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Obesity and Employment in Ireland: Moving Beyond BMI

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Abstract: I use data from the first wave of the Irish Longitudinal Study on Ageing (TILDA) to investigate the impact of obesity on the labour market status of older Irish individuals. I employ an anthropometric indicator of body composition (waist circumference) along with body mass index. I include a wide array of subjective and objective health indicators in the empirical model. I find that obese women are less likely to be at work. However, both the magnitude and statistical significance of this correlation are sensitive to the definition of obesity. Factors other than socioeconomic characteristics and health are also found to play a role in explaining why obese older women are less likely to be employed. Much weaker evidence is found for men.

Keywords: BMI, waist circumference, employment, older, Ireland

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1. Introduction

Obesity is a global health problem, affecting people of all ages (Kopelman, 2000). Obesity and overweight rates have increased sharply in the last decades in many OECD countries and have now reached ‘epidemic proportions’. The WHO (2004) estimated over one billion overweight adults and at least three hundred million obese adults worldwide. Obesity is associated with higher mortality rates and with a number of conditions that interfere with health, well-being, physical function and quality of life (Kopelman, 2000 and Villareal et al, 2005).

The relationship between obesity and labour market outcomes, e.g. wages, labour market status and hours worked, has received some attention in the health and labour economics literature. Three possible explanations of why obese individuals might suffer from worse labour market outcomes have been identified: i) obesity is a risk factor for a wide number of diseases – e.g. congestive heart failure, stroke, diabetes, hypertension, arthritis, asthma and sleep apnea – and a debilitating health condition that impacts on productivity and employment; ii) obese individuals have certain characteristics that are often difficult to measure but impact on their performance in the labour market, e.g. lower self-esteem, lower reservation wages and/or higher discount rates; iii) obese individuals are discriminated against by employers, customers and co-workers (i.e. ‘distaste’ for obese individuals due their physical attributes). In line with this third explanation, Rooth (2009) found clear evidence of discrimination against obese workers in a field experiment carried out in Sweden.[1]

Empirical evidence on the relationship between obesity and labour market outcomes has been collected in the US, UK, Denmark, Finland, Iceland, Germany, Sweden and Europe as a whole (Averett and Korenman, 1996; Cawley, 2004; Norton and Han, 2008; Morris, 2006 and 2007; Brunello and D’Hombres, 2007; Asgeirsdottir, 2011; Greve, 2008; Lindeboom, 2010; Lundborg at al, 2007; Atella et al, 2008; Villar and Quintana-Domeque, 2009; Rooth, 2009; Sabia and Rees, 2012). The results found in these international empirical studies are mixed but generally indicate worse labour market outcomes for obese individuals, and especially for obese women. For example, obese women were found to earn lower wages in the US (Averett and Korenman, 1996 and Cawley, 2004) and Denmark (Greve, 2008) and have lower employment rates in England (Morris, 2007) and Iceland (Asgeirsdottir, 2011).

For reasons of data availability, most surveys have used body mass index (BMI) – either self-reported or measured by qualified and trained interviewers or nurses - to define obesity. BMI is defined as the ratio of weight in kilograms and height in meters square. A BMI greater than or equal to 30 indicates obesity. However, four recent papers (Burkhauser and Cawley,

[1] Fictitious applications were sent to real job openings. The applications were sent in pairs and pictures of an obese or non-obese person were randomly assigned to similar applications. The call-back rate for the curricula vitae with weight-manipulated pictures were found to be 6% points lower for men and 8% points lower for women.

2008; Johansson et al, 2009; Wada and Tekin, 2010; and Bozoyan and Wolbring, 2011) have advocated the need to use alternative measures to define obesity. The main limitation of BMI is that it does not distinguish body composition, i.e. it does not distinguish fat from muscles, bone and other lean body mass. As a result, the BMI of muscular individuals might be seriously overestimated (Kragelung and Omland, 2005 and Burkhauser and Cawley, 2008). Johansson et al (2009), Wada and Tekin (2010) and Bozoyan and Wolbring (2011) have employed measures that take into account body composition: waist circumference and fat mass/fat-free mass. The evidence collected in these studies suggest that 'in absence of measures of body composition, there is a risk that labour market penalties associated with obesity are measured with bias' (Johansson et al, 2009, p. 36).

In this paper, I investigate whether obesity affects the labour market status of older Irish adults using data from the first wave of the Irish Longitudinal Study on Ageing (TILDA). This is a study of people aged 50 and over (and their spouses or partners of any age) resident in Ireland.

I make a number of contributions to the literature. First, I investigate whether obesity impacts on the labour market status of *older* individuals. Up to date, there is only one study that focuses on older adults (Lundborg et al, 2007).[2] I argue that focusing on older individuals is interesting because whilst the arguments of discrimination based on physical attributes and lower self-esteem clearly apply to young individuals, it is unclear whether these effects – if at all in place – persist as the individuals age. Second, I am the first author providing evidence from Ireland. Third, I use two indicators of obesity: BMI and waist circumference (WC). Measurements of height, weight and waist circumference were taken by trained and qualified nurses. Whilst BMI has been employed extensively in the literature, the use of waist circumference has been much more limited. Fourth, due to the richness of health indicators in TILDA, I can control for behavioural, physical and mental health measures on the right hand side of my equation. Some of these measures are 'objective' and hence do not suffer from self-reporting bias. On top on this, I control for unobserved heterogeneity using the instrumental variable approach. Following Morris (2006 and 2007) I use the prevalence rate of obesity in the area in which the respondent lives as instrument.

I find that obese women are less likely to be at work. However, both the magnitude and the statistical significance of the correlation of obesity with employment are sensitive to the definition of obesity. I also find that factors other than socioeconomic characteristics and health play a role in explaining why obese older women are less likely to be at work. Much weaker evidence of a relationship between obesity and labour market status is found for men.

The remainder of the paper is structured as follows. In Section 2, I describe the data used in the empirical analysis, outline the empirical strategy employed and define the dependent and independent variables used in my analysis. In section 3, I present the results of the

[2] Using data from the Survey of Health, Ageing and Retirement in Europe (SHARE), Lundborg et al (2007) find that older European men and women suffer from lower employment rates, but the evidence is weak and seems to be related mostly to poor health.

empirical models, focusing first on women and then turning to men. In section 4, I attempt to capture the true effect of obesity on labour market outcomes by employing the instrumental variable approach. Section 5 provides some conclusions.

2. Data and empirical strategy

2.1 Data description

Data from the first wave (2009/2011) of The Irish Longitudinal Study on Ageing (TILDA) are used. This is a nationally representative study of people aged 50 and over (and their spouses or partners of any age) resident in Ireland. TILDA collects detailed information on all aspects of the respondents' lives, including the economic dimension (pensions, employment, living standards), health aspects (physical, mental, service needs and usage) and the social domain (contact with friends and kin, formal and informal care, social participation). The study is closely harmonised with leading international research (e.g. The English Longitudinal Study of Ageing (ELSA); the Survey of Health, Ageing and Retirement in Europe (SHARE) which is pan-European, and the Health and Retirement Survey (HRS) conducted in the United States).

TILDA is made of three components: the computer-aided personal interview (CAPI) questionnaire; the self-completion questionnaire (SCQ), designed to explore certain areas that were considered particularly sensitive for respondents to answer directly to an interviewer; and the health assessment component of the study, conducted both in dedicated TILDA health assessment centres and, alternatively, in respondents' homes. The first wave of TILDA includes 8,504 respondents for the CAPI questionnaire, 7,191 for the SCQ and 6,153 for the Heath Assessment.

2.2 Dependent variable(s)

In this paper, I focus on the effect of obesity on the labour market status of older Irish adults who have not reached the state pension age, i.e. aged between 50 and 64. The TILDA sample includes individuals who are employed (in paid employment or self-employed), inactive (i.e. retired, permanently sick or disabled, looking after home or family or in education or training), unemployed or 'other'. I first employ a probit model which identifies two categories of response: 1: employed; 0: not-employed. Individuals who have never worked are excluded from the empirical analysis. I then restrict the sample to those who are employed (1) and permanently sick/disabled or unemployed (0). Hence, I exclude those who have already withdrawn from the labour market (i.e. retired) or have spent a higher proportion of their lives in economic inactivity (i.e. home makers). Given the nature of my research question, this is my preferred specification. Ideally, I would like to distinguish between sickness/disability and unemployment and in turn to look at those who are unemployed and actively seeking a job and those who are unemployed but not actively seeking a job separately. Unfortunately, the number of respondents falling in these categories is too small to permit any meaningful inference about those specific groups. In accordance with the previous literature, I focus on men and women separately.

I am left with 1,748 observations for women and 1,477 observations for men. 50.7% of women are employed, compared to 11.8% in retirement, 5.6% in unemployment, 22.5% looking after home or family and 6.7% in inactivity due to illness or disability. 65% of men are employed, compared to 13.3% in retirement, 11.9% in unemployment and 7.4% in inactivity due to illness or disability.

2.3 Obesity measures

In TILDA, measurements of weight, height and waist circumference were taken by trained and qualified nurses during the health assessment. Hence, I use two measures to investigate the impact of obesity on labour market outcomes: measured BMI and measured WC. In my empirical models, both indictors are entered in continuous and discrete forms. In TILDA, weight was measured using a SECA electronic floor scales. Height was measured using a SECA 240 wall mounted measuring rod. The respondent was asked to remove footwear, any heavy outer clothing and any head gear prior to the measurements. Waist circumference was measured with a standard tape measure. Waist circumference is now believed to be a more accurate measure of fatness because it enables to distinguish individuals who have a high fat mass with the bulk of the mass concentrated around the waist (i.e. central obesity). It is also a 'visible' measure of fatness which might be interpreted by employers, customers or co-workers as a non-attractive physical attribute.

I follow the WHO classification system (WHO, 1995) and categorize respondents as: 'underweight' when their BMI is less that 18.5; 'normal' when their BMI ranges between 18.5 and 24.99; 'overweight' when their BMI ranges between 25 and 29.99 and 'obese' when their BMI is greater than or equal to 30. In the sample I am using for the purpose of this paper, 0.7% of women are underweight, compared to 27.9% being of normal weight, 40.7% being overweight and 30.7% being obese. 15.7% of men have a normal weight, compared to 46.3% being overweight and 37.9% being obese. Only one man can be classified as underweight.

Turning to waist circumference, there are not clear cut off points to define central obesity. The WHO (1999, 2000 and 2008) have identified examples - not recommendations - of sex-specific cut-off points. According to these cut-off points, the risk of metabolic complications is 'increased' when waist circumference exceeds 94cm in men and 80cm in women and 'substantially increased' when it exceeds 102cm in men and 88cm in women. However, these cut-off points do not seem to be appropriate for the TILDA sample. 72.4% of men and 75.9% of women aged 50 to 64 have a waist circumference that exceeds 94 and 80cm, respectively. 43.8% of men and 50.5% of women have a waist circumference that exceeds 102 and 88cm, respectively. After careful consideration, I divide waist circumference in sex-specific quintiles and hence identify five discrete categories for measures of central obesity.

2.4 Other covariates

Turning to the other explanatory variables, I control for current socio-economic characteristics; socio-economic characteristics in childhood and a wide array of behavioural, physical and mental health indicators (both subjective and objective). These variables are as follows:

- *Current socio-economic characteristics*: single year of age; highest qualification attained (none/primary; intermediary; tertiary or higher); number of years spent working over the lifetime; individual level household composition (lives alone; lives with spouse; lives with others including children, grandchildren, siblings etc.); current area of residence (lives in Dublin; lives in town/city other than Dublin; lives in a rural area); and number of children
- *Socio-economic characteristics in childhood*: highest qualification attained by parents (both parents completed primary education; education is missing for at least one parent; at least one parent completed secondary or tertiary education and education is not missing for the other parent) and a series of dummy variables for whether: none of the respondent's parents ever worked outside the home when the respondent was aged less than 14; the respondent was living in a rural area at age 14; the respondent grew up in a poor family; the respondent self-rates her health in childhood as poor
- *Behavioural health*: smoking (never smoked; used to smoke but quit; currently smokes); drinking (standard alcoholic drinks per week); exercise (kilocalories burnt per week doing physical activity)
- *Physical health*: number of chronic diseases reported, self-reported health (fair/poor versus excellent/very good/ good), grip strength
- *Mental health*: depression score, using the Center for Epidemiologic Studies Depression Scale (for more details on this index, please see O'Regan et al, 2010, p.158) and self-reported life-satisfaction (measured on a scale from 1 to 7 where 1 is mostly satisfied and 7 is mostly dissatisfied).

As explained in the Introduction, the inclusion of a rich array of (subjective and objective) health indicators is one of the major strengths of my paper. This is particularly important when attempting to disentangle 'health' from 'non-health' effects that link obesity to labour market outcomes. Also, I agree with Lindeboom et al (2010, p. 315) that controlling for early-life events is important because: i) obese persons may come from other types of family backgrounds than their non-obese counterparts; and ii) coming from a background with lower economic and human capital may, for instance, also affect labour market outcomes.

3. Results

3.1 Women

I start by investigating whether obesity impacts on labour market status of older Irish women. Table 1 focuses on BMI. Three Models are reported in the Table: Model 1 includes only the obesity indicator(s); Model 2 also includes the socioeconomic indicators (current and past); health indicators are added in Model 3. This is done in the attempt to disentangle 'health' from 'non-health' effects when investigating the impact of obesity on labour market status. Each Model includes three different specifications. BMI is entered as a continuous variable in specification (a). Discrete categories are employed in specifications (b) and (c). The reference category is 'normal weight' (i.e. 18.5<=BMI<25) in specification (b) and 'non-obese' (i.e. BMI<30) in specification (c). Only a few women in the sample fall into the 'underweight' category so they were excluded from specification (b).

The top panel of Table 1 presents the results of the probit model that includes women who are employed (1) and not-employed (0). The impact of BMI on employment opportunities of older Irish women is negative. An increase of one unit in BMI reduces the probability of being employed by 0.7% points. However, this impact reduces in size when socio-economic indicators are added to the model (2a) and loses its statistical significance when also health variables are controlled for (3a). Also, women with a BMI>=30 are less likely to be employed than women with a BMI<30 (specification c). The impact decreases in size but remains statistical significant also when a wide range of socio-economic and health indicators are added to the model.

The bottom panel of Table 1 presents the results of the probit model that includes women who are employed (1) and sick/disabled or unemployed (0). The impact of BMI is still negative and statistically significant. However, when both socioeconomic and health variables are controlled for, the impact of obesity on employment opportunities is negative but statistically insignificant (Model 3).

Table 2 focuses on WC. Once again, three Models are reported in the Table and each model includes three different specifications. WC is entered as a continuous variable in specification (a). Sex-specific WC quintiles are employed in specifications (b) and (c). The reference category is 'WC 3rd quintile' in specification (b) and 'WC 1st of 4th quintile' in specification (c).

The top panel of Table 2 presents the results of the probit model that includes women who are employed (1) and not-employed (0). One additional centimetre of WC is associated with a reduction of roughly 0.3% points in the probability of being employed. This impact reduces in size when socio-economic indicators are added to the model (2a) and loses its statistical significance when also health variables are controlled for (3a). Women who fall in the 5th quintile of the waist circumference distribution (i.e. 'centrally obese') are significantly less likely to be employed compared to women with an 'average waist circumference' (WC 3rd quintile) and to women who fall in any of the other four quartiles. This remains true when also socio-economic and health indicators are added to the model. The probability of being employed is 8.3% (5.2%) points lower for centrally obese women compared to women with an 'average waist circumference' ('non-centrally obese women'). This conclusion remains true also when I compare women who are at work with women who are sick/disabled or unemployed (bottom panel).[3]

The marginal effects of the socio-economic and health covariates are reported in Appendix A. Women who are poorly educated, smoking, self-reporting to be in poor health, reporting a higher number of chronic diseases, scoring highly in the depression score and reporting a higher level of life dissatisfaction are less likely to be at work. Also, women who have been spending a higher proportion of their lives at work are more likely to be employed.

- Table 1 around here -

- Table 2 around here -

3.2 Men

I then turn to men. Weaker evidence of a relationship between obesity and labour market status is found. When present, the negative correlation between obesity and employment seems to be related mostly to poor health.

Table 3 focuses on BMI. The top panel of Table 3 shows that the probability of being employed is 6.5% points lower for obese men (BMI>=30). However, the effect is not significant at conventional levels when also health indicators are added to the model. Also, the bottom panel of the Table does not show any clear pattern determining the impact of obesity on the probability of being employed versus sick/disabled/unemployed for older Irish men. Table 4 focuses on WC. Interestingly, both men whose weight is lower than the average (i.e. WC 2nd quintile) and greater than the average (i.e. WC 4th and 5th quintile) are less likely to be at work, suggesting an inverted u-shaped relationship between waist circumference and employment opportunities.

The marginal effects of the socio-economic and health covariates are reported in Appendix B. Men who are older, poorly educated, reporting to have grown up in a poor family, smoking, drinking, not exercising, self-reporting to be in poor health and reporting a higher level of life dissatisfaction are less likely to be at work.

- Table 3 around here -

- Table 4 around here –

[3] For consistency purposes, I also investigate an additional model in which women are categorized in quintiles based on their BMI. I do not find evidence that women who fall in the 5th quintile of the BMI distribution are significantly less likely to be employed.

4. Instrumental variable approach

Within the international literature, there is a consensus that standard models might lead to biased results due to: i) reverse causality (for instance, individuals might be obese because they perform poorly in the labour market); unobserved heterogeneity (for example, obese individuals might have higher discount rates or lower self-esteem and these unobserved characteristics affect both their weight and labour market status); iii) measurement errors when the obesity measure is self-reported.

Several papers have used the instrumental variable approach to capture the true causal effect of obesity on labour market outcomes. A good instrument needs to have two main properties: i) be correlated with and exogenous to individual obesity; ii) be uncorrelated with the error term in the labour market outcome equation. The instruments used in the literature are the obesity status of biological family members, defined as a parent, child or sibling (Cawley, 2004; Brunello and D'Hombres, 2007; Lindeboom et al, 2010; Greve, 2008; Wada and Tekin, 2010; Sabia and Rees, 2012); birth order (Lundborg et al, 2007); number and sex compositon of siblings (Lundborg et al, 2007) and prevalence of obesity in the area in which the respondent lives (Morris, 2006 and 2007).

I follow Morris (2006 and 2007) and use the prevalence of obesity in the area in which the respondent lives as an instrument. Ideally, I would use more than one instrument but information on parental obesity, birth order or number and sex composition of siblings was not collected in the first wave of TILDA. Morris (2006 and 2007) argues that the effect of area obesity on individual obesity is a peer group effect. This is due to two main reasons: 1) individual obesity is determined by the characteristics of the local population, such as food intake and physical activity of peers (exogenous peer effect); 2) also when holding the characteristics of peers constant – such as food intake and physical activity - individual obesity is determined by the social norm (endogenous peer effect). If this is the case, then area prevalence of obesity is a good predictor of individual obesity, and hence a relevant instrument.

I calculate the prevalence of obesity (i.e. 'obesity rate') at *county* level using TILDA sample[4]. Ireland is divided into 34 counties with a mean population of 134,743 residents in 2011 (ranging from 31,778 in Leitrim to 525,383 in Dublin City). In the TILDA sample used in this paper, the mean number of observations for county is 103 (ranging from 22 to 355). For reasons of space constraint, I discuss the IV results for the model that compares those who are in employment with those who are sick, disabled or unemployed (my preferred specification). However, the IV results for the model that compares those at work with those not at work are presented in Appendix C.

I employ a bivariate probit model which includes two equations: 1) the employment equation (1: employed; 0: sick/disabled/unemployed) and 2) the obesity equation (1: obese,

[4] TILDA is the first nationally representative study focusing on individuals aged 50 and above in Ireland where objective measures of BMI and waist circumference are taken. Hence, it is also the best dataset to use to compute obesity measures at county level for the population is this age group.

0: non-obese). In 2), individual obesity is regressed on the instrument and the set of covariates. Once again, I first employ BMI as an obesity indicator and then I turn to waist circumference. The bivariate probit model allows me to deal with the issue of endogeneity by allowing the error terms in both the employment and obesity equations to be correlated. Evidence of exogeneity of the obesity variable is found if one fails to reject the null hypothesis that the error terms are independent. This is done through a Wald test of the rho parameter - the correlation between the error terms in the employment and obesity equations.

I also need to ensure that the instrument is orthogonal, i.e. it is not correlated with the error term in the employment equation. Following Morris (2006 and 2007), I include a range of covariates that capture the impact of local area characteristics on individual employment in the bivariate probit models. This is based on the argument that if the area prevalence of obesity is correlated with individual employment other than through its impact on individual obesity, then plausibly this is only through its correlation with individual and local area deprivation and health (e.g., the local employment rate or income level). For each county, I include the following indicators: unemployment rate (2006); proportion of residents unable to work due to permanent sickness or disability (2006); proportion of unskilled workers (2006); proportion of residents with no or primary education (2006); proportion of residents with a disability (2006); vacancy rate (2006); disposable income per person (2008) and proportion of private households with internet access and PC ownership (2006). In doing this, I aim to remove any correlation between area obesity and the error term in the employment equation.

4.1 Women

I start by focusing on the results for women. Results are reported in Table 5. In Model 1, women are identified as obese when their BMI>=30. I use the prevalence rate of obesity at county level as instrument, i.e. the share of individuals with a BMI>=30 in the county in which the respondent lives. The coefficient of the instrument is positive and significant at 1% level in the obesity equation: women who live in counties with a higher prevalence of obesity are more likely to be obese. The rho parameter is negative. This means that unexplained factors that affect obesity are negatively correlated with unexplained factors that affect employment. However - using the Wald test - I fail to reject the hypothesis that rho is equal to zero. This suggests that – assuming that the instrument is valid – the results of the standard probit model are not biased.

Although I do not seem to find evidence of endogeneity, I calculate the marginal effect of the obesity variable in the outcome equation in the bivariate probit model. For each observation, I compute the conditional probability that the individual is employed given that she is obese. I then compute the conditional probability that the individual is employed given that she is non-obese. I finally compute the difference between the two probabilities for each observation. The average of the difference over all observations is the marginal effect reported in the Table. I also use the bootstrapping method to build a confidence interval around this estimate. Unsurprisingly, the marginal effect obtained in this way are in line with those reported in the standard probit model (-0.023 vs -0.022).

In Model 2, women are identified as centrally obese when they fall into the 5th quintile of WC distribution. As instrument, I use the county average waist circumference. The instrument is positive and significant at 1% level in the obesity equation. Using the Wald test, I reject the hypothesis that rho is equal to zero. This seems to suggest that the correlation between the error terms in the employment and obesity equations is different from zero. Marginal effects are computed as explained in the previous paragraph. The magnitude of the marginal effect is higher than in the standard probit model and significant at 1% level. In this specification, the probability of being employed is 5.6% points lower for women who fall into the 5th quintile of the WC distribution.

- Table 5 around here -

4.2 Men

Results of the bivariate probit models for men are reported in Table 6. Evidence of endogeneity is found – once again provided that the instrument is valid - in both Models 1 and 2. The marginal effects computed in the bivariate probits model are higher in magnitude if compared with those of the standard probit models, but still statistically insignificant. Also in this specification, there does not appear to be a relationship between (central) obesity and employment opportunities for men.[5]

- Table 6 around here –

5. Discussion and Conclusions

In this paper, I have examined the relationship between obesity and labour market status using an anthropometric indicator of body composition (waist circumference) along with body mass index. I have focused on older individuals (aged 50-64) resident in Ireland. I have used the first wave of The Irish Longitudinal Study on Ageing (TILDA). The paper demonstrates – in line with some recent studies in the international literature - that results depend on the obesity measure used and the discrete categories employed, at least to some extent.

For women, I find clear evidence of a negative association between obesity and employment. Waist circumference - a measure of central obesity - seems to be a better predictor of labour market status. Factors other than health and socioeconomic characteristics are found to play a role in explaining why obese older women are less likely

[5] As a final robustness check, I investigate the impact of the area prevalence of obesity on employment, controlling for the full set of covariates but excluding individual obesity. I do this for men and women and focusing on BMI and WC separately. The area prevalence of obesity has always an insignificant impact on individual employment.

to be at work, and in particular more likely to be (permanently) sick or disabled or unemployed. The natural question to ask is whether this effect is driven mostly by women who report to be unable to work due to illness or by women who are unemployed. The latter explanation seems to be more plausible. But even if these was the case, one might wonder if higher unemployment rates for centrally obese women are due to discrimination based on physical appearance or to the fact that these women are more ‘discouraged’ and hence do not actively look for a job although reporting to be unemployed. The small numbers of women who are unemployed and actively seeking a job and unemployed but not actively seeking a job do not permit any meaningful inference about these two specific groups.

Much weaker evidence of a relationship between obesity and labour market status is found for men. If anything, the results of the models employed in this paper seem to show an inverted u-shape relationship between ‘weight’ and employment. Also, when present, the negative correlation between obesity and employment seems to be related mostly to poor health.

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Table 1: Marginal effects of obesity indicators (based on BMI). Estimation method: Probit Model. Women only.

	Model 1: Only Obesity indicator			*Model 2: Obesity + Socio-economic indicators*			*Model 3: Obesity+ Socio-economic + Health indicators*		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Outcome variable: 1: employed; 0: not-employed									
BMI	-0.007*** [2.90]	--	--	-0.004** [2.26]	--	--	-0.003 [1.54]	--	--
Over-weight	--	0.000 [0.0]	--	--	0.008 [0.27]	--	--	0.004 [0.18]	--
Obese	--	-0.092*** [2.69]	-0.089*** [3.24]	--	-0.066** [2.28]	-0.067*** [2.77]	--	-0.052* [1.8]	-0.051** [2.18]
N	1,748	1,736	1,748	1,748	1,736	1,748	1,748	1,736	1,748
Outcome variable: 1: employed; 0: permanently sick or disabled / unemployed									
BMI	-0.008*** [3.48]	--	--	-0.006*** [2.96]	--	--	-0.002 [1.15]	--	--
Over-weight	--	-0.024 [0.73]	--	--	-0.008 [0.29]	--	--	-0.022 [0.82]	--
Obese	--	-0.100*** [2.96]	-0.085*** [2.97]	--	-0.070** [2.34]	-0.063** [2.51]	--	-0.037 [1.25]	-0.022 [0.93]
N	1,125	1,119	1,125	1,125	1,119	1,125	1,125	1,119	1,125

Note: in Models (b) the reference category is "normal weight" and the category "underweight" is excluded. In models (c) the reference category is "non-obese". t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 2: Marginal effects of obesity indicators (based on WC). Estimation method: Probit Model. Women only.

	Model 1: Only Obesity indicator			Model 2: Obesity + Socio-economic indicators			Model 3: Obesity+ Socio-economic + Health indicators		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Outcome variable: 1: employed; 0: not-employed									
WC	-0.003*** [3.20]	--	--	-0.002** [2.25]	--	--	-0.001 [1.51]	--	--
WC 1st quintile	--	-0.053 [1.32]	--	--	-0.032 [0.89]	--	--	-0.038 [1.09]	--
WC 2nd quintile	--	-0.078* [1.96]	--	--	-0.032 [0.9]	--	--	-0.036 [1.03]	--
WC 4th quintile	--	-0.105** [2.57]	--	--	-0.046 [1.23]	--	--	-0.048 [1.3]	--
WC 5th quintile	--	-0.168*** [4.28]	-0.109*** [3.42]	--	-0.101*** [2.82]	-0.073*** [2.61]	--	-0.083** [2.39]	-0.052* [1.91]
N		1,748			1,748			1,748	
Outcome variable: 1: employed; 0: permanently sick or disabled / unemployed									
WC	-0.003*** [3.29]	--	--	-0.002*** [2.67]	--	--	-0.001 [0.97]	--	--
WC 1st quintile	--	-0.033 [0.74]	--	--	-0.018 [0.46]	--	--	-0.028 [0.77]	--
WC 2nd quintile	--	-0.061 [1.47]	--	--	-0.032 [0.88]	--	--	-0.039 [1.12]	--
WC 4th quintile	--	-0.032 [0.7]	--	--	-0.006 [0.14]	--	--	-0.006 [0.16]	--
WC 5th quintile	--	-0.164*** [4.02]	-0.132*** [4.41]	--	-0.112*** [3.07]	-0.098*** [3.70]	--	-0.069** [2.01]	-0.052** [2.14]
N		1,125			1,125			1,125	

Note: in Models (b) the reference category is "WC 3rd quintile". In models (c) the reference category is "WC 1st to 4th quintile".
t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 3: Marginal effects of obesity indicators (based on BMI). Estimation method: Probit Model. Men only.

	Model 1: Only Obesity indicator			*Model 2: Obesity + Socio-economic indicators*			*Model 3: Obesity+ Socio-economic + Health indicators*		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Outcome variable: 1: employed; 0: not-employed									
BMI	-0.004 [1.36]	--	--	-0.003 [1.53]	--	--	-0.001 [0.48]	--	--
Over-weight	--	0.050 [1.32]	--	--	-0.005 [0.14]	--	--	-0.009 [0.29]	--
Obese	--	-0.03 [0.75]	-0.065** [2.44]	--	-0.045 [1.38]	-0.041* [1.81]	--	-0.027 [0.8]	-0.019 [0.389]
N	1,477	1,476	1,477	1,477	1,476	1,477	1,477	1,476	1,477
Outcome variable: 1: employed; 0: permanently sick or disabled / unemployed									
BMI	-0.001 [0.27]	--	--	-0.001 [0.70]	--	--	0.000 [0.10]	--	--
Over-weight	--	0.077** [2.18]	--	--	0.00 [0.00]	--	--	-0.007 [0.23]	--
Obese	--	0.019 [0.52]	-0.037 [1.40]	--	-0.015 [0.48]	-0.015 [0.67]	--	-0.002 [0.06]	0.003 [0.16]
N		1,238			1,238			1,238	

Note: in Models (b) the reference category is "normal weight" and the category "underweight" is excluded. In models (c the reference category is "non-obese". t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 4: Marginal effects of obesity indicators (based on WC). Estimation method: Probit Model. Men only.

	Model 1: Only Obesity indicator			Model 2: Obesity + Socio-economic indicators			Model 3: Obesity+ Socio-economic + Health indicators		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Outcome variable: 1: employed; 0: not-employed									
WC	-0.002** [2.19]	--	--	-0.001 [1.40]	--	--	-0.000 [0.22]	--	--
WC 1st quintile	--	-0.033 [0.81]	--	--	-0.006 [0.17]	--	--	-0.010 [0.28]	--
WC 2nd quintile	--	-0.075* [1.81]	--	--	-0.063* [1.79]	--	--	-0.060* [1.76]	--
WC 4th quintile	--	-0.072* [1.7]	--	--	-0.073** [2.15]	--	--	-0.060* [1.78]	--
WC 5th quintile	--	-0.129*** [3.31]	-0.084*** [2.79]	--	-0.073** [2.27]	-0.037 [1.44]	--	-0.044 [1.38]	-0.010 [0.40]
N		1,477			1,477			1,477	
Outcome variable: 1: employed; 0: permanently sick or disabled / unemployed									
WC	-0.001 [0.61]	--	--	-0.000 [0.30]	--	--	0.000 [0.71]	--	--
WC 1st quintile	--	-0.052 [1.38]	--	--	-0.016 [0.47]	--	--	-0.020 [0.59]	--
WC 2nd quintile	--	-0.060 [1.53]	--	--	-0.054* [1.66]	--	--	-0.053* [1.71]	--
WC 4th quintile	--	-0.017 [0.39]	--	--	-0.029 [0.84]	--	--	-0.022 [0.64]	--
WC 5th quintile	--	-0.090** [2.33]	-0.057* [1.86]	--	-0.042 [1.38]	-0.017 [0.70]	--	-0.022 [0.73]	0.002 [0.10]
N		1,238			1,238			1,238	

Note: in Models (b) the reference category is "WC 3rd quintile". In models (c) the reference category is "WC 1st to 4th quintile".
t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Table 5: Results of bivariate probit models. Outcome variable in employment equation: 1: employed; 0: (permanenetly) sick or disabled / unemployed. Obesity indicators: BMI and WC. Women only.

	Model 1 *Obesity indicator = BMI*	*Model 2* *Obesity indicator = WC*
Impact of instrument on obesity (obesity equation)	2.38*** [3.83]	0.010*** [5.31]
Rho	-0.396	-0.835
Wald test rho=0 [p value]	$X^2(1)$=2.48 [0.12]	$X^2(1)$= 8.04*** [0.005]
Marginal effect of obesity on employment (bivariate probit model)	-0.023 [0.86]	-0.056*** [3.40]
Marginal effect of obesity on employment (standard probit model)	-0.022 [0.93]	-0.052** [2.14]

Note: t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are adjusted for county level clustering.

Table 6: Results of bivariate probit models. Outcome variable in employment equation: 1: employed; 0: (permanenetly) sick or disabled / unemployed. Obesity indicators: BMI and WC. Men only.

	Model 1 *Obesity indicator = BMI*	*Model 2* *Obesity indicator = WC*
Outcome variables in Employment Eq:		
Impact of instrument on obesity (obesity equation)	2.59*** [5.46]	0.112*** [5.17]
Rho	0.790	0.648
Wald test rho=0 [p value]	$X^2(1)$= 8.93*** [0.003]	$X^2(1)$= 3.16* [0.08]
Marginal effect of obesity on employment (bivariate probit model)	0.006 [0.30]	0.018 [0.45]
Marginal effect of obesity on employment (standard probit model)	0.003 [0.16]	0.002 [0.10]

Note: t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are adjusted for county level clustering.

Appendix A

Table A.1: Marginal effects of socio-economic and health indicators. Estimation method: Probit model. Obesity indicators: BMI and WC. Women only.

	1: employed 0:employed		1: employed; 0:sick/disabled/unemployed	
Obesity indicator:	*BMI*	*WC*	*BMI*	*WC*
Age	-0.026***	-0.026***	0.001	0.001
	[9.22]	[9.14]	[0.28]	[0.32]
Secondary education	-0.039	-0.040*	-0.096***	-0.097***
	[1.63]	[1.65]	[4.15]	[4.15]
No/primary education	-0.163***	-0.163***	-0.182***	-0.183***
	[4.33]	[4.33]	[3.86]	[3.87]
Lives alone	0.086**	0.088**	0.032	0.032
	[2.47]	[2.51]	[1.09]	[1.09]
Lives with others	0.010	0.010	0.083***	0.082***
	[0.38]	[0.39]	[3.30]	[3.24]
Lives in Dublin	0.010	0.011	0.005	0.007
	[0.34]	[0.37]	[0.17]	[0.23]
Lives in another town/city	-0.019	-0.019	-0.026	-0.025
	[0.70]	[0.68]	[0.93]	[0.90]
N living children	0.022***	0.022***	0.009	0.009
	[2.94]	[2.95]	[1.27]	[1.28]
N years spent at work	0.016***	0.016***	0.007***	0.007***
	[18.49]	[18.44]	[6.63]	[6.61]
Grew up in rural area	0.030	0.031	0.058**	0.060**
	[1.26]	[1.30]	[2.26]	[2.34]
Poor health in childhood	-0.054	-0.054	-0.060	-0.059
	[1.30]	[1.28]	[1.41]	[1.38]
Grew up in a poor family	-0.024	-0.024	-0.026	-0.026
	[0.74]	[0.74]	[0.91]	[0.91]
Parents were not working	0.032	0.033	0.019	0.019
	[0.62]	[0.64]	[0.43]	[0.44]
Both parents low education	0.033	0.033	-0.016	-0.017
	[1.26]	[1.25]	[0.63]	[0.69]
One parent missing education	0.030	0.031	-0.060	-0.061
	[0.68]	[0.69]	[1.39]	[1.40]
Currently smokes	-0.070**	-0.067**	-0.086***	-0.084**
	[2.39]	[2.29]	[2.61]	[2.56]
Used to smoke	0.002	0.003	-0.042	-0.041
	[0.07]	[0.11]	[1.52]	[1.49]
Energy expenditure	0.000	0.000	0.000	0.000
	[0.33]	[0.31]	[0.85]	[0.84]
Drinks per week	0.000	0.000	0.001	0.001
	[0.06]	[0.09]	[0.85]	[0.86]
Info on alcohol intake missing	-0.023	-0.026	-0.123	-0.122
	[0.16]	[0.18]	[1.09]	[1.08]
N chronic illnesses	-0.024***	-0.024***	-0.034***	-0.034***
	[2.70]	[2.69]	[3.57]	[3.61]
Poor health	-0.075**	-0.076**	-0.116***	-0.118***
	[2.31]	[2.35]	[4.56]	[4.68]
Grip strength	0.004	0.004	0.002	0.002
	[1.56]	[1.59]	[0.89]	[0.92]
CES-D score	-0.003**	-0.003**	-0.003**	-0.003**
	[1.97]	[1.98]	[2.26]	[2.25]
Life un-satisfaction	-0.016	-0.016	-0.034***	-0.034***
	[1.48]	[1.51]	[3.73]	[3.75]
N	1,748		1,125	

Reference categories for dichotomous variable with at least 3 categories are: third/higher level of education; lives with spouse only; lives in a rural area; at least one parent has/had secondary/tertiary education; never smoked. BMI and WC are entered in continuous form. t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Appendix B

Table B.1: Marginal effects of socio-economic and health indicators. Estimation method: Probit model. Obesity indicators: BMI and WC. Men only.

	1: employed 0:employed		*1: employed; 0:sick/disabled/unemployed*	
Obesity indicator:	*BMI*	*WC*	*BMI*	*WC*
Age	-0.054***	-0.054***	-0.031***	-0.030***
	[13.43]	[13.42]	[7.60]	[7.57]
Secondary education	-0.085***	-0.085***	-0.126***	-0.126***
	[3.10]	[3.11]	[4.70]	[4.68]
No/primary education	-0.132***	-0.132***	-0.230***	-0.230***
	[3.40]	[3.39]	[5.26]	[5.25]
Lives alone	0.045	0.045	0.028	0.029
	[1.26]	[1.26]	[0.91]	[0.92]
Lives with others	0.052**	0.052**	0.059**	0.060**
	[1.97]	[1.98]	[2.34]	[2.38]
Lives in Dublin	-0.014	-0.014	0.009	0.009
	[0.48]	[0.47]	[0.33]	[0.34]
Lives in another town/city	0.018	0.018	0.041*	0.041*
	[0.68]	[0.68]	[1.71]	[1.72]
N living children	-0.005	-0.005	-0.005	-0.006
	[0.84]	[0.87]	[0.92]	[0.97]
N years spent at work	0.034***	0.034***	0.026***	0.026***
	[10.70]	[10.71]	[9.65]	[9.61]
Grew up in rural area	0.047*	0.046*	0.035	0.035
	[1.77]	[1.76]	[1.40]	[1.37]
Poor health in childhood	0.002	0.002	0.038	0.037
	[0.04]	[0.05]	[0.94]	[0.91]
Grew up in a poor family	-0.052**	-0.053**	-0.045*	-0.046*
	[2.07]	[2.08]	[1.92]	[1.95]
Parents were not working	0.097**	0.097**	0.093**	0.094**
	[2.14]	[2.16]	[2.48]	[2.50]
Both parents low education	-0.044*	-0.044*	-0.030	-0.030
	[1.80]	[1.80]	[1.33]	[1.35]
One parent missing education	-0.067	-0.066	-0.057	-0.057
	[1.33]	[1.33]	[1.23]	[1.24]
Currently smokes	-0.062*	-0.061*	-0.087***	-0.084***
	[1.86]	[1.84]	[2.69]	[2.64]
Used to smoke	-0.002	-0.002	-0.006	-0.006
	[0.07]	[0.07]	[0.27]	[0.27]
Energy expenditure	0.000***	0.000***	0.000***	0.000***
	[2.89]	[2.89]	[2.92]	[2.93]
Drinks per week	-0.002***	-0.002***	-0.002***	-0.002***
	[2.61]	[2.60]	[2.97]	[2.96]
Info on alcohol intake missing	0.164**	0.164**	0.150**	0.149**
	[2.32]	[2.31]	[2.56]	[2.55]
N chronic illnesses	-0.020**	-0.020**	-0.004	-0.005
	[2.07]	[2.11]	[0.49]	[0.61]
Poor health	-0.094***	-0.094***	-0.109***	-0.110***
	[3.25]	[3.26]	[4.47]	[4.51]
Grip strength	-0.003	-0.003	-0.001	-0.001
	[1.64]	[1.64]	[0.72]	[0.71]
CES-D score	-0.002	-0.002	-0.002	-0.002
	[1.16]	[1.16]	[1.01]	[1.02]
Life un-satisfaction	-0.019*	-0.019*	-0.023**	-0.023**
	[1.77]	[1.77]	[2.36]	[2.37]
N	1,477		1,238	

Reference categories for dichotomous variable with at least 3 categories are: third/higher level of education; lives with spouse only; lives in a rural area; at least one parent has/had secondary/tertiary education; never smoked. BMI and WC are entered in continuous form. t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Appendix C

Table C.1: Results of bivariate probit models. Outcome variable in employment equation: 1: employed; 0: not employed. Obesity indicators: BMI and WC. Women only.

	Model 1 *Obesity indicator = BMI*	*Model 2* *Obesity indicator = WC*
Impact of instrument on obesity (obesity equation)	2.08*** [2.66]	0.073*** [3.12]
Rho	-0.70	-0.93
Wald test rho=0 [p value]	$X^2(1)$=2.10 [0.15]	$X^2(1)$=4.85** [0.03]
Marginal effect of obesity on employment (bivariate probit model)	-0.050** [2.10]	-0.044*** [4.28]
Marginal effect of obesity on employment (standard probit model)	-0.051** [2.18]	-0.052* [1.91]

Note: t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are adjusted for county level clustering.

Table C.2: Results of bivariate probit models. Outcome variable in employment equation: 1: employed; 0: not employed. Obesity indicators: BMI and WC. Men only.

	Model 1 *Obesity indicator = BMI*	*Model 2* *Obesity indicator = WC*
Outcome variables in Employment Eq:		
Impact of instrument on obesity (obesity equation)	2.42*** [7.37]	0.058** [2.6]
Rho	0.49	0.55
Wald test rho=0 [p value]	$X^2(1)$=2.25 [0.14]	$X^2(1)$= 3.6* [0.06]
Marginal effect of obesity on employment (bivariate probit model	-0.012 [0.53]	0.019 [0.80]
Marginal effect of obesity on employment (standard probit model)	-0.019 [0.389]	-0.010 [0.40]

Note: t statistics (absolute value) in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Standard errors are adjusted for county level clustering.

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