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Abstract

Objective: To explore relationships between disability, food insecurity (FI) and age and examine how socioeconomic factors impact risk of FI among disabled people in working and older age.

Design: Logistic regression models used to analyse the contribution of socioeconomic factors to gaps in risk of FI for disabled people. In models stratified into working and older age groups, differences in risk of FI for disabled and non-disabled people were examined by employment, education, and assets.

Setting: England, Wales, and Northern Ireland, 2016 and 2018

Participants: A representative sample of 6,187 adults aged 16+, of whom 28% were disabled, from the Food & You survey.

Results: The gap in FI risk by disability status decreased as age increased. For ages 25-34 for disabled versus non-disabled people, risk of FI was 31% (95% CI: 21%-41%) versus 10% (8-12%); at ages 45 to 54, it was 18% (11-23%) versus 7% (5%-8%), and at ages 75+, there was no gap in risk. Accounting for socioeconomic variables halved the gap in risk among working ages. However, among working-age adults, FI among disabled people in full-time work was 15% (11%-20%) compared to only 7% (6%-9%) among non-disabled people in full-time work. Among older people, disabled people without savings were at higher risk of FI (5% (3-7%)) than non-disabled people without savings (2% (1-3%)) but having savings closed risk gap.

Conclusions: Socioeconomic resources partially explain disparities in FI risk when disabled. Disparities remained for people in full-time work and among people without savings in older age.

Introduction

Food insecurity (FI) is common in low-income countries, but it is also a critical and increasing public health concern in high-income countries (1,2). The United States Department of Agriculture (USDA) defines household FI as the uncertainty of having, or inability to acquire, enough food to meet the needs of all household members at all times in socially acceptable ways because of insufficient money or other resources for food (3). Low food security is characterised by reduced dietary quality or variety of diet with possible indication of reduced food intake; very low food security is when there are multiple indications of disrupted eating patterns and reduced food intake (3). Research in the UK, US, and Canada suggests the risk of FI increased during the COVID-19 pandemic and with rising costs of living (4,5). Food insecurity monitoring by The Food Foundation using YouGov's UK panel recently showed that from a monthly prevalence of around 7% in January 2021, moderate and severe experiences of FI were much higher, around 18%, in January 2023 (6).

Some groups have been identified as having systematically higher risk of FI. These include people in receipt of income-replacement social security, people who are unemployed or underemployed, adults in younger age groups, and people from disadvantaged groups (1,7–9). Similarly, disabled people have also been found to be at higher risk compared to non-disabled people across several high-income countries (1,10–14). A recent study found that having multiple disabilities, as well as a combination of both physical and mental/cognitive disabilities, was associated with increased risk of moderate-to-severe and chronic FI, particularly among working-age adults (15). However, the explanation of these differences remains unclear – in particular, whether these differences affect only working-age adults or also older adults; and whether they result primarily from differences in socioeconomic resources. Data from the UK consistently show that risk of FI declines with age and is particularly low among over 65s (1,2). On the other hand, Census data from the UK show that about 42% of State Pension age adults were disabled in 2021 (16). It is yet unclear how the relationship between disability and FI varies between working ages and older ages.

There are multiple reasons why the risk of FI associated with disability may not be present at older age. According to the biopsychosocial model of disability, disability is the result of an interaction between a person and their environment and social context, including their socio-economic position (17,18). Thus, the experience of disablement may differ with the changes in socio-economic circumstances that tend to occur with aging (19,20). For example,

65   financial security generally increases over the life course as individuals accumulate savings

66   and assets. Additionally, social security (i.e in the form of state pensions) tends to be more

67   secure and more services are provided for people of older age (21–23). At working age, there

68   is often a large gap in income between disabled and non-disabled people; disabled people are

69   more likely to be in deep poverty and less likely to be in full-time employment (24); and

70   disabled people are more likely to have lower educational attainment, earnings, and

71   likelihood of home ownership than non-disabled people (25). A disability-income gap may

72   not be evident at older age, as sources of income are more homogenous between disabled and

73   non-disabled groups (i.e. pension income). Further, disability becomes more prevalent at

74   older age, affecting people from both low and high socio-economic groups. Yet, older people

75   who have been disabled for a long time may not have built up private pensions, savings or

76   accumulated wealth through home ownership due to cumulative disadvantage (19), thus risk

77   of FI may still be higher for some disabled older adults. Importantly, even when disabled

78   people have the same socio-economic resources as non-disabled people, other factors such as

79   problems with transport, higher costs of living, and difficulties with food preparation may

80   increase their risk of FI. Identifying which factors close the gap in risk of FI for disabled

81   people is important for understanding potential points of intervention and identifying where

82   additional risk factors need to be explored.

83

84   In this paper, we first examine how the risk of FI associated with disability changes across

85   age bands (roughly 10 years each from age 16 to 75+). We then explore the contribution of

86   socioeconomic status, particularly work status, qualifications, and wealth to this relationship.

87   We expect that the higher risk of FI among disabled people will be reduced once we account

88   for the higher likelihood of disabled people being socioeconomically disadvantaged,

89   especially at working age. Lastly, we explore where gaps in risk of FI remain between

90   disabled and non-disabled in the same socio-economic groups and where the gap in risk

91   closes, focusing on employment status, home ownership, access to savings, and educational

92   attainment. We stratify this analysis into working-age (16-64) and older age adults (65+)

93   because of differences in employment status (i.e. pension age was 65 for men and women in

94   2018) and because, as highlighted above, socio-economic resources are more evenly

95   distributed between disabled and non-disabled people in older age.

96

97   **Methods**

98   Throughout this paper, we use the identity-first terminology of "disabled people" (26),

99   preferred by Disability Rights UK, who advised on the project in which this study was

100   included.

101   *Data source and sample*

102   Data came from two waves of the Food Standards Agency's Food & You survey (F&Y), a

103   repeat cross-sectional, representative survey of adults aged 16 and over in England, Wales,

104   and Northern Ireland. The survey used random probability sampling and face-to-face

105   computer-assisted personal interviewing (CAPI). At the time that analysis began, it was the

106   only nationally representative dataset in the UK containing an internationally agreed measure

107   of household FI: the USDA's Adult Food Security Survey Module (27). Data from Wave 4

108   and 5 of F&Y, conducted in 2016 and 2018 respectively, were used. These independent

109   samples were combined, resulting in a sample of 6,187 adults (NatCen, 2018; NatCen Social

110   Research, 2016) of whom 28% (n=1,699) were disabled. Notably, these data were collected

111   from a relatively stable period in the UK and prior to the pension age changing from 65 to 66

112   for both men and women. They were also collected prior to the COVID-19 pandemic

113   subsequent period of rising inflation, when relationships between disability, age, and FI may

114   have been fluctuating (6).

115

116   *Survey measures*

117   The operationalisation of disability differed slightly between the two survey waves. Wave 4

118   asked respondents if they had any physical or mental health conditions or illnesses lasting or

119   expected to last for 12 months or more. If respondents answered yes, this was followed by a

120   question asking whether the condition or illness reduces respondents' ability to carry-out day-

121   to-day activities a lot, a little or not at all, in line with the Equality Act definition of disability

122   and used in Office of National Statistics surveys. In wave 5, respondents were asked the same

123   initial question but if respondents answered yes, the following question asked whether any of

124   the conditions or illnesses affected respondents in specified domains. The domains listed

125   were: vision, hearing, mobility, dexterity, learning/understanding/concentrating, memory,

126   mental health, stamina/breathing/fatigue, and socially/behaviourally. We merged this

127   disability data by creating a new variable that combined people from Wave 4 who answered

128   yes and who had a condition that reduced their ability to carry out day-to-day activities (a

129   little or a lot) with people who in Wave 5 answered yes and reported at least one condition,

130   illness or impairment. A sensitivity analysis was run to test whether use of one or the other

131   measure changed the results.

132

FI was measured by the USDA's 10-item Adult Food Security module, a validated scale that
aims to capture prevalence of FI, at the household level, in the general population (27).
According to standard USDA practice, FI is identified by three or more affirmative responses
to questions on the module. We use this binary measure of FI, capturing people with both low
and very low food security.

Covariates

The dataset provided age data in the following bands: 16–24, 25–34, 35–44, 45–54, 55–64,
65-74, and 75+. Gender was provided as a binary variable (male/female), as was presence of
dependent child(ren) in the household (yes/ no) and ethnicity (white ethnicity/other ethnicity).
Marital status captured whether respondents were in marriage/civil partnership, single,
separated, divorced or widowed. Data on education denoted whether a degree was the highest
level of qualification a respondent achieved, another type of qualification or no qualification.
Gross household annual income was only available in four income bands: <£10 399, £10
400–£25 999, £26 000–51 999, and >£52 000, as well as missing. Main employment status
for the household was captured as a 9-level variable denoting: full-time education, paid
employment, self-employed, unemployed, temporarily unable to work, permanently unable to
work, retired, looking after the home, or other. Home ownership recorded the tenure of
respondents' living accommodation: own home outright, buying with a mortgage, renting, or
living rent free. Sixteen different sources of income data were captured including state and
private sources. These were not mutually exclusive categories. The source of interest for our
analysis was whether they collected interest from savings and investments because this
income source represents a marker of wealth and access to assets, which could act as a
financial security buffer (30).

Low cell counts for some subcategories meant we had to reclassify some variables for
descriptive and regression analyses. A binary housing tenure variable was made to capture
households who had investment in their own homes (owned outright or buying on a
mortgage) compared to people who were renting. Marital status was recoded into living with
a partner or not living with a partner. For our stratified analysis of working-age adults (see
below), we wanted to explore if people who were in the same work status group (e.g.
unemployed) had similar risk of FI, whether disabled or not. To do this, we combined
information about the nature of employment in the household (full-time or part-time) with

166 employment status to denote household work status as (1) full-time work; (2) part-time work;

167 (3) unemployed, temporarily inability to work, or waiting to take up work; (4) permanent

168 inability to work; (5) retirement, in education, caring for the home/family, or not working for

169 other reasons. We had to combine reasons for being out of work for the latter group due to

170 small numbers for these subgroups across disabled and non-disabled working-age adults.

171

172 With the exception of the income variable, data were missing for only 48 respondents; these

173 individuals were excluded from the analysis. As 23% of respondents had missing values for

174 income, we included these individuals into the analysis, including an indicator variable for

175 missing income in the analysis.

176

177 *Statistical analysis*

178 First, to visualise the relationship between disability and FI across age bands, we used logistic

179 regression including an interaction term for age and disability and corresponding predicted

180 probabilities to examine risk of FI for disabled and non-disabled people by age bands (16-24;

181 25-34; 35-44; 45-54; 55-64; 65-74; and 75+).

182

183 Adding to this logistic regression model and including all survey respondents, we then added

184 gender and ethnicity terms, followed by a model that added socio-economic characteristics,

185 namely, qualification level, household income, main household employment status, housing

186 tenure, presence of child(ren) in the household, and partnership status. In Figure 2, we plot

187 the marginal difference in predicted risk of FI between disabled and non-disabled adults over

188 age bands before and after adjustment for socio-economic characteristics to show how the

189 risk gap for FI for disabled people changes. The results for the logistic regression models

190 underlying this figure can be seen in Web Appendix Table A1.

191

192 Next, in models stratified into working-age and older age groups, we examined if differences

193 in risk of FI were observed for adults in the same socio-economic subgroups or if there was

194 evidence of gaps in risk of FI remaining. Among working-age adults, we examined

195 differences in FI for disabled and non-disabled people by three markers of socio-economic

196 status: main household employment status, highest qualification, and housing tenure. Too few

197 disabled people had savings to enable us to examine the impact of this asset on this

198 relationship for working-age people. Then among older age adults, having already observed

199 no difference in risk of FI between disabled and non-disabled adults in older age, we examine

200   if any disparity in risk of FI is apparent for disabled older adults who were socioeconomically

201   disadvantaged compared to people who were not. We used information on savings and

202   investments, highest qualification and housing tenure as markers for socioeconomic

203   advantage in older age.

204

205   **Results**

206

207   *Descriptive statistics*

208   In the combined F&Y Wave 4 and 5 sample, over one-fifth of respondents (21%) were

209   identified as disabled. In Table 1, we show characteristics of disabled and non-disabled

210   people stratified into working-age and older age groups. In both groups, there were

211   significant differences across socio-economic characteristics, with disabled people more

212   likely to be in socio-economically disadvantaged groups. For example, among both working-

213   age and older adults, disabled people were more likely to have no degree qualification than

214   non-disabled adults (17% vs. 10% for working-age; 42% vs. 28% for older ages; for both,

215   p<0.0001). Among older adults, 75% of disabled people owned their own home outright or

216   were buying it compared to 86% among non-disabled people, and 24% of disabled people

217   were renting compared to 13% of non-disabled people (p<0.0003). Among working-age

218   adults, 47% of disabled people owned or were buying a home compared to 63% of non-

219   disabled people, and 51% of disabled people were renting compared to only 34% of non-

220   disabled people (p<0.0001). Among working-age adults, only 52% of disabled people were in

221   households with paid employment compared to 73% of non-disabled people (p<0.0001).

222   However, there was no difference in whether households had earnings from savings between

223   disabled and non-disabled among both working-age and older age adults (p>0.05 for both age

224   groups).

225

226   [Table 1 about here]

227

228   *Food insecurity risk by disability status and age band*

229   In Figure 1, we show the risk of FI by age band for disabled and non-disabled adults. The gap

230   in FI risk by disability status decreased as age increased. There was a wide gap in risk until

231   about age 45 (though confidence intervals were wide for the 16-24 age group). For ages 25

232   to 34 for disabled versus non-disabled people, predicted risk of FI was 31% (95% CI: 21%-

233   41%) versus 10% (95% CI: 8-12%), a risk gap of 21 percentage points. From age 45, the gap

234   in risk of FI appeared to reduce between disabled and non-disabled people. For ages 45 to 54,

235   the predicted probability was 18% (95% CI: 11-23%) versus 7% (95% CI: 5%-8%) for

236   disabled versus non-disabled adults, a risk gap of only 11 percentage points. The gap between

237   disabled and non-disabled people then closed further at age 65-74, and by age 75+, there was

238   no visible difference in risk of FI between disabled and non-disabled adults.

239

240   [Figure 1 about here]

241

242   *Contribution of socioeconomic factors to FI disparities*

243   In Figure 2, we show the plotted risk gaps (i.e. differences in predicted probabilities) between

244   disabled and non-disabled adults before and after adding socio-economic characteristics to a

245   model adjusted for gender and ethnicity. In Model 1, we see that the gap in risk of FI by

246   disability status is 21 percentage points (95% CI:12-31%) for the 25-34 age bands, 12

247   percentage points (95% CI:5-18%) for ages 45-54 and 13 percentage points (95% CI:7-18%)

248   for 55-64, compared to 7 percentage points (95% CI:4-11%:) for age band 65-74, and close

249   to zero for adults aged 75+. For all working-age bands, the addition of socio-economic

250   variables to the model reduced the difference in risk of FI between disabled and non-disabled

251   people by about half. For example, the 21 percentage point difference in FI at ages 25-34

252   between disabled and non-disabled people declined to a 9 percentage point difference (95%

253   CI: 3%-16%).

254

255   [Figure 2 about here]

256

257   *Do employment status, housing tenure, and/or education close gaps in risk of FI for disabled*

258   *people of working age?*

259   Figure 3 shows predicted probabilities of FI by disability status and household work status

260   among working-age adults. Though full-time work reduced the risk of FI for both disabled

261   and non-disabled people, the risk of FI among disabled people in households with full-time

262   work remained significantly higher than non-disabled people: 15% (95% CI: 11%-20%)

263   compared to the 7% (95% CI: 6%-9%) for non-disabled people in households with full-time

264   work. There was also a significantly higher risk of FI among disabled people who were

265   'unemployed, waiting to take up work, or temporarily unable to work' compared to non-

266   disabled people with this status. However, there was no significant difference in risk of FI for

267 people who were in part-time work, permanently unable to work, or not working for other
268 reasons.

269

270 [Figure 3 about here]

271

272 Having no degree level qualification equalised risk of FI between disabled and non-disabled
273 working-age adults (web appendix Figure A1). Among people with degree-level
274 qualification, the predicted risk of FI among disabled people was higher at 14% (95% CI:
275 8%-19%) compared to 7% (95% CI: 4%-9%) for non-disabled people, though confidence
276 intervals overlapped. There was also a significant difference in risk of FI between disabled
277 and non-disabled working adults with some qualification but not a degree.

278

279 Home ownership also may not equalise the risk of FI between disabled and non-disabled
280 working-age adults, with predicted probability of FI for disabled adults at 9% (95% CI: 6% -
281 13%) compared to 4% (95% CI: 3%-6%) for non-disabled adults (web appendix Figure A2),
282 but did appear to reduce the gap compared to people living in rental accommodation. Here,
283 the predicted probability of FI was 24% (95% CI: 19%-30%) among disabled adults versus
284 15% (95% CI: 12%-17%) among non-disabled adults.

285

286 *Is economic vulnerability in older age associated with higher risk of FI for disabled older*
287 *age adults compared to non-disabled adults?*
288 Figure 4 shows the predicted probabilities of FI by disability status and savings for older
289 adults. Whilst the overall probability of FI was low for all older age adults, among disabled
290 people who had no savings, the predicted level of FI was close to 5% (95% CI: 3%-7%),
291 significantly higher than non-disabled older adults without savings (2% (95% CI: 0.5%-3%).
292 In contrast, savings appeared to close the gap in risk of FI for older age adults, with no
293 difference in risk of FI between disabled and non-disabled people.

294

295 [Figure 4 about here]
296 Home ownership also appeared to narrow the gap in risk of FI for older disabled compared to
297 non-disabled adults (web appendix figure A4). Disabled people who were renting had a
298 predicted risk of FI of about 7% (95% CI: 2%-11%) compared to only about 1% (95% CI:
299 0%-2%) for non-disabled people. Among homeowners, the gap was only about 2 percentage
300 points and differences in risk were not statistically significant.

301 There were not significant differences in risk of FI between disabled and non-disabled people

302 at older age among people with a degree qualification or other qualification; indeed, the risk

303 of FI for both disabled and non-disabled adults with degree qualifications was not

304 significantly different than zero (web appendix figure A3). However, among people with no

305 qualification, the risk of FI was significantly higher (7% (95% CI: 3-12%) vs. 2% (95% CI:

306 0-4%)).

307 *Sensitivity analyses*

308 In sensitivity analyses, we implemented models examining the interaction between FI and

309 age band using data for the 2016 and 2018 surveys separately, given that disability was

310 measured differently across these two years. Our results were consistent across survey waves,

311 albeit with wider confidence intervals, suggesting that the difference in classification of

312 disability between survey waves did not change relationships between disability and age in

313 relation to FI (Web Appendix Figure A4).

314

315 **Discussion**

316 In this paper, we explored differences in the probability of FI between disabled and non-

317 disabled people across different age bands. We found that gap in FI risk was largest between

318 disabled and non-disabled people among people under 45, and that it closed for adults aged

319 75 and older. At working ages, socio-economic factors explained about half of the difference

320 in risks and appeared to eliminate the observable gaps in risk for adults 65+. In stratified

321 models for working-age and older age adults, we observed where there were gaps in risk of

322 FI between disabled and non-disabled people in the same socio-economic group and where

323 these gaps were closed. We observed that significant gaps in risk remained between disabled

324 and non-disabled working-age adults among people where the main earner had full-time work

325 and where the main earner was unemployed or temporarily unable to work. Gaps in risk were

326 not significant where main earners were permanently unable to work or not working for other

327 reasons. Having a degree qualification or other qualification also did not close the gap in risk

328 of FI between disabled and non-disabled working-age adults, though among people with no

329 education, risks were the same among disabled and non-disabled adults. Lastly, there were

330 significant differences in risk between disabled and non-disabled among renters and among

331 homeowners, though gaps were narrower for the latter group. Among older age adults, it was

332 disabled people who were in more disadvantaged groups that had significantly higher risk of

333 FI, namely, people who were without savings, without a qualification, and were renting their

334   home. Having savings in older age closed the gap in risk of FI between disabled and non-

335   disabled adults.

336

337   Our results are consistent with research from other high-income countries, which have found

338   that disabled people generally have higher risk of FI than non-disabled people as a result of

339   disadvantage (13,31). Previous research has also suggested that FI decreases with age

340   (31,32), but that some groups of older people such disabled people and who are

341   disadvantaged may still be at higher risk of FI at older ages (7,21). Our findings also support

342   research that indicates that wealth and assets such as savings are particularly important for

343   disabled peoples' food security (33); indeed, savings eliminated the difference in FI risk

344   between disabled and non-disabled people in older age. Savings may be particularly

345   beneficial for disabled people who can experience higher day-to-day living costs, such as

346   energy costs, travel costs, and care costs (34). Unfortunately, due to low numbers of working

347   age people with savings, we could not confirm if the same was true for disabled people of

348   working age.

349

350   The high-level finding that the gap in risk of FI between disabled and non-disabled adults

351   declines with age suggests age may be protective against disparities in FI risk associated with

352   disability. This may reflect the relatively higher level of protection against economic

353   disparities for older people in the UK as a result of pensions and other financial supports. For

354   example, the ability to access state pension, which is more generous than social security for

355   people unable to work, may lead to greater economic security among both disabled and non-

356   disabled people of pensionable age (35). It may also reflect, other forms of social support and

357   services that may impact on food security beyond socio-economic factors including free

358   public transport, access to social services, and activities providing free or low-cost meals for

359   older people (23). Targeted financial support for older people that we were unable to capture

360   in our analysis may also contribute to greater food security in older age for disabled people,

361   for example, free prescriptions and winter fuel allowance. Another explanation for the high-

362   level finding is that many people become disabled in older age, and therefore may be

363   socioeconomically better off compared to younger disabled people (35). Whilst we could not

364   examine this hypothesis directly due to the cross-sectional nature of our data and lack of

365   information on duration of disability, our analysis of disability and FI in older age suggested

366   that disabled people who were better off socio-economically had no difference in risk of FI

367   from non-disabled people, but that gaps in risk were apparent for disabled people from lower

368   socioeconomic backgrounds (i.e. no qualification; renting their home; lacking savings). These

369   findings suggest the benefits of older age may not equally reach people who are disabled or

370   that further support is needed to meet their food needs. For example, physically accessing

371   food and preparing it may be more difficult for more severely disabled older adults compared

372   to non-disabled adults(36), particularly where both lack financial assets. A final explanation

373   for the reduction in risk gap between disabled and non-disabled adults among people aged

374   75+ that cannot be ruled out is selective survival, as research has found that disability is

375   associated with increased mortality (37–39) a different demographic composition of disabled

376   people at older ages, however, this needs examining in longitudinal data.

377

378   Among working-age adults, we observed that socioeconomic factors explained some

379   difference in risk between disabled and non-disabled people, however, about 50% of the risk

380   gap remained. In our working-age models, we observed persistent gaps in risk of FI between

381   disabled and non-disabled people remained among people with full-time work and people

382   who were unemployed or temporarily unable to work. Similarly, having a degree

383   qualification or other qualification and home ownership did not close the gap in risk between

384   disabled and non-disabled people, and disabled people who were renting had a much higher

385   risk of FI compared to non-disabled people who were renting.

386   These findings suggest unobserved factors may play a role. Among disabled renters,

387   inappropriate accommodation for disabled people may impact on health and make it

388   particularly difficult for people to access, store and prepare food, compared to non-disabled

389   people. There are also higher costs of living associated with being disabled and with

390   accessing food(40). Experiences of discrimination may also make it harder for disabled

391   people to go out to access food. Among disabled people in full-time work, work may be of

392   poorer quality and pay may be lower for disabled people; disabled people are also more likely

393   to experience job insecurity (19,34,41,42). Our findings may also reflect that higher

394   education may not translate into higher incomes for disabled people in the same way that it

395   does for non-disabled people, similar to other stigmatised and marginalised groups (7,8,43).

396   These findings raise concerns about efficacy of work alone as a solution to poverty and FI

397   among disabled people.

398   *Strengths and limitations*

399   A strength of this study is the use of standardised measures of FI and disability, and use of

400   from a representative sample of UK adults. These data were collected at a time of relative

401 stability in levels of FI in the UK; relationships between disability, age, and FI likely

402 fluctuated over the COVID-19 pandemic and subsequent rises in costs of living. There is a

403 need for further examination of these relationships using more recent data. A relatively small

404 sample size also limited our ability to examine type and severity of disability may influence

405 relationships with age and FI. We also lacked data on age of onset of disability which would

406 have been helpful for understanding how economic disadvantages of disability may accrue

407 over working age and into older age. Instead, we used markers of socio-economic status more

408 relevant in older age, namely savings and home ownership, in order to identify economically

409 disadvantaged older disabled people. We are unable to establish, however, whether these

410 factors reflect economic disadvantage since early age.

411

412 Our measure of FI is focused on financial access to food and therefore may underestimate the

413 level of FI among disabled people who face non-financial challenges to accessing

414 food(44,45). Factors like ability to go out to purchase, transport and prepare food were not

415 available in the dataset, which may influence FI among disabled people. These findings

416 clearly highlight the need for more in-depth research that explores the mechanisms

417 contributing to insecure access to food among disabled people. Our measure of household

418 income was crude, and therefore these findings do not rule out low levels of income as one

419 explanation. We also had only a crude measure of saving and investment, a binary variable

420 indicating whether the respondent's household was receiving interest from either of these

421 sources. More detailed data on the value and nature of savings and investment would aid

422 understanding of how these variables may reduce risk of FI. Because of having limited

423 measures of socio-economic factors, we are unable to tell if having savings and owning a

424 home reduce the risk of FI themselves or whether they may reflect cumulative financial

425 characteristics we were unable to assess. In addition, we had no data on living costs,

426 including housing costs or costs associated with living with a disability; data on these types

427 of factors would have contributed to a better understanding of socioeconomic differences in

428 risk of disability. Future analyses would benefit from larger datasets with more detailed

429 information on disability and FI, including measures capturing insecure food access arising

430 from inaccessibility. Longitudinal assessments of disability and FI over the life course would

431 also help better understand these relationships.

432

433 *Conclusion*

Our findings suggest that socioeconomic resources play an important role in the relationship between FI and disability, both at working ages as well as at older ages. Socioeconomic factors explained about half of the relationship at working-age, and more fully the relationship among older people. However, full-time work and having a degree qualification did not close the gap in risk of FI between disabled and non-disabled people, suggesting these factors are not sufficient to reduce disparities in FI between disabled and non-disabled people. Unobserved factors that contribute to disabled people's increased risk of FI require further research. Our results suggest that targeting interventions to specific groups of disabled people, such as people living in rental accommodations, people in full-time work and older people without access to savings, may be effective in addressing the increased risk of FI associated with disability.

Key Findings:

- Disparities in risk of FI between by disability status decrease with age and are close to zero at ages 75+.
- Socioeconomic factors explain about half of the gap in predicted FI risk among working-age adults (16-64).
- We find that disabled people have higher risk of FI even among people in full time work, suggesting work itself may not be sufficient to reduce the gap in FI risk between disabled and non-disabled people.
- Among people 65+, savings and home ownership closed the gap in risk FI between disabled and non-disabled people.

References:

1. Loopstra R, Reeves A, Tarasuk V. The rise of hunger among low-income households: An analysis of the risks of food insecurity between 2004 and 2016 in a population-based study of UK adults. J Epidemiol Community Health (1978). 2019 Jul 1;73(7).

2. Yau A, White M, Hammond D, White C, Adams J. Socio-demographic characteristics, diet and health among food insecure UK adults: cross-sectional analysis of the International Food Policy Study. Public Health Nutr. 2020;23(14):2602–14.

3. United States Department of Agriculture. USDA webpages on Definition and Measurement of Food Security [Internet]. 2023 [cited 2024 Jan 18]. Available from: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/

4. Loopstra R. Vulnerability to food insecurity since the COVID-19 lockdown Preliminary report [Internet]. 2020. Available from: https://ukdataservice.ac.uk/.

5. O'Hara S, Toussaint EC. Food access in crisis: Food security and COVID-19. Ecological Economics. 2021 Feb 1;180.

6. The Food Foundation. Round 12. 2023 [cited 2023 Jun 23]. Food Insecurity Tracking. Available from: https://foodfoundation.org.uk/initiatives/food-insecurity-tracking#tabs/Round-12

7. Berning J, Bonanno A, Cleary R. Disparities in food insecurity among Black and White households: An analysis by age cohort, poverty, education, and home ownership. Appl Econ Perspect Policy. 2022;

8. Dhunna S, Tarasuk V. Black–white racial disparities in household food insecurity from 2005 to 2014, Canada. Canadian journal of public health. 2021;112(5):888–902.

9. Tarasuk V, Fafard St-Germain AA, Mitchell A. Geographic and socio-demographic predictors of household food insecurity in Canada, 2011-12. BMC Public Health. 2019;19(1).

10. Coleman-Jensen A. U.S food insecurity and population trends with a focus on adults with disabilities. Physiol Behav. 2020;220:112865.

11. Heflin CM, Altman CE, Rodriguez LL. Food insecurity and disability in the United States. Disabil Health J [Internet]. 2019 Apr 1 [cited 2019 Nov 20];12(2):220–6. Available from: https://www.sciencedirect.com/science/article/pii/S1936657418301936?via%3Dihub

12. Brucker DL. The association of food insecurity with health outcomes for adults with disabilities. Disabil Health J. 2017;10(2):286–93.

13. Schwartz N, Buliung R, Wilson K. Disability and food access and insecurity: A scoping review of the literature. Health and Place. 2019.

14. Parish SL, Rose RA, Andrews ME. Income Poverty and Material Hardship among U.S. Women with Disabilities. The Social service review (Chicago). 2009;83(1):33–52.

15. Hadfield-Spoor M, Avendano M, Loopstra R. Food insecurity among disabled adults. Eur J Public Health. 2022;

16. Wellard N, Colvin H. Disability by age, sex and deprivation, England and Wales: Census 2021. 2021.

17. WHO, World Bank. World report on disability. World Health Organization; 2011. 325 p.

18. Shakespeare T, Watson N. Frameworks, Models, Theories, and Experiences for Understanding Disability. In: The Oxford Handbook of the Sociology of Disability. Oxford University Press; 2021.

19. Willson A, Shuey K. Cumulative Disadvantage in Employment: Disability over the life course and wealth inequality in later life. In: The Oxford Handbook of the Sociology of Disability. Oxford University Press; 2022.

20. Putnam M. Linking aging theory and disability models: increasing the potential to explore aging with physical impairment. Gerontologist. 2002;42(6):799–806.

21. Leroux J, Cox J, Rosenberg M. Food Insecurity and Aging: A Scoping Study of the Literature. Canadian journal on aging. 2020;39(4):662–96.

22. Singleton P. The effect of social security benefits on food insecurity at the early entitlement age. Appl Econ Perspect Policy. 2023;45(1):392–413.

23. Lee JS, Bhargava V, Smith TA, Walker TA. The effects of aging services and the supplemental nutrition assistance program on food insecurity among older Georgians: 2018–2020. Appl Econ Perspect Policy. 2022;44(2):635–52.

24. She P, Livermore GA. Material Hardship, Poverty, and Disability Among Working-Age Adults *. Soc Sci Q. 2009;88(4):970–89.

25. Pettinicchio D, Maroto M. Relational Inequality and the Structures that Disadvantage. In: The Oxford Handbook of the Sociology of Disability. Oxford University Press; 2022.

26. Best KL, Mortenson W Ben, Lauzière-Fitzgerald Z, Smith EM. Language matters! The long-standing debate between identity-first language and person first language. Assistive technology. 2022;34(2):127–8.

27. Bickel G, Nord M, Price C, Hamilton W, Cook J. Measuring Food Security in the United States Guide to Measuring Household Food Security Revised 2000 [Internet]. 2000. Available from: http://www.fns.usda.gov/oane

28. NatCen Soical Research. Food and You Survey Wave 4 (2016) User Guide NatCen Social Research A survey carried out for Food Standards Agency [Internet]. 2016. Available from: www.natcen.ac.uk

29. NatCen Social Research. Food and You Survey, Wave 5 (2018): User Guide [Internet]. 2018. Available from: www.natcen.ac.uk

30. McIntyre L, Pow J, Emery JCH. A Path Analysis of Recurrently Food-Insecure Canadians Discerns Employment, Income, and Negative Health Effects. J Poverty. 2015;19(1):71–87.

31. Coleman-Jensen A, Nord M. Food insecurity among households with working-age adults with disabilities. In: Food Insecurity Among Disabled Adult Households. Nova Science Publishers, Inc.; 2013. p. 1–60.

32. Gregory CA, Coleman-Jensen A. Food Insecurity, Chronic Disease, and Health Among Working-Age Adults. 2017. (Economic Research Report Number 235).

33. Huang J, Guo B, Kim Y. Food insecurity and disability: Do economic resources matter? Soc Sci Res. 2010 Jan;39(1):111–24.

34. Veruete-McKay L, Schuelke L, Davy C, Moss C. SCOPE - Disability Price Tag 2023 Summary [Internet]. 2023 [cited 2023 Jun 23]. Available from: https://www.scope.org.uk/campaigns/extra-costs/disability-price-tag-2023/

35. Men F, Tarasuk V. Severe food insecurity associated with mortality among lower-income Canadian adults approaching eligibility for public pensions: a population cohort study. BMC Public Health. 2020;20(1):1484–1484.

36. Hancock R, Morciano M, Pudney S. Disability and poverty in later life. 2016.

37. Men F, Gundersen C, Urquia ML, Tarasuk V. Association between household food insecurity and mortality in Canada: a population-based retrospective cohort study. Canadian Medical Association journal (CMAJ). 2020;192(3):E53–60.

38. Langballe EM, Tangen GG, Engdahl B, Strand BH. Increased mortality risk for adults aged 25–44 years with long-term disability: A prospective cohort study with a 35-year follow-up of 30,080 individuals from 1984–2019 in the population-based HUNT study. The Lancet regional health Europe. 2022;22:100482–100482.

39. Andersson HI. Increased mortality among individuals with chronic widespread pain relates to lifestyle factors: A prospective population-based study. Disabil Rehabil. 2009;31(24):1980–7.

40. Food Foundation. Food insecurity and inequalities experienced by disabled people. 2023.

41. Phelan JC, Lucas JW, Ridgeway CL, Taylor CJ. Stigma, status, and population health. Soc Sci Med. 2014 Feb;103:15–23.

42. Batty E, Lewis Brown R. Evolving Perspectives on Disability, Stigma, and Discrimination. In: The Oxford Handbook of the Sociology of Disability. Oxford University Press; 2022.

43. Shuey KM, Willson AE. Cumulative Disadvantage and Black-White Disparities in Life-Course Health Trajectories. Res Aging. 2008;30(2):200–25.

44. Vaudin AM, Moshfegh AJ, Sahyoun NR. Measuring Food Insecurity in Older Adults Using Both Physical and Economic Food Access, NHANES 2013–18. J Nutr. 2022;152(8):1953–62.

45. Wolfe WS, Frongillo EA, Valois P. Understanding the Experience of Food Insecurity by Elders Suggests Ways to Improve Its Measurement. J Nutr. 2003;133(9):2762–9.

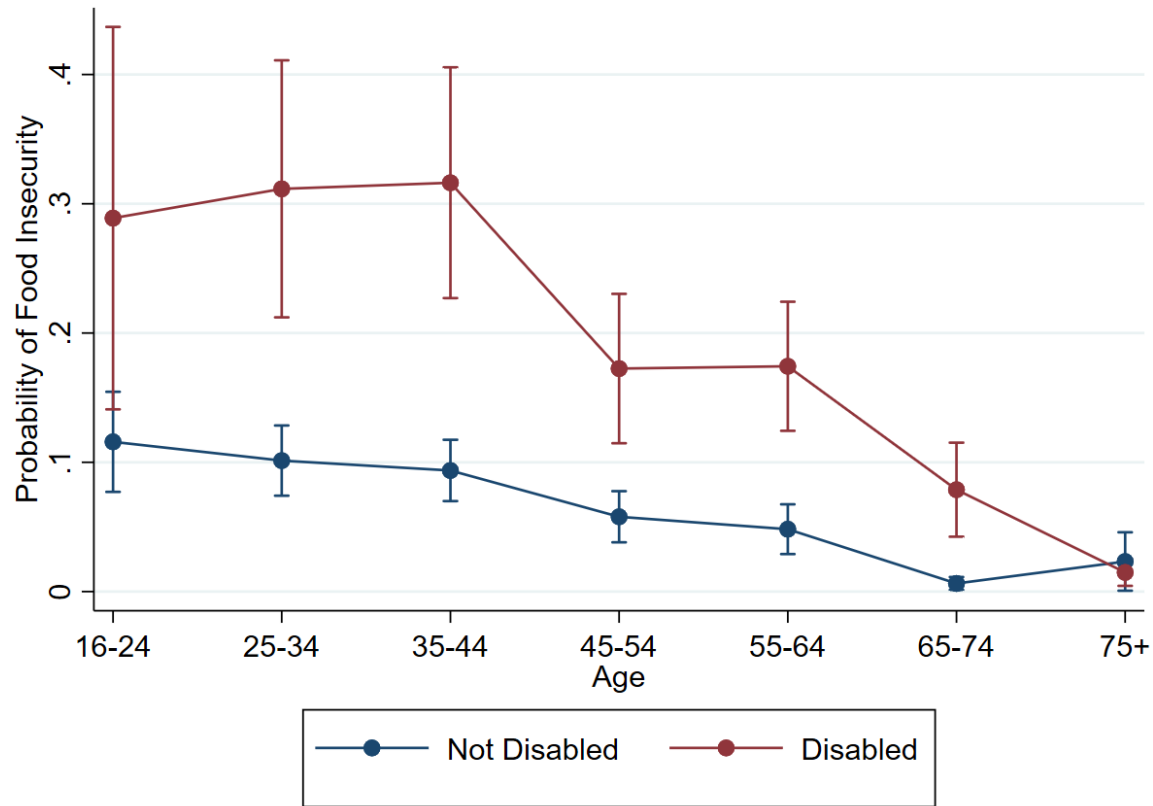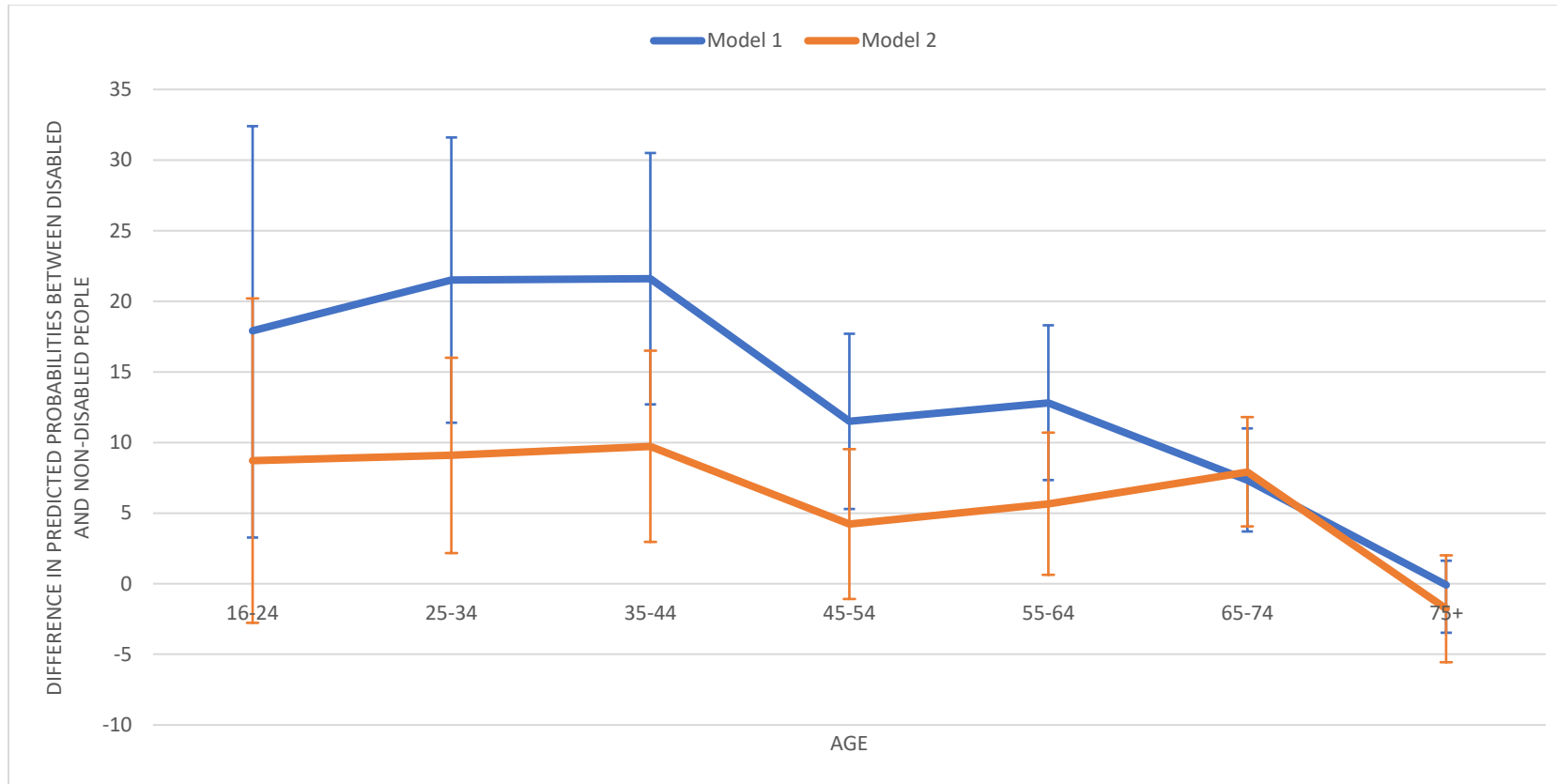Figure 1 Probability of food insecurity for Disabled and Non-disabled people at different ages (unadjusted).

Figure 2 Impact of adjusting for demographic and socioeocnomic factors on differences in predicted probability of food insecurity between disabled and non-disabled people


Notes: Model 1 is adjusted for gender and ethnicity. Model 2 is additionally adjusted for highest level of qualification, employment status, household income, presence of children in the household, home ownership, and partnership status.

Figure 3 Adjusted predicted probability of food insecurity among working age adults with and without disabilities by household work status.
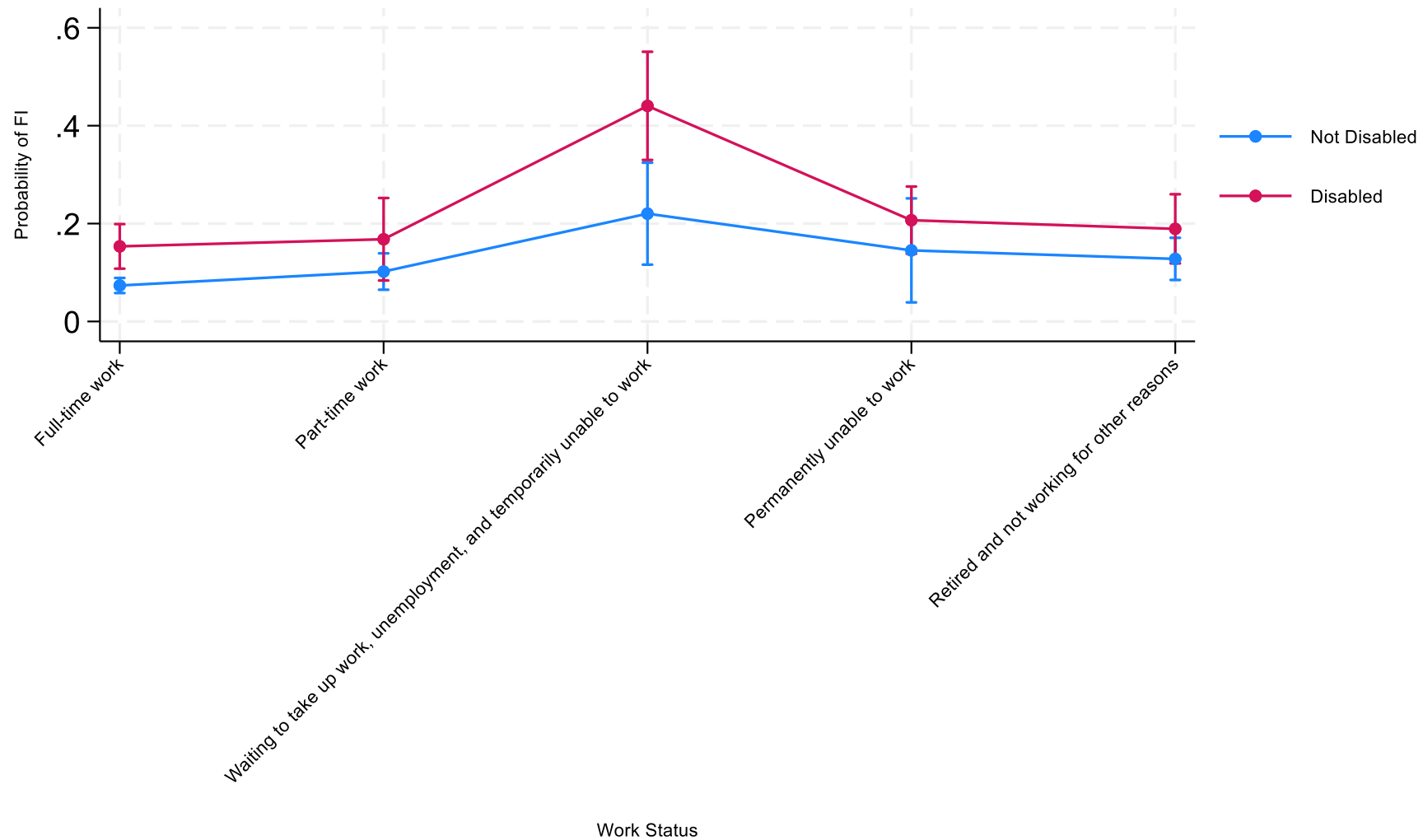
Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, highest qualification, household savings, presence of child(ren) in household, household income, homeownership, and presence of partner.

Figure 4 Adjusted predicted probability of food insecurity among older adults with and without disabilities by access to savings.
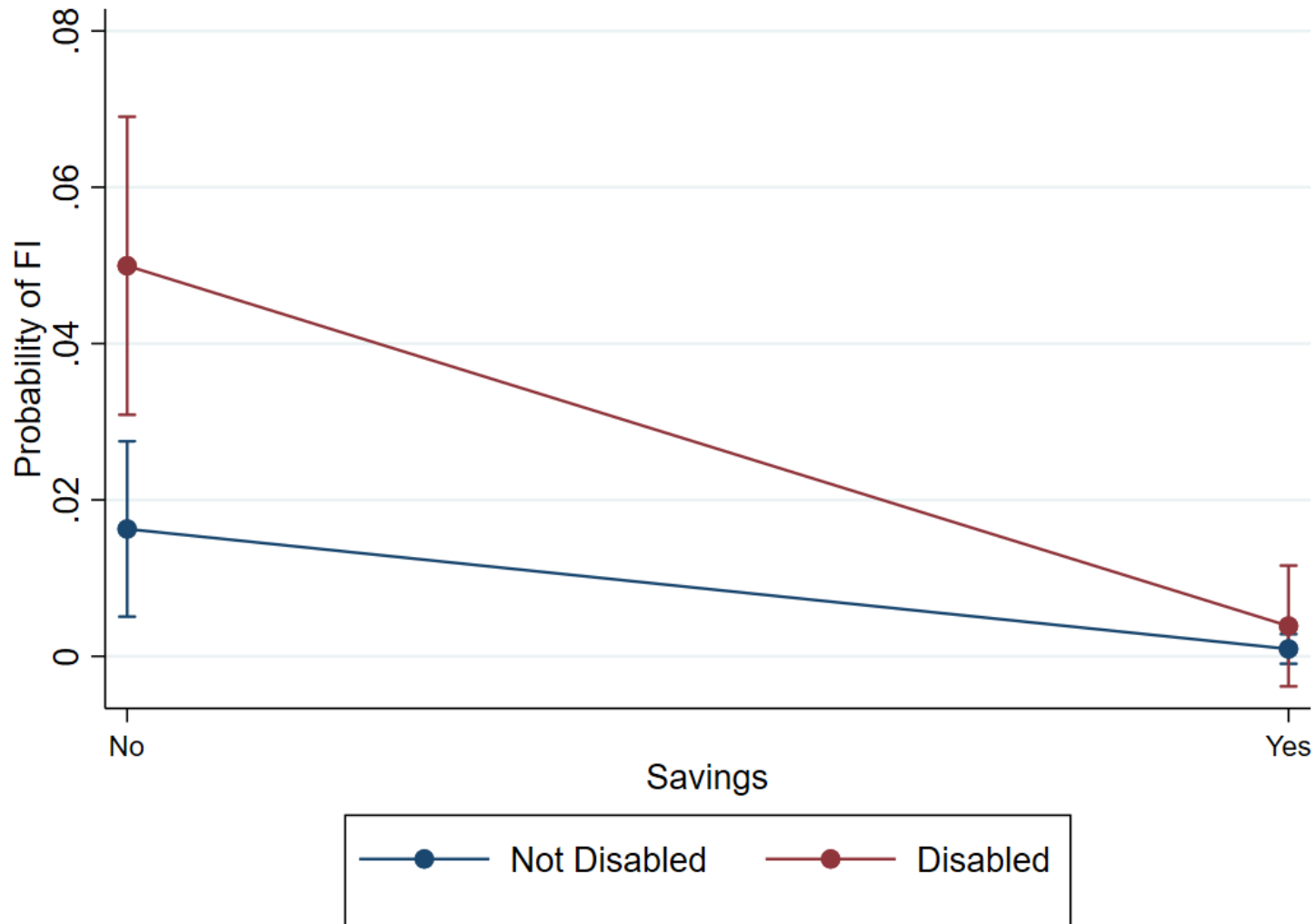
Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, highest qualification, presence of child(ren) in household, household income, homeownership, and presence of partner (work status not included for 65+).

Table 1 Socio-economic characteristics of disabled and non-disabled people stratified by working and older age.

		Under 65			Over 65		
		Disabled (n=911)	Not disabled (n=3,363)	P value for X^2	Disabled (n=786)	Not disabled (n=1,101)	P value for X^2
Sex				0.0174			0.0296
	Female	55%	49%		58%	52%	
	Male	45%	51%		42%	48%	
Highest qualification				p<0.0000			p<0.0000
	Degree	25%	37%		17%	24%	
	Other	58%	53%		41%	48%	
	None	17%	10%		42%	28%	
Household main employment status				p<0.0000			0.0061
	Full-time education/training	1%	2%		0%	8.0e-04%	
	In paid employment	52%	73%		6%	12%	
	Self-employed	12%	12%		5%	6%	
	Unemployed or waiting to take up work	2%	1%		0%	3.1e-04%	
	Temporarily unable to work	4%	0%		0%	7.4e-04%	
	Permanently unable to work	13%	1%		2%	0%	
	Retired	7%	5%		85%	80%	
	Looking after the home	8%	4%		1%	1%	
	Doing something else	1%	1%		1%	1%	
Work status				p<0.0000			0.0004
	Full-time work	50%	75%		4%	10%	
	Part-time work	14%	10%		8%	7%	
	Waiting to take up work, unemployed and temporarily unable to work	6%	1%		0%	0%	
	Permanently unable to work	13%	1%		2%	0%	

Retired and not working for other reasons	17%	12%		86%	83%	
Household income band			p<0.0000			0.0011
<£10,399	11%	4%		10%	7%	
£10,400-£25,999	26%	15%		33%	30%	
£26,000-£51,999	19%	25%		19%	24%	
>£52,000	18%	29%		8%	14%	
Missing	25%	27%		30%	26%	
Marital status			p<0.0000			p<0.0001
Single	42%	44%		7%	7%	
Married / Civil Partnership	41%	47%		53%	63%	
Separated	3%	2%		1%	2%	
Divorced	11%	5%		10%	9%	
Widowed	3%	1%		29%	18%	
Dependent children in household			0.5928			0.9104
Yes	44%	46%		9%	9%	
No	56%	54%		91%	91%	
Home ownership			p<0.0000			p<0.0003
Own it outright	21%	22%		72%	82%	
Buying with help of mortgage/loan	26%	41%		3%	4%	
Part own and part rent	0%	1%		0%	0%	
Rent	51%	34%		24%	13%	
Live here rent free	2%	2%		1%	1%	
Household earnings from savings and investment			0.7807			0.2358
Yes	7%	7%		16%	18%	
No	93%	93%		84%	82%	

Web appendix - Table A1 - Logistic regression models (unadjusted, model 1, model 2), containing age*disability interaction term.

		Unadjusted Model		Model 1		Model 2	
		OR	95% CI	OR	95% CI	OR	95% CI
Disability							
	Yes	3.10	(1.41-6.84)	3.31	(1.51-7.27)	2.31	(0.40-6.01)
Age							
	25-34	0.86	(0.53-1.39)	0.89	(0.55-1.44)	0.71	(0.40-1.27)
	35-44	0.79	(0.51-1.22)	0.81	(0.52-1.25)	0.84	(0.49-1.44)
	45-54	0.47	(0.29-0.77)	0.49	(0.30-0.81)	0.62	(0.34-1.15)
	55-64	0.39	(0.22-0.67)	0.43	(0.24-0.75)	0.66	(0.36-1.18)
	65-74	0.05	(0.02-0.12)	0.05	(0.02-0.13)	0.09	(0.03-0.23)
	75+	0.18	(0.06-0.54)	0.20	(0.07-0.60)	0.29	(0.09-0.95)
Disability # Age							
	Disabled # 25-34	1.29	(0.51-3.28)	1.27	(0.50-3.22)	1.18	(0.40-3.51)
	Disabled # 35-44	1.44	(0.57-3.67)	1.36	(0.54-3.41)	1.16	(0.38-3.51)
	Disabled # 45-54	1.09	(0.42-2.87)	1.03	(0.39-2.74)	0.77	(0.24-2.47)
	Disabled # 55-64	1.34	(0.52-3.48)	1.25	(0.48-3.24)	0.88	(0.29-2.71)
	Disabled # 65-74	4.37	(1.38-13.8)	3.93	(1.24-12.4)	3.96	(1.12-14.0)
	Disabled # 75+	0.20	(0.47-0.88)	0.19	(0.43-0.81)	0.22	(0.45-1.08)
Sex							
	Female			1.45	(1.09-1.92)	1.24	(0.91-1.69)
Ethnicity							
	Other			1.63	(1.10-2.42)	1.47	(0.96-2.26)
Child in HH							
	No					0.61	(0.43-0.86)
Highest Qualification							
	Other					1.71	(1.16-2.51)
	None					2.33	(1.47-3.68)
HH income							
	<£10,399					1.58	(0.95-2.63)
	£10,400-£25,999					1.55	(1.06-2.27)
	>£52,000					0.49	(0.29-0.81)
	Missing					0.95	(0.63-1.43)
Employment Status							
	In paid employment					1.10	(0.33-3.71)
	Self-employed					0.96	(0.27-3.46)
	Waiting to take up work					4.78	(1.17-19.5)
	Temporarily unable to work					4.84	(1.19-19.6)
	Permanently unable to work					1.87	(0.54-6.55)
	Retired					1.01	(0.28-3.58)
	Looking after the home or					2.34	(0.63-8.68)
	Doing something else					0.92	(0.21-4.01)
Homeownership							
	Renting					3.55	(2.51-5.02)
Living with partner							
	Yes					0.79	(0.61-1.04)

Figure A1 Adjusted predicted probability of food insecurity among working-age disabled and non-disabled adults by highest qualification.
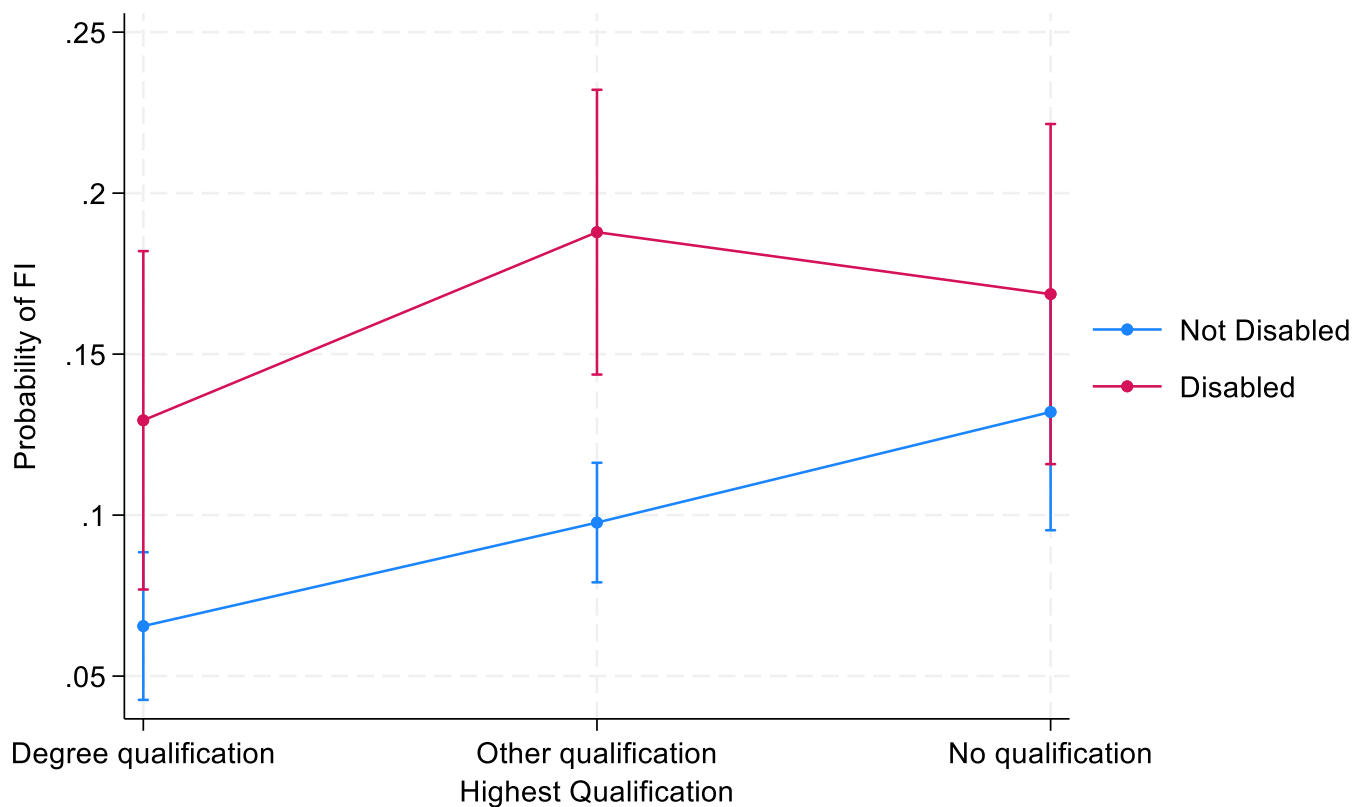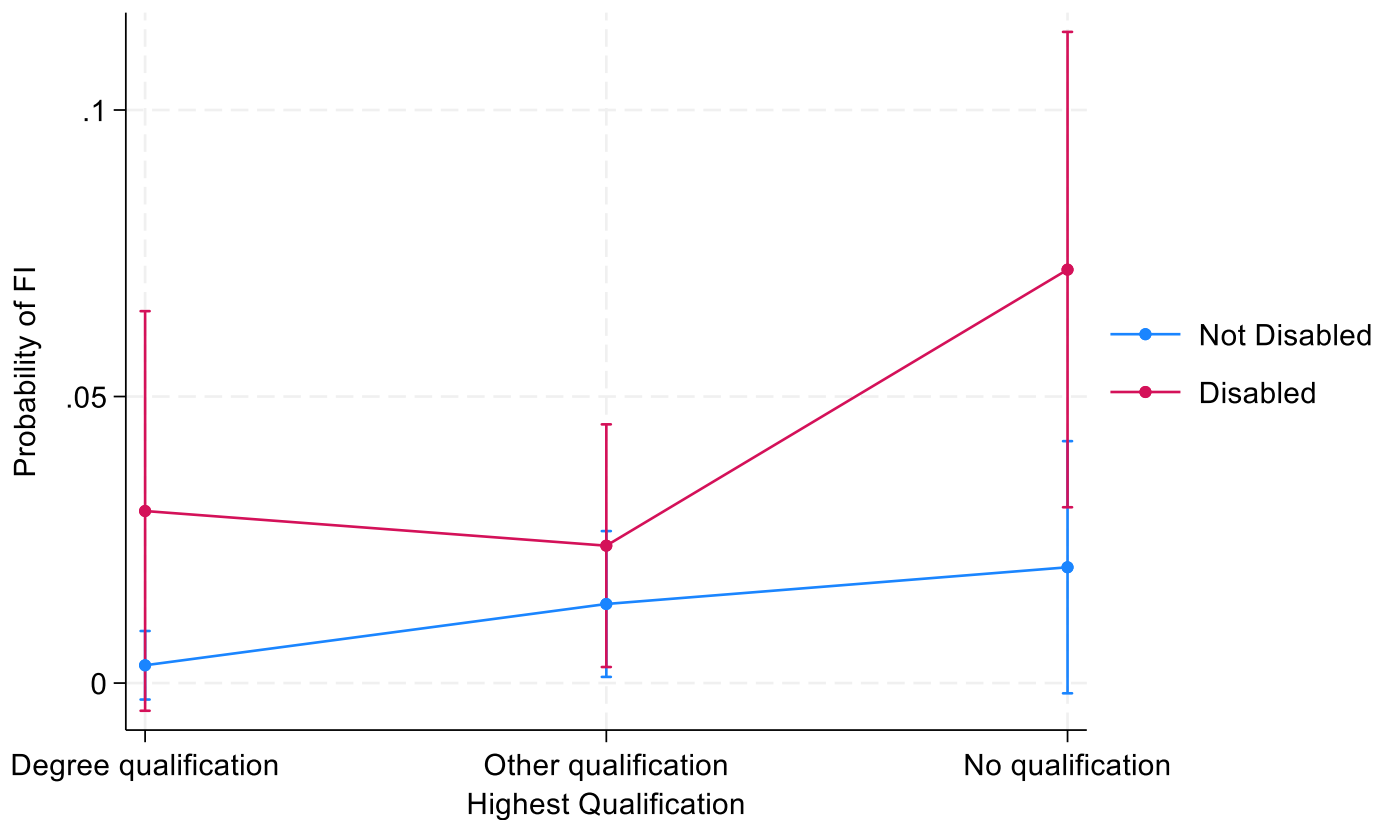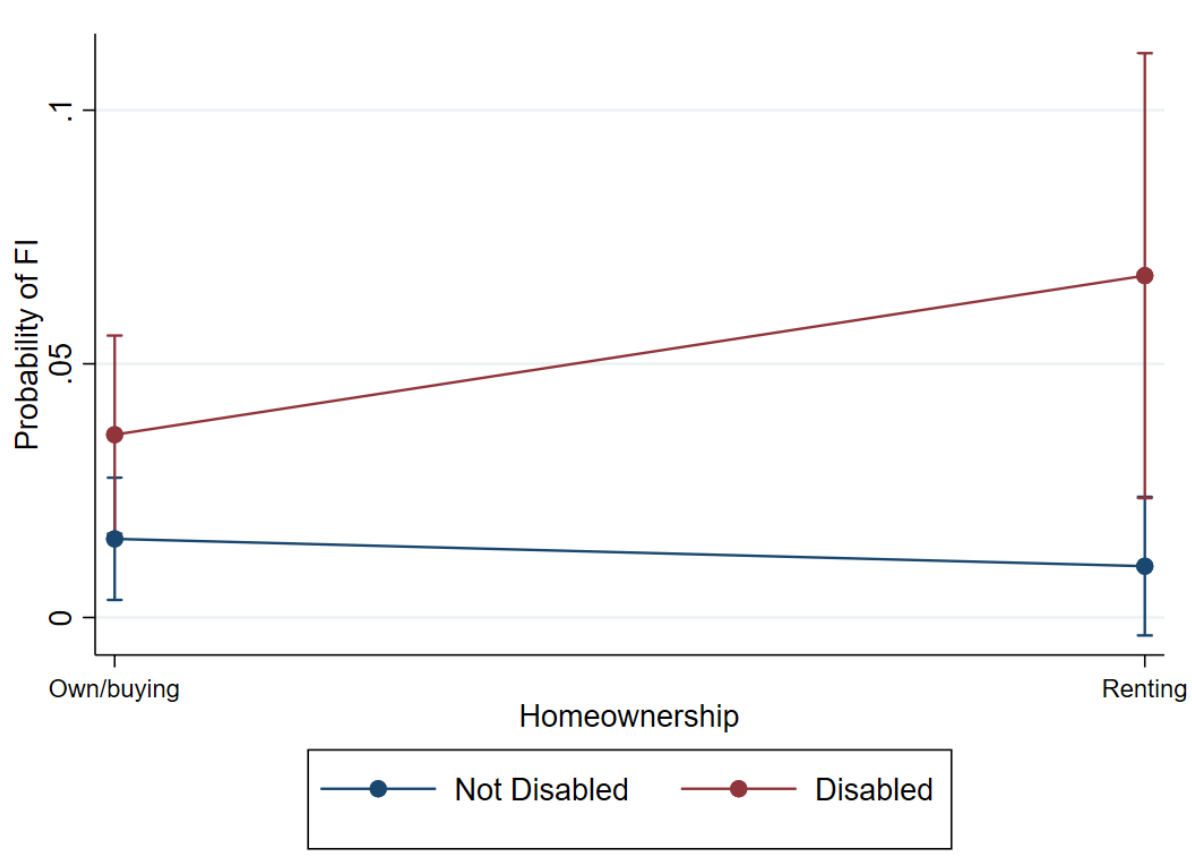

Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, presence of child(ren) in household, household income, work status, household savings, presence of partner and home ownership.

Figure A2 Adjusted predicted probability of food insecurity among working-age disabled and non-disabled adults by home ownership.
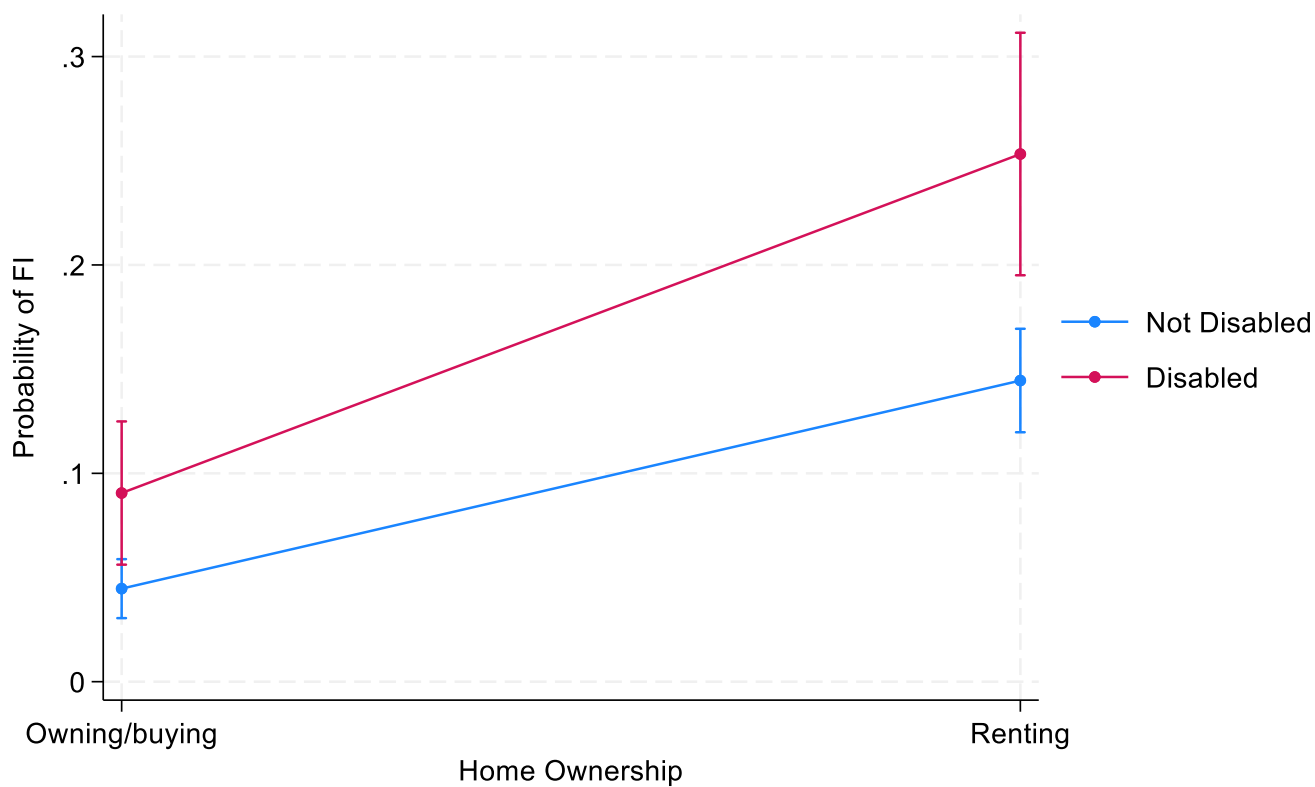
Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, presence of child(ren) in household, household income, work status, household savings, and presence of partner.

Figure A3 Adjusted predicted probability of food insecurity among older age disabled and non-disabled adults by highest qualification.

Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, presence of child(ren) in household, household income, household savings, presence of partner and home ownership.

Figure A4 Adjusted predicted probability of food insecurity among older disabled and non-disabled adults by home ownership.

Note: Predicted probabilities from a logistic regression model adjusted for sex, ethnicity, presence of child(ren) in household, household income, household savings, and presence of partner (work status not adjusted for in 65+).

Figure A4a: Relationship between disability and food insecurity over age. In 2016 disability was defined as a 'yes' response to having a physical or mental health conditions or illnesses lasting or expected to last for 12 months or more and then respondents saying 'a little' 'a lot' response to the condition or illness reducing respondent's ability to carry-out day-to-day activities. Only mobility, dexterity and vision difficulties were further specified.
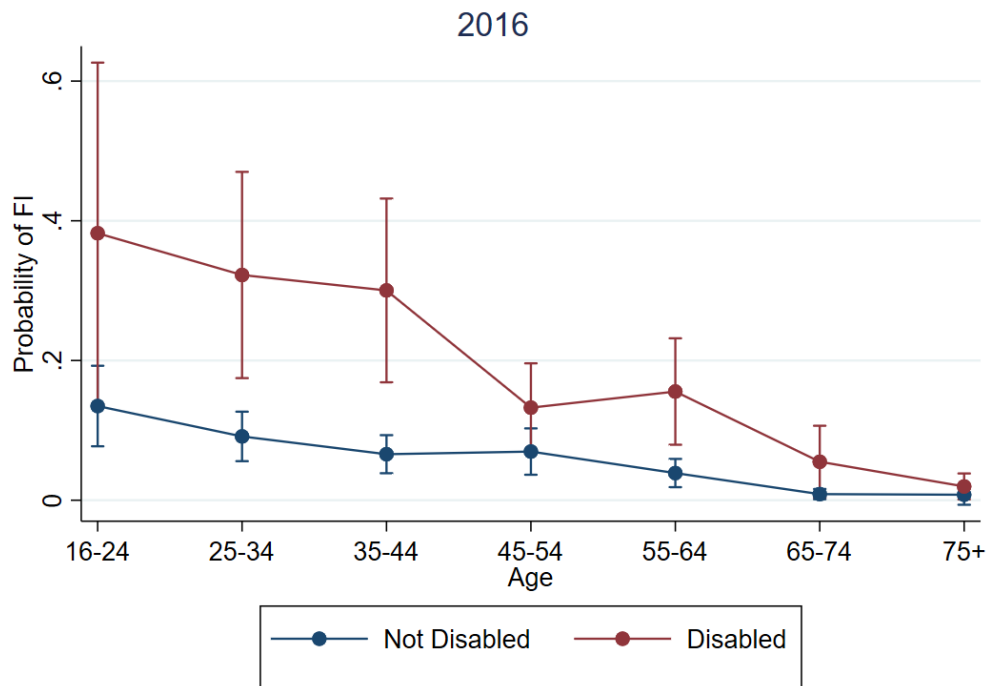

Figure A4b: Relationship between disability and food insecurity over age. In 2018 disability was defined as a 'yes' response to having a physical or mental health conditions or illnesses lasting or expected to last for 12 months or more. Respondents were then asked whether they were impacted in the following areas: Vision, Hearing, Mobility, Dexterity, Learning or understanding or concentrating, Memory, Mental health, Stamina or breathing or fatigue, Socially or behaviourally, Other.