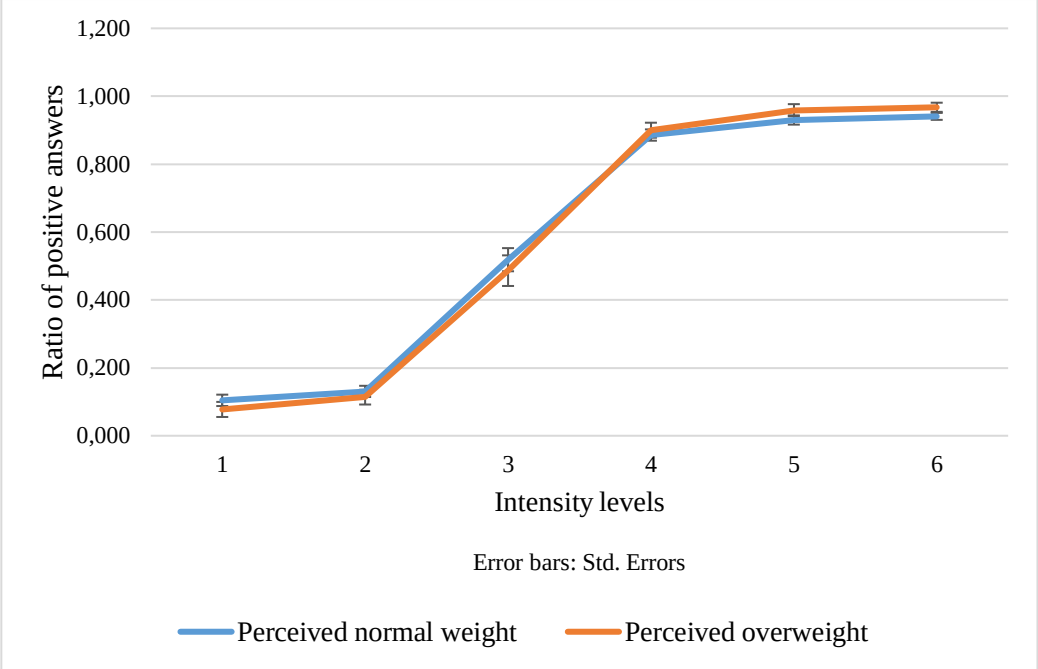

Figure I.2. Results for the 2 X 6 Mixed ANOVA for Disgust. Results indicate the ratio of positive answers (Disgust over Neutral) as the emotional intensity of the faces presented increases.

Discussion.

We ran a facial recognition task expecting that participants who perceived themselves as overweight would be more likely to interpret neutral information as signalling social rejection when compared to perceived normal weight participants. However, we found no effect of weight perception in our analyses, suggesting that self-perception of overweight was not associated with facial recognition performance.

Appendix II: Supplementary material for Chapters 3 and 6

Additional details

Study 1

Method.

Measures.

Demographics. Participants indicated their ethnicity (White, Black, Asian, Hispanic, Mixed, or Other), income (Less than $25,000 [student], Less than $25,000 [non-student], Between $25,000 and $39,999, Between $40,000 and $49,999, Between $50,000 and $74,999, Between $75,000 and $99,999, $100,000 or higher), and highest education level (Never completed High School, Completed High School, College, Bachelor's Degree, Master's Degree, and PhD/Professional Degree). The two lowest income categories were recoded into a single category for analysis ('Less than $25,000'). Presence of chronic illness was assessed with a single yes/no item *"Do you have any long-standing illness, disability or infirmity? By long-standing, we mean anything that has troubled you over a period of time, or that is likely to affect you over a period of time".* When calculating BMI, values lower than 15 and higher than 50 were considered implausible, according to criteria used in previous research (Armour et al., 2016).

Neuroticism. The neuroticism subscale of the Mini International Personality Item Pool (Mini IPIP) (Donnellan et al., 2006) consists of 4 items (e.g., *"I get upset easily"*), to which participants indicated how accurately each statement reflects their personality on 5-point Likert scales ranging from 1 (*'Very Inaccurate'*) to 5 (*'Very*

Accurate'). Responses to each item were summed to provide a neuroticism score, with higher values indicating higher neuroticism.

Depressive symptoms. Participants completed the 10-item Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977), with items (e.g., *"I was bothered by things that don't usually bother me"*) rated on 4-point scales ranging from 1 ('*Rarely'*) to 4 (*'All of the time'*). Responses to each item were summed to provide a measure of depressive symptoms, and higher scores indicated higher levels of depressive symptoms.

Perceived weight discrimination. Participants completed an adapted version of the Perceived Everyday Experiences with Discrimination Scale (Hunger & Major, 2015; D. R. Williams et al., 1997) in which they indicated how frequently they had encountered five discriminatory experiences because of their weight (e.g., *"You are treated with less courtesy or respect than others"*) on 6-point Likert scales ranging from 1 ('*Never'*) to 6 ('*Almost every day'*). The total score was calculated by summing answers to each item.

Attention checks.

The attention checks included in the questionnaire were *"You travelled back in time"*, *"When I'm upset, select response option sometimes for this question"*, *"Select somewhat agree as the response option for this question"* and *"Please disregard this as a question and select agree"*. Participants who did not select *'Never'* for the first item and who did not select the indicated response options for the others were excluded from the analyses.

Additional measures.

In Study 1, we collected additional self-report measures for the purpose of testing other research questions unrelated to the hypotheses of the present studies.

Demographics. Participants also reported their heaviest weight as an adult and their parents' educational level. Moreover, they were asked about how a doctor or a healthcare professional would perceive their weight, and whether they had ever been diagnosed as overweight by a doctor or a healthcare professional.

People pleasing. Participants completed a short self-devised scale to measure people pleasing tendencies. Participants indicated their agreement to 4 statements (e.g. *"I am the type of person that tries to avoid arguments and disagreements"*). Responses were indicated on a 7-point Likert scale ranging from 1 ('*Strongly disagree'*) to 7 (*'Strongly agree'*).

Adverse childhood experiences. Participants completed the Adverse Childhood Experiences questionnaire (Felitti et al., 1998). Participants indicated whether or not they experienced a list of 10 experiences (e.g. *"Did a parent or other adult in the household often or very often push, grab, slap, or throw something at you? Or ever hit you so hard that you had marks or were injured?"*), with responses indicated as either *'Yes'* or *'No'*.

Life satisfaction. Participants completed the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). The scale consists of five items (e.g. *"The conditions of my life are excellent"*) with responses indicated on a 7-point Likert scale ranging from 1 ('*Strongly disagree'*) to 7 (*'Strongly agree'*).

Emotional dysregulation. Participants completed the 36-item Difficulties in Emotional Regulation Scale (Gratz & Roemer, 2004). Items such as *"When I'm upset,*

I become angry with myself for feeling that way" are answered on a 5-point Liker scale ranging from 1 (*'Almost never (0-10%)'*) to 5 (*'Almost always (91 – 100%)'*).

Self-control. Participants completed the brief Self-control Scale (Tangney, Baumeister, & Boone, 2004). The scale has 10 items (e.g. *"I get distracted easily"*), with answers ranging from 1 (*'Not at all like me'*), to 5 (*'Very much like me'*).

Attachment styles. Participants completed the revised 36-item Experiences in Close Relationships Scale (Fraley, Waller, & Brennan, 2000). Items such as *"My romantic partner makes me doubt myself"* are rated on a 7-point Likert scale ranging from 1 ('*Strongly disagree'*) to 7 (*'Strongly agree'*).

Results.

Table II.1

Correlation matrix for the variables analysed in Study 1

	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	--											
2. Gender	-.034											
3. Ethnicity	.185***	.049										
4. Income	.157***	-.104*	.057									
5. Education	.079	.021	.015	.312***								
6 Chronic illness	-.132**	-.066	-.001	.151**	.074							
7. BMI	.133**	-.077	.075	.016	-.106*	-.214***						
8. Weight perception	.128**	.021	.043	.003	-.030	-.146**	.566***					
9. Weight stigma concerns	-.064	.194***	.059	-.051	-.099*	-.176***	.464***	.456***				
10. Stress-induced eating	-.110*	.159***	.005	-.091*	-.020	-.142**	.253***	.311***	.406***			
11. Neuroticism	-.168***	.109*	-.016	-.161***	-.035	-.211***	.014	.102*	.302***	.316***		
12. Depression	-.130**	-.006	-.027	-.206***	-.071	-.288***	.083	.160***	.287***	.290***	.650***	
13. Perceived weight discrimination	-.043	.043	-.045	-.031	-.101*	-.049	.298***	.256***	.468***	.202***	.190***	.236***

Categorical variables: Gender (1 = Male, 2 = Female), Ethnicity (0 = Not White, 1 = White), Chronic illness (1 = Yes, 2 = No), and Weight perception (1 = Normal weight, 2 = Overweight).

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

Study 2

Method.

Measures.

Demographics. Demographic variables and categories were the same as Study 1, except for income (Less than $26,000, Between $26,000 and $39,999, Between $40,000 and $49,999, Between $50,000 and $74,999, Between $75,000 and $99,999, $100,000 or higher), and highest education level, which did not include the option for College.

Weight stigma concerns. In Study 2, the Weight Stigma Concerns scale (Hunger & Major, 2015) was rated on 7-point Likert scales, ranging from 1 ('Strongly Disagree') to 7 ('Strongly Agree').

Depressive symptoms. In Study 2, the 10-item Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977) was rated on 4-point scales ranging from 1 ('Rarely') to 4 ('All of the time').

Perceived weight discrimination. In Study 2, the Perceived Everyday Experiences with Discrimination Scale (Hunger & Major, 2015; D. R. Williams et al., 1997) included a sixth item (*"People act as if they are afraid of you"*).

Self-esteem. Rosenberg's self-esteem scale (Rosenberg, 1965) consists of 10 items (e.g. *"I feel that I am a person of worth, at least on an equal plane with others"*) to which participants rated their agreement on 4-point Likert-scales, ranging from 1 (*'Strongly disagree'*), to 4 (*'Strongly agree'*). Responses were summed to provide a self-esteem score, with higher scores indicating higher self-esteem.

Body dissatisfaction. The Body Dissatisfaction subscale of the Eating Disorder Inventory (EDI-BD) (Garner et al., 1983) consists of 9 items that assess feelings of

discontentment with the shape and size of regions of the body that are typically of concern to people with eating disorders (e.g., stomach, hips, thighs, buttocks). Responses are provided on 6-point Likert scales ranging from 0 (*'Never'*) to 5 (*'Always'*). The total score is obtained by reverse-coding five items and summing them with the other ones, with higher scores indicating higher body dissatisfaction.

Attention checks.

The attention checks included in the questionnaire were *"You are often bullied, please select Never for this question"*, *"I think my feet are alright, please select Often for this question"*, and *"My life is perfect as it is, please select Agree for this question"*. Participants who did not select the indicated response options for the items were excluded from the analyses.

Additional measures.

In Study 2 we collected one additional self-report measure, the Self-Objectification Questionnaire (Noll & Fredrickson, 1998), for the purpose of other research questions. Participants were asked to rank a list of ten body attributes (e.g. *"Strength"*, *"Physical Attractiveness"*) from the one which had the greatest impact on their physical self-concept (ranking it as *'1'*), to the one which had the least impact on their physical self-concept (ranking it as *'10'*).

Results.

Table II.2

Correlation matrix for the variables analysed in Study 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	--														
2. Gender	.043														
3. Ethnicity	.142***	.086*													
4. Income	-.012	-.083*	-.003												
5. Education	.032	-.098*	-.009	.328***											
6. Chronic Illness	-.199***	-.133**	-.109**	.212***	.131**										
7. BMI	.075	-.102**	.055	-.064	-.140***	-.158***									
8. Weight perception	.090*	.062	.015	-.008	-.011	-.166***	.579***								
9. Weight stigma concerns	-.108**	.129**	.051	-.029	-.060	-.122**	.412***	.487***							
10. Uncontrolled eating	-.144***	.022	.049	-.019	.032	-.047	.235***	.296***	.474***						
11. Neuroticism	-.123**	.178***	.010	-.122**	-.057	-.100*	.105**	.161***	.374***	.341***					
12. Depression	-.078*	.075	.030	-.180***	-.037	-.223***	.178***	.244***	.517***	.399***	.692***				
13. Perceived weight discrimination	-.114**	-.002	-.051	.008	-.054	-.084*	.231***	.200***	.531***	.330***	.254***	.414***			
14. Physical activity	.006	-.151***	-.013	.118**	.107**	.109**	-.201***	-.191***	-.224***	-.172***	-.255***	-.269***	-.041		
15. Self-esteem	.108**	-.033	-.016	.182***	.089*	.116**	-.169***	-.197***	-.493***	-.337***	-.614***	-.714***	-.353***	.297***	
16. Body dissatisfaction	.032	.280***	.091*	-.052	-.076	-.194***	.457***	.595***	.626***	.423***	.364***	.429***	.308***	-.319***	-.462***

Categorical variables: Gender (1 = Male, 2 = Female), Ethnicity (0 = Not White, 1 = White), Chronic illness (1 = Yes, 2 = No), and Weight perception (1 = Normal weight, 2 = Overweight).

* p <.05 (2-tailed); **p <.01 (2-tailed); ***p <.001 (2-tailed).

Appendix III: Supplementary material for Chapter 4

Attention checks

The attention checks included in the questionnaire were: *"In your day-to-day life, how often have any of the following things happened to you because of your weight? - You are often bullied (This question is just to check your attention: please select "Never" for this question)"*, *"How often, over the past four weeks, did you engage in the following behaviours or attitudes? - Shared a meal with a friend (This question is just to check your attention: please select "Occasionally" for this question)"*, and *"Please indicate the extent to which you agree or disagree with the following statements. - I often call people on the phone (This question is just to check your attention: please select "Disagree" for this question)"*. Participants who did not select the indicated response options for the items were excluded from the analyses.

Additional measures

For the purpose of other research questions, the following measures were also included in the questionnaire.

Alcohol Use Disorders Identification Test (AUDIT). The AUDIT consists of ten fixed response questions regarding alcohol consumption and consequences of drinking (e.g. *"How often during the last year have you found that you were not able to stop drinking once you had started?"*). Scores on the AUDIT range from 1 (*'Never'*) to 5 (*'Daily or almost daily'*) (J. B. Saunders, Aasland, Barbor, De La Fuente, & Grant, 1993).

Experiences in Close Relationships (ECR) scale. The ECR is a 12-item scale to assess attachment styles (e.g. *"Please indicate the extent to which you agree or disagree with the following statements. - I worry about being alone."*). Items are rated on a 7-point Likert scale ranging from 1 (*'Strongly disagree'*) to 7 (*'Strongly agree'*) (Lafontaine et al., 2016).

Substance Use Risk Profile Scale (SURPS). The SURPS is a 23-items questionnaire based on a model of four personality risk factors for substance abuse. Responses on items such as *"I like doing things that frighten me a little"* are rated on four point Likert scales ranging from 1 (*'Strongly disagree'*) to 4 (*'Strongly agree'*) (Woicik, Stewart, Pihl, & Conrod, 2009).

Modified Drinking Motives Questionnaire Short Form (MDMQ-R SF). The measure consists of 12 items assessing motivations to drink (e.g. *"In the last 12 months, how often did you drink because it helps you enjoy a party?"*). Items are rated on 5-point Likert scales ranging from 1 (*'Never/almost never'*) to 5 (*'Always/almost always'*) (Kuntsche & Kuntsche, 2009).

Palatable Eating Motives Scale - Revised (PEMS). The measure consists of 20 items assessing motivations to eat palatable foods (e.g. *"How often would you say that you ate tasty foods to forget your worries?"*). Responses are listed on 5-point Likert scales ranging from 1 (*'Never/almost never'*) to 5 (*'Always/almost always'*) (Burgess, Turan, Lokken, Morse, & Boggiano, 2014).