Obesity and Labor Market Outcomes:

New Danish Evidence

Jane Greve

Aarhus School of Business, Denmark

jap@sfi.dk

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Abstract

This paper analyzes the relationship between body weight and employment status, thereby broadening the perspective of the literature on obesity and labor market outcomes. The analysis uses a unique data set consisting information from a Danish panel survey from 1995 and 2000, combined with administrative registers. This data set contains thorough information on about 8000 individuals, including body weight, health, income, employment history, and medical prescriptions. The results of the Danish analysis show a negative effect of increasing body weight on employment levels for women, with a small positive effect of being overweight compared to being in healthy weight on employment for men. The results further show that unlike in the U.S. studies, body weight in Denmark has no influence on wages for either men or women.

1. Introduction

The relationship between obesity and labor market outcomes has been studied broadly in recent U.S. literature. The prevalence of obesity in the U.S., around 30 percent 1999-2002 (Hedley et al. 2004), is the highest in the world, and its impact on wages is significantly negative, especially for white women (Cawley 2004). Sanz-de-Galdeano (2005) finds for a selected sample of European countries that the obesity levels on average rose 8.5 percent from 1998 to 2001 for both men and women, indicating that obesity is also a growing health problem in the European context. Yet, data on obesity rates in Europe are sparse and inadequate.

The existing literature on the relationship between obesity and labor market outcomes concentrates mainly on the impact of obesity on wages (Cawley 2004; Bhattacharya and Bundorf 2005; d'Hombres and Brunello 2005; Morris 2006). However, labor markets in the Northern European welfare state economies are characterized by a compact wage distribution, and a considerable share of the labor force is employed in the public sector, with fixed wage structures. Although, we therefore cannot expect to find large impacts of obesity on wages in Europe, focusing on the impact of body weight on employment may prove relevant. Because finding and holding a job is a prerequisite to other relevant aspects of an individual's labor market experience, the main focus of this paper is to estimate the impact of obesity on the likelihood of having a job. Compared to the existing literature, this paper broadens the perspective on obesity and labor market outcomes by analyzing the impact of obesity on both employment status and wages.

Obesity is defined as a physical condition that results from excessive storage of fat in the body, with consequences for the individual's health (Svendsen et al., 2001). The precise percentages of body fat that lead to negative health consequences are not yet known. In practice, obesity is usually defined by a body mass index, BMI (measured as weight in kilos over height in meters squared, kg/m^2), above 30.

According to the medical literature obesity is genetically inheritable (Comuzzie and Allison 1998; Astrup, Rössner and Sørensen 2006). But the genetic component does not explain the significant increase in the prevalence of obesity. Instead, factors such as the technological change both in food preparation and in the kitchen, the low prices of fast food and soft drinks, the decline in manual labor, and a general decline in physical activity are some of the possible causes of the increased obesity level in advanced nations (Rashad and Grossman 2004; Cutler, Glaeser and Shapiro 2004).

The consequences of obesity are serious: First, obesity is a major health problem for a large and growing number of people, as it is related to a number of serious diseases. In particular, obesity or being overweight substantially increases the rate of morbidity from hypertension, type 2 diabetes, coronary heart disease, and sleep apnea. Higher body weight is also associated with an increase in all-cause mortality and lower fertility (NHLBI 1998). Second, obesity may lead to psychological problems arising from social rejection, humiliation and dissatisfaction with oneself. These problems seem particularly present among women. Several studies have shown that obesity has a considerably more stigmatizing effect on women, and that women appear to internalize this stigma more than men (Sobal 1989; Peralta 2003). The stigmatization may also depend on the prevalence of obesity, so that obesity becomes more stigmatizing in countries like Denmark, where the prevalence is less than half of the U.S. level.

The problems at the personal level may also affect the individual’s relationship to the labor market. Obesity may reduce work ability, thereby reducing the individual’s productivity. Although results from the Burkhauser and Cawley study (2004) are mixed, they nonetheless show evidence that weight increases the probability of health-related work limitations and the probability of receiving disability-related benefit payments. Obesity may also increase sick days. More days out for illness do not necessarily imply lower productivity. However, if obese people on average do have a significantly higher rate of absenteeism, which creates higher costs for the employer, then more sick days may lead to statistical discrimination (Jensen, Greve and Tranæs, 2005). Finally, several experimental studies from the U.S. have documented weight-based discrimination at every stage of employment, from the hiring decision through wage-setting and promotion (Puhl and Brownell, 2001).

This paper contributes new data to the literature, in addition to a new approach to the subject of obesity and labor market outcomes. First, it presents estimates of the impact of obesity on both employment and wages for both men and women in Denmark. Second, it uses a unique data set that consists of information from both a Danish panel survey from 1995 and 2000 and the administrative registers. This data set, which contains thorough information on about 8000 individuals, includes a long list of employment variables, categories on body weight, employment history, hospitalizations and related diagnoses, frequency of doctor consultations, and medical prescription records. This data combination allows us to take into account methodological problems–such as measurement error, endogeneity, and selection–that arise in studies of the relationship between obesity and labor market outcomes.

The remainder of the paper proceeds as follows: Section 2 discusses the theoretical framework, hypotheses, and method. Section 3 describes the data set and variables used, and section 4 presents the empirical strategy. Section 5 present the empirical results, and section 6 provides some concluding remarks.

2. Theoretical Framework: The Impact of Body Weight on Employment

Three central hypotheses explain the impact of body weight on employment: differences in labor supply, personal discrimination and statistical discrimination.

First, body weight may affect labor supply. Obesity may cause lower productivity (e.g. work disability), or overweight people may not have the same incentives to participate in the labor market as healthy weight people (e.g. resultant health problems may limit the individual's ability to and preferences for work).

Second, discrimination against obese people in the labor market can be a consequence of prejudice or preferences (for non-obese workers) on the part of employers, employees or customers (Becker 1973). Determining when differences in employment should be categorized as discrimination is not easy, as employment differences are often justified as productivity differences or additional costs associated with employing a specific individual.

However, sociological literature supports the hypothesis that obese people meet discrimination on the labor market. Research on the hiring process shows that some of the most important values an employer looks for are non-measurable characteristics such as engagement, commitment, and social qualifications (Behrenz and Delander 1996; Csonka 1995). These values may work against obese people in the hiring process, especially as research has revealed widely-held public beliefs that obese people are lazier and less socially and intellectually skilled than healthy-weighted people (Sobal and Stunkard 1989; Puhl and Brownell 2001). Furthermore, obesity is often considered self-inflicted, and therefore discriminating against the obese seems more "legitimate" than discriminating against other sub-groups, e.g., the physically disabled (DeJong 1980).

These preferences against overweight and obese people leads to a stigmatization of obese people and this stigma even seems to be internalised by people suffering from this physical condition (Teachman et al. 2003). Furthermore, research in the socio-psychological literature show that women's appearances in general evoke stronger reactions, both positive and negative, than men's do (Hatfiels and Sprecher, 1986); a fact that may have both introversive psychological implications and extroversive judgemental consequences for women.

Third, discrimination against obese workers may also have statistically validation if obese people on average have more sick days, lower productivity or higher quitting rates than non-obese people. Although obesity is associated with a low health status, not all obese people are unhealthy. But the statistical relationship between increasing BMI and health problems may have negative consequences for obese people when employers have imperfect information about the true health and productivity of the obese individual. Given a statistical positive relationship between increasing BMI and health problems, an employer may choose to hire a non-obese worker instead of an obese worker, in the interest of maximizing profits.

3 Methods and the Empirical Strategy

The main focus of this paper is to estimate the impact of body weight on employment. However, as body weight is partly an effect of individual life patterns and choices, the impact of body weight on employment is difficult to analyze, as employment simultaneously may affect weight and thereby impose endogeneity. Unemployment may affect weight if, for example, a relationship exist between long-term unemployment and mental health, and between mental health and obesity. Studies from the U.S. have further linked obesity and mental illness to unemployment or job delay, particularly among women (Peralta 2003; Bove and Olsen 2005).

Employment may also affect weight if the unemployed and low-wage earners have restricted access to healthy food and live in areas where fattening fast food is cheap and easily available. Yet, in this example, the reverse causality–i.e. poor labor market outcomes' promoting obesity–is less likely to obfuscate the issue in Denmark, where taxes on fast food are relatively high and eating out is relatively expensive (Lipsey and Swedenborg 1996). Still, obesity may affect employment for other reasons. A study on healthcare in Europe (Alber and Köhler 2004) shows a considerably higher share of the working population feel stressed when compared to those not employed. Furthermore, stress is known to be related to body weight (Harris et al. 1998; Hannerz et al. 2004).

However, when unobserved factors are correlated with both weight and labor market outcomes, a third factor may also explain the relationship between obesity and employment (Cawley 2004). This factor could be the willingness to delay gratification. Perhaps those people who do not engage in overeating are also those who invest more in skills and work harder than other people. A number of recent studies have analyzed the relationship between BMI and time preferences (Borghans and Golsteyn 2005; Cutler and Glaeser 2005; Komlos, Smith and Bogin 2004; Smith, Bogin and Bishai 2005) and find some evidence of the relationship between BMI and the discount rate. But the results on the relationship between BMI and time preferences depend on both the proxy for the discount rate and the variances between specific sub-groups within the population.

Typically, problems with endogeneity are associated with simultaneity. But other endogeneity problems such as measurement error and omitted variables arise as well in estimations of the relationship between body weight and labor market outcomes. Previous studies has dealt with the problem of endogeneity with a measure of previous body weight (Averett and Korenman 1996; Sargent and Blanchflower 1995), with twin studies (Averett and Korenman 1996; Conley and Glauber 2005), with a propensity score approach (Sousa 2005) or with the method of instrumental variable (Cawley 2004; Cawley, Grabka and Lillard 2005; d´Hombres and Brunello 2005; Morris 2006). Using instrumental variable methods to control for endogeneity requires a variable that is correlated with and exogenous to obesity but uncorrelated with employment. Therefore, we need to find a variation in the body weight measure that the individual cannot control.

Recent research into the impact of obesity on wages (Cawley 2004; Cawley, Grabka and Lillard 2005; d´Hombres and Brunello 2005) uses information on the BMI of siblings, parents or children controlling for age and gender as instruments for the interviewee’s BMI. Information on the BMI of family members is supposed to be a good instrument when correlated with the interviewee’s BMI. First, biological family members are expected to share half of the same hereditary material. Second, the argument is that family members’ BMI is uncorrelated with the unobserved factors in the interviewee’s labor market outcome equation. Potentially, these unobserved, non-genetic factors could be, for example, habits learned in the family and passed on from parents to their children. But, according to a long list of studies in the clinical literature, there is no effect of common environment on body weight in samples comparing adopted and biological children (Grilo and Pogue-Geile 2001). However, a few medical studies find the opposite results (Jacobson and Rowe 1998). Thus, as the question remains an empirical one, a pragmatic approach is to test a set of instruments for uncorrelatedness with the error term in the outcome equation.

The instrumental variables in this study are whether or not the father or the mother of the interviewee has been prescribed medication for genetically determined illnesses or health problems related to obesity (in any of the years in the administrative data period 1995-2000), the parents' age, and the parents' mortality status in 2000. Although obesity is associated with a number of diseases, two are of particular interest, namely, hypertension and Type 2 diabetes, because these diseases are mainly genetically correlated with obesity (Carmelli D., L.R. Cardon and R. Fabsitz 1994).

To illustrate the overall tendencies in the employment situation for people within a weight category above that of healthy weight people, I use a non-linear model. An important aspect of the non-linear model is that it accommodates the likely possibility that the effect of BMI varies across heterogeneous subgroups of the population. I have estimated all models separately for men and women due to differences in labor market behavior and different behavior with respect to body related issues. To illustrate the heterogeneous effect of BMI on employment, I compute this effect for four different subgroups for both men and women.

To test for exogeneity, I apply a two-step approach by Rivers and Vuong (1988) in the probit model. Additionally, I estimate a linear probability model (LPM) to test for exogeneity.

4. Data and variables

4.1 Data

The unique data set in this paper is a panel survey from 1995 and 2000, containing information on self-reported height and weight, and a number of self-reported health variables and lifestyle factors. Due to a unique identifier, these variables are merged with information from administrative registers which–besides holding thorough information on socioeconomic status, employment, income, housing and information on family members–contain information on hospitalizations and related diagnoses, frequency of doctor consultations, and medical prescription records. Therefore, the dataset contains a set of good and relevant indicators necessary for studying the relationship between body weight and labor market outcomes.

In the 2000 sample, 11,437 people ages 18-69 and living in Denmark were selected for an interview and, of these people, 75 percent participated. I selected a sample of people between 18 and 59 of age for this study, as only people available for labor market participation are of interest. As weight is affected by pregnancy, I have left out 145 women who were pregnant during the relevant year, as well as 155 observations because of missing information on height or weight. The data set for year 2000, therefore, includes 7,186 observations: 3,569 men and 3,617 women.

4.2 Obesity measures

The explanatory variable of chief interest is a measure that characterizes body weight. The primary body weight measure in this paper is the Body Mass Index, BMI, which is calculated as weight in kilograms, kg, divided by height in meters squared, m^2. Several different versions of the BMI are used. First, I use a continuous measure of body weight. I have tested several functional forms of BMI (the natural logarithm of BMI and BMI squared). As the medical literature shows an increase in the probability for diseases and mortality for BMI higher than 25, indicator variables for obesity and being overweight is also used as a body weight measure. The indicator for being overweight is defined as a BMI between 25 and 30, and the indicator for obesity is defined as a BMI of 30 or more.

The control group for these indicator variables is made up of individuals with a BMI under 25. This group includes people in both the healthy weight and underweight categories, because the number of people with a BMI less than 18.5–the standardized definition of "underweight"–is small. Even though this group contains both underweight and healthy-weighted people, it will be labeled as "healthy weighted". Furthermore, I calculate a relative measure as the distance from the mean BMI for each gender. A relative BMI measure shows location in distribution and can be relevant when social norms influence the concept of being “normal” and punish deviators.

Medical research in Denmark shows an overall tendency for people to under-report their true weight but over-report their height (Bendixen et al. 2004). A study by Bendixen et al. (2004) finds that self-reported BMI on average is underestimated by 1.9 percentage points for men and by 5.3 percentage points for women. To correct for measurement error, this study predict the true BMI using Bendixsen’s information on the relationship between the reported and true BMI. All estimations have been done both with and without this correction for measurement error. But this correction is relevant only in the analysis, where I do not use instrumental variables to correct for endogeneity and measurement error. The instrumental variables method correct at the same time for both the endogeneity and the measurement error problem. Correcting for measurement error may therefore lead to an over-correction of the estimate when applying the instrumental variable method.

Table 1: Summary statistics for independent variables for body weight in 2000, mean (standard deviation)

Variables	*Men*		*Women*	
	N	Mean (standard deviation)	N	Mean (standard deviation)
BMI	3,569	25.3 (3.6)	3,617	23.6 (4.0)
Predicted BMI	3,569	25.6 (3.5)	3,617	24.9 (3.9)
Weight in kilo grams	3,569	82.5 (12.7)	3,617	66.2 (11.8)
Height in metres	3,569	180.4 (6.9)	3,617	167.3 (6.2)
Healthy weight	3,569	0.52 (0.50)	3,617	0.71 (0.46)
Overweight	3,569	0.39 (0,49)	3,617	0.23 (0.42)
Predicted Overweight	3,569	0.43 (0.49)	3,617	0.32 (0.47)
Obese	3,569	0.10 (0.30)	3,617	0.07 (0.25)
Predicted Obese	3,569	0.10 (0.31)	3,617	0.09 (0.29)
BMI deviated from the mean	3,569	0.86 (3.6)	3,617	-0.84 (4.04)

On average, men have a body mass index (BMI) of 25 and women on average have a BMI of 24. The prevalence of obesity and being overweight is higher for men than for women. Among men, 39 percent are in the category “overweight” and 10 percent are in the category “obese”. Among women, 23 percent are in the category “overweight” and 7 percent are in the category “obese”. However, the predicted BMI, which corrects for measurement error, shows that 43 percent of men and 32 percent of women are in the category “overweight”, while 10 percent of men and 9 percent of women are obese. These obesity figures are similar to those that Sanz-de-Galdeano (2005) reports.

Figure 1: Density of BMI in year 2000, men age 18-59

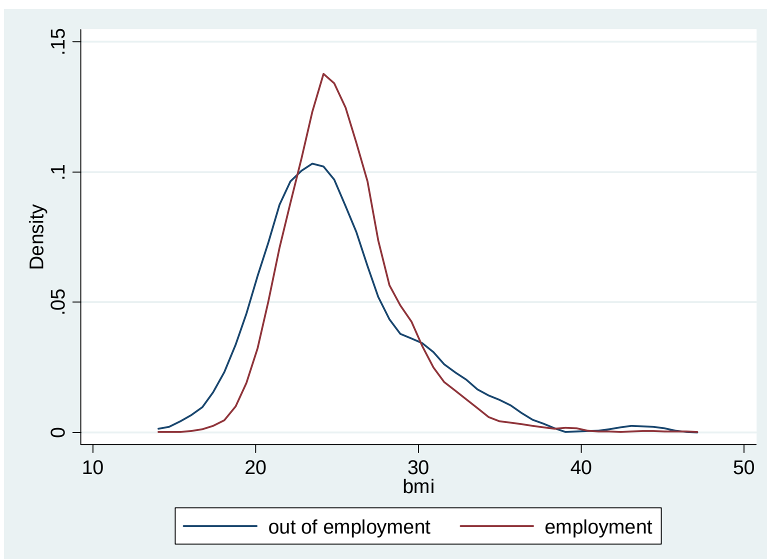
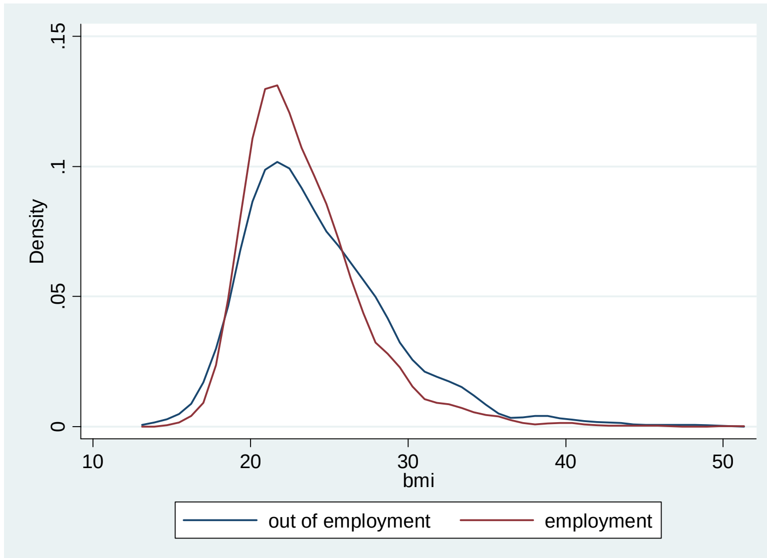


Figure 2: Density of BMI in year 2000, women age 18-59



Figures 1 and 2 illustrates the density of BMI for people in and out of employment, separately for men and women. In general the distribution of BMI for people both in and out of employment lies more to the left for women than for men. The distribution of people out of employment exceeds the distribution of people in employment in the right tail. For men out of employment, the left tail exceeds men in employment.

Simple comparisons of people divided into the categories of healthy weight, overweight and obese show several significant differences (see table A1 in the appendix). Obese people are on average less employed, more likely to be married, more likely to have older and more children, and more likely to evaluate their health status as poorer than healthy-weighted people. The age difference may partly explain the different characteristics between the different weight categories.

Besides the body weight measure, I use additional control variables in the empirical models (see appendix table A1 for mean values of these variables). The socio-demographic variables include information on age, children under 6 years old and above 6 years old living at home, a dummy for being of foreign nationality, marital status (either single or married/cohabiting), education (represented with a dummy variable for no education, basic vocational education, post-secondary non-tertiary education, first stage of tertiary education, and second stage of tertiary education), and region of residence. Information on job characteristics includes variables on work experience, industry, occupational category and working hours.

Furthermore, I include a list of choice variables in the later estimations. These variables, which are self-rated, contain an indicator of good general health and a mental health score in the range 0–100. People with a low mental health score are suffering from depressive conditions and are referred to as in "poor mental health."

5. Empirical results

The main focus of this paper is to get consistent estimates of the relationship between body weight and employment status. The empirical strategy is first to look at the relationship between different functional forms of BMI and the probability of being employed. Second, I include a number of health measures to take into account the unobserved factors that these measures may reflect. Third, I apply a fixed effect model to consider unobserved heterogeneity. Fourth, I use instrumental variables to test for exogeneity.

5.1 The Impact of Body Weight on Employment

The estimates in Table 2 and Table 3 show how different body weight measures are related to the probability of employment for men and women. In general, the different body weight measures show consistent results.

“Insert Table 2 and Table 3 here”

For males, body weight is positively correlated with employment. When body weight is measured with the functional form BMI and BMI squared, BMI reveals a significant inverted u-shaped relationship in the probability of being employed. An indicator variable of being overweight also shows a strong positive correlation with employment. These estimates suggest that men in the overweight category have a higher probability of being employed compared to men who are in the healthy weight category. The mean value of BMI for men is 25, which is also the marginal value for the indicator of being overweight. Hence, an increase in the probability of being employed for overweight men may indicate that men in very good physical condition, with a high total mass of muscles, are more likely to be employed than men in poor physical condition. Table A2 calculates the marginal effects for three different men (see appendix).

For women, the labor market situation seems more problematic for individuals in the weight categories “obese” and “overweight.” The different body weight measures indicate a negative linear relationship between body weight and employment. All body weight measures (excluding BMI squared) show a significantly negative relationship between body weight and the probability of being employed. Furthermore, the results show that taller women have a higher probability of being employed. The marginal effect of obesity shows that obese women on average are 8 percent less likely to be employed than healthy-weighted women. Table A3 calculates the marginal effects for three different women (see appendix).

5.2 The impact of including health measures

If unobserved variables are correlated with obesity and employment probabilities in the same way as observed characteristics such as self-rated general health, mental health, sick days and working capacity, then we may expect that the estimates in Tables 2 and 3 suffer from omitted variable bias. Descriptive results in the appendix, in Table A1, show that obese people on average are more unemployed, are in worse health, and consider their working capacity to be worse than healthy weight people.

True health, lifestyle, and preferences for investment in health are factors that, while unobserved, are related to obesity. Including health variables, therefore, necessarily changes the estimates for body weight. The general assumption is that obesity is the cause of serious health problems. If obesity causes health problems, and health influences labor market status, then leaving out health in the employment regression causes the estimate for obesity additionally to include the impact of body weight on health and the impact of health on labor market status (Morris 2005).

"Insert Table 4 and Table 5 here"

Tables 4 and 5 present the impact of BMI on employment, with an indicator for mental health and self-reported general health. The model where BMI and BMI squared are included for men shows that the marginal effect changes only very little compared to the probability model without health variables, and that the effect of BMI remains positive and significant. Among women, the negative effect of obesity on employment becomes insignificant (p=0.27) with the addition of a self-rated health variable, indicating that the self-evaluation of health crowds out the effect of body weight on employment for women. Table A4 and Table A5 (see appendix) shows a multinominal probability model on the impact of body weight on employment with three outcomes: employment, unemployment, and out of labor force. These models show that, among men, the probability of being employed, as opposed to being out of the labor force, is significantly positive, whereas no effect of body weight exist for the probability of being employed or unemployed. Among women, the results are different. Irrespective of health variables, a significantly higher probability of being unemployed compared to being employed exists, whereas no difference exists between being out of the labor force and employed. Clearly, the negative relationship between BMI and employment persist for women when the employed are compared to the unemployed when more comprehensive measures for labor market relations.

5.3 Unobserved heterogeneity

Besides genetically determined influences on physical conditions, body weight also reflects family culture and traditions, personality, and preferences. Therefore, BMI may be an indicator for a number of unobserved factors. The self-rated health evaluation captures some of these unobserved factors. In fact, self-rated health is itself endogenous to labor market status if "justification bias" (i.e. when individuals out of the labor force try to rationalize their non-participation by reporting themselves to be in poor health) is present. The justification bias would give an upward bias to self-rated health and a downward bias to any variable correlated with health, such as obesity. Table A6 (see appendix) shows fixed effects regressions of the impact of body weight on employment. Unfortunately, two problems arise: First, a considerable number of 1995 observations lack information on BMI in 1995; second, too few of these observations change status from 1995 to 2000, especially among men. Furthermore, unobserved variables that influence both body weight and employment may vary over time. The results show that when unobserved characteristics are taken into account, there is no significant relationship between BMI and employment for men. However, the impact of BMI on employment is maintained for women, thereby indicating that the negative relationship between BMI and employment is not due to unobserved characteristics.

5.4 The Instrumental variable method

By using variables exogenous to BMI and uncorrelated with the employment situation we can identify the effect of body weight on employment. As mentioned before, these exogenous variables include information on whether or not the father or the mother of the interviewee has been prescribed medication (in any of the years in the administrative data period 1995-2000) for genetically determined illnesses or health problems related to obesity, as well as the parents' age, and the parents' mortality status in 2000.

Table 6: Impact of BMI on employment with test of endogeneity. A probit model conditional on x and v, and a linear probability model (2SLS).

	Men		Women	
	Pr(empl|x,v)	2SLS	Pr(empl|x,v)	2SLS
BMI (std. error) BMI^2 (std. error)	0.61 (0.22)*** -0.005 (0.01)***	0.06 (0.01)*** -0.0011 (0.0003)***	-0.03 (0.12) - -	-0.03 (0.03) - -
F-test of instruments	12.4	12.4	7.6	7.6
R^2	0.26	0.29	0.23	0.18
v (std. error)	-0.31 (0.21)	-	-0.01 (0.13)	-
Wu-Hausman-test (p-value)	-	0.36 (0,99)	-	0.77 (0.99)
N	3,569	3,569	3,617	3,617

***: significant at a 1 percent. level

The causal relationship between BMI and employment is tested with the method proposed by Rivers and Vuong (1988). The identifying assumption in this test is that the instrument is exogenous to BMI. Regressing the instruments on BMI reveal an F-test of 12 for men and 8 for women, a result suggesting that the instrumental variables are significant predictors of BMI. When I add the residual from the auxiliary regression, the residual, *v*, is insignificant for both men and women (see table 6). This result indicates that no significant endogeneity exist in the relationship between BMI and employment.

An additional test of endogeneity has also been performed in a linear probability model using the method of Two Stage Least Squares, 2SLS. The Wu-Hausman test indicates that we cannot reject the hypothesis that OLS and IV coefficients are equal and therefore we should rely on the OLS estimates, because the OLS estimates produce lower standard errors compared to the IV estimates.

6 The Impact of Body Weight on Wages

Several studies find the impact of body weight on wages to be negative for (white) women and positive for men (Cawley 2004; Averett and Korenman 1996). As already mentioned, we may not see this effect in Denmark. First, as shown in section 5 the Danish analysis shows that the negative effect of increasing body weight for women, and the positive effect of being overweight for men is present in the employment stage. Second, we may expect people who face discrimination in some sectors in the labor market to move to other sectors where, for example, the wage structure is fixed. Figures 3 and 4 show the wage density for men and women in the body weight categories of healthy weight, overweight and obese. These figures indicate no significant difference in wages among the three weight categories.

Figure 3: Density of wage in year 2000, men age 18-59

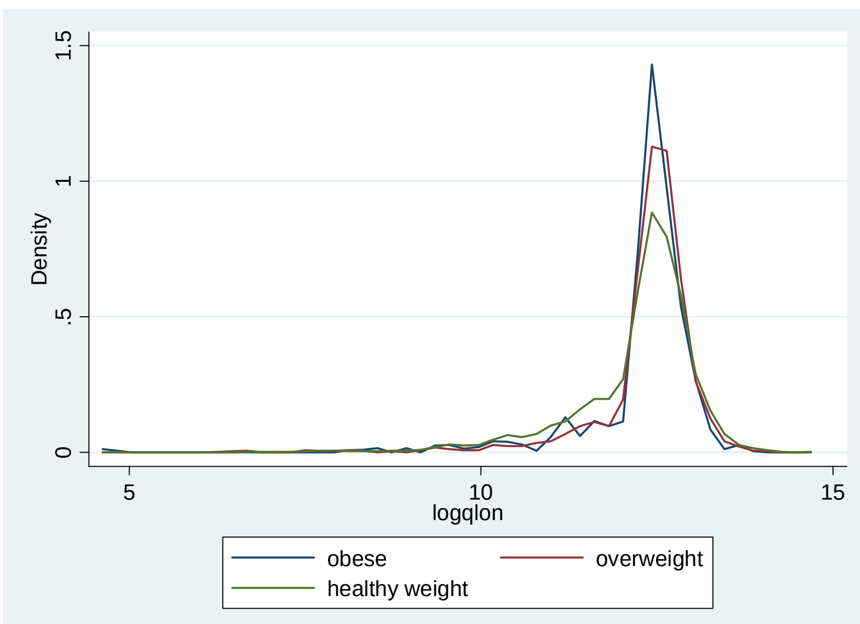
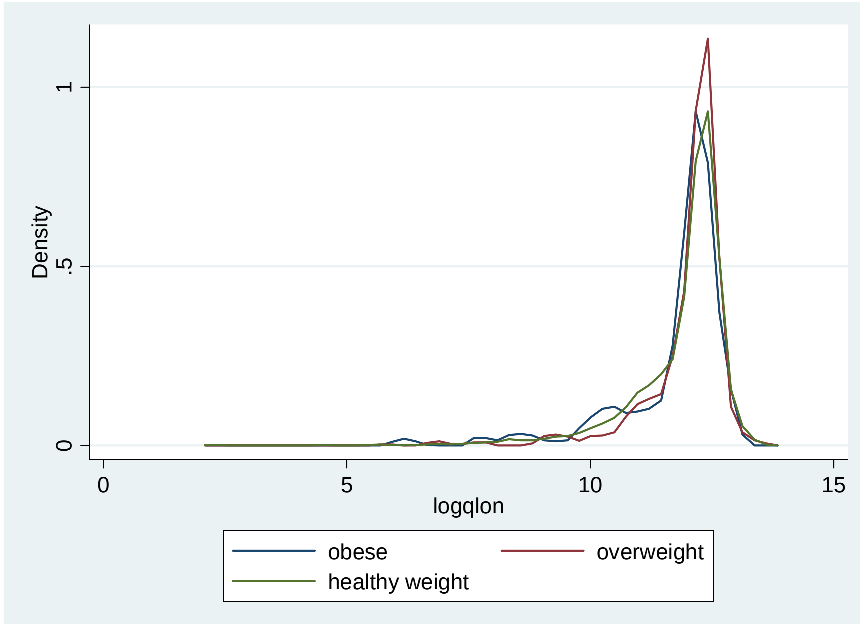


Figure 4: Density of wage in year 2000, women age 18-59



"Insert Table 7 and Table 8 here"

Table 7 and Table 8 show wage regression for men and women. I have compared the results to a selection model with BMI treated as exogenous. All selection models show the same results as the models without selection. For both men and women, body weight has no effect on wages.

7. Conclusion

The results of this paper show different effects of BMI on employment for men and women. The effect of BMI on employment takes on a significant inverted u-shaped relationship for men and a significant negative linear relationship for women. The different results for men and women are to some extend explained by the use of BMI as a body weight measure. First, BMI does not distinguish between the very different body compositions of men and women. Second, the inverted u-shaped relationship between BMI and employment for men may be because “overweight” men are quite muscular with little fat. We do not see the same effect among women, mainly because there is less variation in muscle mass for women (because fewer women than men lift weights or have physically demanding jobs). However, the negative relationship between BMI and employment for women remains a puzzle compared to the results for men.

The different results for men and women have implications for the hypotheses of the impact of body weight on employment i.e., differences in productivity or labor supply, personal discrimination, and statistical discrimination. When the effect of increasing body weight on employment has opposite signs for men and women, the cause cannot be that obesity reduces productivity and, consequently, labor supply. Instead, reduced labor supply may arise if obese women have less self-esteem and internalise the stigma of being obese more than men in same weight category do. The non-economic literature shows evidence of these gender-based differences related to obesity.

That the effect of BMI on employment is different for men and women also contradicts the hypothesis that statistical discrimination could explain a negative relationship between BMI and employment if the statistical discrimination rests on missing information on true health. Yet, if statistical discrimination differs depending on industry or occupation, and work place characteristics vary with gender, statistical discrimination may still be a possible explanation. Table A1 (see appendix) shows that obese men work in the private sector and in manufacturing and transportation more often than do healthy weight men, whereas sector and industry do not differ significantly between obese and healthy weight women.

A considerably large part of relevant literature supports the hypothesis that the negative relationship between increasing BMI and employment is due to discrimination (Puhl and Brownell, 2001), and especially so among women.

In contradiction to the relationship between BMI and employment, the impact of BMI on wages shows no significant results. The result of no relation between BMI and wages contradicts most other studies on body weight and wages. However, the known “wage penalty” faced by white women in the U.S. is comparable to the negative effect on employment for women in Denmark. Furthermore, this paper shows a small positive effect of being overweight compared to being in healthy weight on employment for men. This effect may also reflect the positive effect of body weight found in the U.S. studies on wages for men.

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TABLES

Table 2: Probit estimates of the impact of body weight measures on employment[1], coefficients (std. err, in parentheses), marginal effects, pseudo-R^2, and number of observations. Men age 18-59

	Body weight measures										
	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Overweight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients (std. Err.)	0.01 (0,01)*	0.01 (0.01)*	0.52 (0.23)**	0.29 (0.06)***	-0.005 (0.001)***	0.005 (0.003)*	-0.003 (0,005)	0.14 (0.07)**	-0.13 (0.11)	0.03 (0.02)	0.01 (0,01)*
Marginal effect (robust std. err.)	0.002 (0.001)	0.002 (0.001)	0.07 (0.03)**	0.04 (0.01)***	-0.0006 (0.0001)***	0.001 (0.0004)*	-0.0004 (0,0007)	0.02 (0.01)*	-0.019 (0.016)	0.002 (0.001)	0.002 (0,001)
Log likelihood	-987	-987	-986	-977		-987		-985		-356	-987
Pseudo-R^2	0.25	0.25	0.25	0.25		0.25		0.25		0.19	0.25
N	3,569	3,569	3,569	3,569		3,569		3,569		2,141	3,569

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, education, work experience, work experience squared, local area code

Table 3: Probit estimates of the impact of body weight measures on employment[1], coefficients (std. err, in parentheses), marginal effects, pseudo-R^2, and number of observations. Women age 18-59

	Body weight measures										
	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Over-weight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients (std. Err.)	-0.02 (0,01)***	-0.02 (0,01)***	-0.43 (0.17)**	-0.02 (0.04)	0.0001 (0.0008)	-0.006 (0.002)***	0.017 (0.005)***	-0.16 (0.06)**	-0.29 (0.10)***	-0.01 (0.01)	-0.02 (0,01)***
Marginal effect (robust std. Err.)	-0.004 (0.002)***	-0.004 (0.002)***	-0.10 (0.04)***	-0.01 (0.01)	0.00002 (0.00002)	-0.001 (0.001)***	0.004 (0.001)***	-0.04 (0.02)**	-0.08 (0.03)***	-0.001 (0.002)	-0.002 (0.002)***
Log likelihood	-1,436	-1,436	-1,437	-1,436		-1,433		-1,434		-537	-1,436
Pseudo-R^2	0.23	0.23	0.23	0.23		0.24		0.23		0.16	023
N	3,617	3,617	3,617	3,617		3,617		3,617		1,941	3,617

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, education, work experience, work experience squared, local area code

Table 4: Probit estimates of the impact of body weight measures on employment[1], *health variables included* as control variable[2], coefficients (std. err, in parentheses), marginal effects, pseudo-R^2, and number of observations. Men age 18-59

	Body weight measures										
	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Overweight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients (std. Err.)	0.02 (0.01)**	0.02 (0.01)**	0.58 (0.24)***	0.22 (0.07)***	-0.004 (0.001)***	0.006 (0.003)**	-0.004 (0.005)	0.12 (0.07)	-0.01 (0.11)	0.02 (0.02)	0.02 (0.01)**
Marginal effect (robust std. err.)	0.002 (0.001)**	0.002 (0.001)**	0.07 (0.03)**	0.03 (0.01)***	-0.0004 (0.0001)***	0.0007 (0.0003)**	-0.0005 (0.0006)	0.01 (0.01)	-0.001 (0.014)	0.001 (0.001)	0.002 (0.001)**
Log likelihood	-929	-929	-928	-924		-928		-929		-342	-929
Pseudo-R^2	029	0.29	0.29	0.29		0.29		0.29		0.22	0.29
N	3,559	3,559	3,559	3,559		3,559		3,559		3,559	3,559

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, education, work experience, work experience squared, local area code, self-rated general health, and self-rated mental health.

[2]Note that due to missing information on health variables 10 observations are left out of the analysis. Descriptive analysis on these 10 observations show that they are a selected sample, but leaving them out in the probit model without health variables (see table 2) does not change the results.

Table 5: Probit estimates of the impact of body weight measures on employment[1], *health variables included* as control variable, coefficients (std. err, in parentheses), marginal effects, log likelihood value, pseudo-R[2], and number of observations. Women age 18-59

	Body weight measures										
	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Overweight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients (std. err.)	-0.008 (0.006)	-0.008 (0.007)	-0.21 (0.17)	-0.05 (0.05)	0.0007 (0.0008)	-0.003 (0.002)	0.01 (0.004)***	-0.11 (0.07)*	-0.15 (0.10)	0.001 (0.013)	-0.008 (0.007)
Marginal effect (std. err.)	-0.002 (0.002)	-0.002 (0.002)	-0.05 (0.04)	-0.01 (0.01)	0.0002 (0.0002)	-0.0006 (0.0006)	0.003 (0.001)***	-0.03 (0.02)*	-0.04 (0.03)	0.0002 (0.002)	-0.002 (0.002)
Log likelihood	-1,374	-1,374	-1,374	-1,374		-1,371		-1,373		-520	-1,374
Pseudo-R^2	0.26	0.26	0.26	0.26		0.26		0.26		0.19	0.26
N	3,605	3,605	3,605	3,605		3,605		3,605		1,906	3,605

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, education, work experience, work experience squared, local area code, self-rated general health, and self-rated mental health.

[2]Note that due to missing information on health variables 12 observations are left out of the analysis. Descriptive analysis on these 12 observations show that they are a selected sample, but leaving them out in the probit model without health variables (see table 2) does not change the results.

Table 7: Wage regressions. The impact of body weight measures on employment[1], coefficients (std. err, in parentheses), Adjusted R^2, and number of observations. Men age 18-59

	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Overweight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients	-0.0003	-0.0003	0.002	0.02	-0.004	-0.00007	-0.001	0.01	-0.04	-0.003	-.0003
(std. Err.)	(0.003)	(0.004)	(0.09)	(0.03)	(0.005)	(0.001)	(0.002)	(0.02)	(0.04)	(0.004)	(0.003)
Adj. R^2	0.46	0.46	0.46	0.46		0.46		0.46		0.46	0.46
N	3,099	3,099	3,099	3,099		3,099		3,099		2,056	3,099

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, education, work experience, work experience squared, local area code, sector, occupation category, an indicator for general self-rated health and mental health.

Table 8: Wage regressions. The impact of body weight measures on employment[1], coefficients (std. err, in parentheses), Adjusted R^2, and number of observations. Women age 18-59

	BMI	Predicted BMI	Ln(BMI)	BMI	BMI^2	Weight in kilo grams	Height in metres	Overweight	Obese	Five-year lag BMI	BMI deviation from mean
Coefficients	-0.002	-0.002	-0.05	-0.014	0.003	-0.0005	0.0009	-0.0007	-0.01	-0.003	-.002
(std. Err.)	(0.003)	(0.004)	(0.09)	(0.03)	(0.005)	(0.0012)	(0.002)	(0.03)	(0.06)	(0.004)	(0.003)
Adj. R^2	0.51	0.51	0.51	0.51		0.51		0.51		0.51	0.51
N	3,026	3,026	3,026	3,026		3,026		3,026		1,789	3,026

***: significant at a 1 percent. level; **: significant at a 5 percent. level; *: significant at a 10 percent. level

[1] The following co-variates are also included but not reported: age, foreign nationality, children below 6 year, education, work experience, work experience squared, local area code, sector, occupation category, an indicator for general self-rated health and mental health.

Appendix

Table A1: Summary statistics, year 2000, mean (Standard deviation)

Variable	Men				Women			
	Healthy weight	Overweight	Obese	All	Healthy weight	Over-weight	obese	All
Employed in percentage of total population[1]	0.87 (0.33)	0.91 (0.29)	0.82 (0.38)	0.88 (0.38)	0.81 (0.39)	0.76 (0.43)	0.65 (0.65)	0.79 (0.41)
Unemployed in percentage of total population[1]	0.03	0.02	0.02	0.02	0.03	0.06	0.08	0.04
Out of labor force in percentage of total population[1]	0.10	0.07	0.16	0.10	0.15	0.18	0.27	0.17
Age[1]	35.6 (11.5)	40.6 (11.2)	42.4 (11.1)	38.2 (12)	37.6 (11.7)	41.2 (11.4)	42.0 (11.6)	38.7 (11.8)
Foreign nationality[4]	0.06 (0.23)	0.05 (0.22)	0.03 (0.18)	0.05 (0.22)	0.05 (0.21)	0.06 (0.24)	0.04 (0.20)	0.05 (0.22)
Married/cohabiting[1]	0.61 (0.49)	0.76 (0.43)	0.71 (0.46)	0.67 (0.47)	0.66 (0.47)	0.74 (0.44)	0.71 (0.46)	0.68 (0.47)
Children less than or equal to 6 years old[3]	0.23 (0.42)	0.24 (0.43)	0.16 (0.37)	0.23 (0.42)	0.20 (0.40)	0.19 (0.40)	0.18 (0.39)	0.20 (0.40)

Children above 6 years old[3]	0.17 (0.38)	0.24 (0.43)	0.23 (0.42)	0.20 (0.40)	0.25 (0.46)	0.29 (0.45)	0.27 (0.45)	0.26 (0.44)
One child[3]	0.14 (0.34)	0.19 (0.39)	0.16 (0.36)	0,16 (0,37)	0.19 (0.40)	0.19 (0.39)	0.19 (0.39)	0.19 (0,39)
Two children[4]	0.19 (0.39)	0.21 (0.41)	0.17 (0.37)	0,19 (0,39)	0.19 (0.39)	0.22 (0.41)	0.17 (0.37)	0.19 (0,40)
Three or more[2] children	0.08 (0.27)	0.09 (0.28)	0.07 (0.26)	0,08 (0,27)	0.07 (0.25)	0.08 (0.27)	0.10 (0.31)	0.07 (0,26)
Basic general education[1]	0.33 (0.47)	0.29 (0.45)	0.40 (0.49)	0.32 (0.47)	0.38 (0.49)	0.38 (0.48)	0.53 (0.50)	0.39 (0.49)
Basic Vocational Education[3]	0.42 (0.49)	0.50 (0.50)	0.46 (0.50)	0.45 (0.50)	0.36 (0.48)	0.38 (0.49)	0.35 (0.48)	0.36 (0.48)
Post-Secondary Non Tertiary Education[3]	0.05 (0.21)	0.05 (0.23)	0.04 (0.19)	0.05 (0.21)	0.04 (0.19)	0.04 (0.19)	0.02 (0.13)	0.04 (0.18)
First Stage of Tertiary Education[2]	0.10 (0.30)	0.10 (0.30)	0.08 (0.27)	0.10 (0.30)	0.18 (0.38)	0.16 (0.37)	0.08 (0.27)	0.17 (0.37)
Second Stage of Tertiary Education[3]	0.10 (0.30)	0.06 (0.23)	0.03 (0.16)	0.08 (0.27)	0.05 (0.22)	0.04 (0.21)	0.03 (0.16)	0.05 (0.21)
Work experience since 1980, years[1]	10.4 (7,3)	12.9 (6.9)	12.7 (6.9)	11.6 (7.2)	9.4 (6.8)	10.5 (6.6)	8.9 (6.7)	9.6 (6.7)

Indicator of good health[1]	0.86	0.85	0.64	0.83	0.84	0.75	0.56	0.80
Mental health[1] (0-100)	86.6 (12.0)	87.9 (12.1)	85.7 (15.0)	87.0 (12.8)	83.5 (15.0)	83.3 (16.4)	81.4 (17.7)	83.3 (15.51)
No. of obs. in total population	**1,845**	**1,376**	**348**	**3,569**	**2,552**	**814**	**251**	**3,617**
Unemployed in percentage of people in the labor force[2]	0.03	0.02	0.02	0.03	0.04	0.07	0.11	0.05
Unemployment degree for people in the labor force	33 (124)	27 (109)	26 (105)	30 (117)	49 (150)	71 (199)	90 (207)	56 (157)
No. of obs. in the labor force	**1,655**	**1,279**	**294**	**3,228**	**2,159**	**666**	**183**	**3,008**
High level employees among wage earners[1]	0.19	0.16	0.11	0.17	0.14	0.12	0.07	0.13
Working *non*-daytime shift percentage of wage earners (Note not information from all wage earners)	0.17 (0,38)	0.16 (0,36)	0.23 (0,42)	0.17 (0,38)	0.18 (0,39)	0.19 (0,40)	0.27 (0,44)	0.19 (0,39)
Average working hours percentage for wage earners (Note not information from all wage earners)	41.33 (11.12)	43.22 (11.90)	43.44 (12.48)	42.28 (11.60)	35.55 (9.39)	36.13 (9.95)	36.76 (11.0)	35.75 (9.62)
Average wage rate	257,569 (169,214)	259,612 (143,137)	250,308 (130,989)	257,718 (156,005)	195,989 (106,649)	202,331 (97,625)	188,780 (90,441)	196,953 (103,909)
Reduced workability[1]	0.09 (0.28)	0.11 (0.32)	0.20 (0.40)	0.11 (0.31)	0.11 (0.31)	0.15 (0.36)	0.25 (0.43)	0.12 (0.33)

Days with sickness[1]	3.98 (22.98)	4.24 (22.60)	9.17 (34.96)	4.55 (24.19)	4.69 (26.87)	6.59 (28.97)	11.88 (39.9)	5.53 (28.31)
Working in private sector	0.76	0.76	0.82	0.77	0.49	0.46	0.46	0.48
Industry								
Agriculture	2.83	3.33	2.50	2.99	0.86	0.93	1.65	0.92
Manufacturing	21.97	23.15	28.57	23.02	9.44	12.50	11.54	10.2
Energy	0.55	1.00	0.36	0.71	0.18	0.15	0.00	0.16
Construction	9.35	10.41	9.29	9.76	1.32	0.31	2.20	1.15
Commercial	15.63	17.57	13.93	16.23	12.89	12.96	12.64	12.89
Transportation	6.58	8.99	13.21	8.11	3.81	5.09	4.40	4.12
Finance	13.97	10.32	10.36	12.23	12.26	10.49	8.24	11.64
Public sector	23.38	21.48	17.14	22.09	50.52	51.08	46.70	50.41
No sector code	5.72	3.75	4.64	4.86	8.72	6.48	12.64	8.47
No. of wage earners	**1,604**	**1,249**	**287**	**3,140**	**2,068**	**617**	**162**	**2,847**

1 Differ significantly between weight categories for both men and women.
2 Differ significantly between weight categories for women.
3 Differ significantly between weight categories for men.
4 Does not differ significantly between weight categories either for men or women.

Table A2: The estimated probability of being employed for men:

	Case 1	Case 2	Case 3	Case 4
Estimated effect of being overweight compared to being healthy weight	0,03 (0,02)	0,03 (0,02)	0,05 (0,02)	0,02 (0,01)

Case 1: A married native Danish man at age 38.2 with no kids, a vocational education, 11.6 years of work experience and living in the local area of Roskilde
Case 2: A non-married native Danish man at age 30 with no kids, a long education 4 years of work experience and living in the local area of Roskilde
Case 3: A married native Danish man at age 45 with kids above 6, no education, 20 years of work experience and living in the local area of Roskilde
Case 4: A married native Danish man at age 30 with kids above 6, no education, 10 years of work experience and living in the local area of Roskilde

Table A3: The estimated probability of being employed for women:

	Case 1	Case 2	Case 3	Case 4
Estimated effect of being overweight compared to being healthy weight	-0.06 (0.03)	-0.04 (0.02)	-0.06 (0.03)	-0.06 (0.03)
Estimated effect of being obese compared to being healthy weight	-0.11 (0.04)	-0.08 (0.03)	-0.11 (0.04)	-0.12 (0.04)

Case 1: A married native Danish woman at age 38.7 with no kids, a vocational education, 9.6 years of work experience and living in the local area of Roskilde
Case 2: A non-married native Danish woman at age 30 with no kids, a long education 4 years of work experience and living in the local area of Roskilde
Case 3: A married native Danish woman at age 45 with kids above 6, no education, 20 years of work experience and living in the local area of Roskilde
Case 4: A married native Danish woman at age 30 with kids above 6, no education, 10 years of work experience and living in the local area of Roskilde

Table A4: Multinomial probit estimates of the impact of body mass index on the employment status. Base category employment. Men age 18-59

	Model without health variables[1]			Model with. health variables[2]		
	BMI	BMI	BMI^2	BMI	BMI	BMI^2
Unemployment Coefficients (std. Err.)	-0.02 (0.02)	0.07 (0.18)	-0.02 (0.03)	-0.02 (0.02)	0.14 (0.18)	-0.03 (0.03)
t-value	-1.33	0.38	-0.49	-1.2	0.79	-0.92
Out of the labor force Coefficients (std. Err.)	-0.019 (0.011)	-0.60 (0.12)	0.11 (0.02)	-0.01 (0.01)	-0.42 (0.12)	0.07 (0.02)
t-value	-1.8	-4.96	4.80	-1.2	-3.56	3.37
Share predicted correctly by the model	0.88	0.88		0.88	0.88	
Log likelihood	-1,366	-1349		-1,299	-1,200	
N	**3,559**	**3,559**		**3,559**	**3,559**	

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old and education

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, education, self-rated health and mental health

Table A5: Multinomial probit estimates of the impact of body mass index on the employment status. Base category employment[1]. Women age 18-59

	Model without health variables			Model with. health variables		
	BMI	BMI	BMI^2	BMI	BMI	BMI^2
Unemployment Coefficients (std. Err.)	0.04 (0.01)	0.12 (0.08)	-0.01 (0.02)	0.04 (0.01)	0.14 (0.09)	-0.02 (0.02)
t-value	3.9	1.44	-0.91	3.5	1.63	-1.16
Out of the labor force Coefficients (std. Err.)	0.016 (0.009)	-0.22 (0.10)	0.05 (0.02)	-0.01 (0.01)	-0.17 (0.10)	0.03 (0.02)
t-value	1.8	-2.28	2.39	-0.96	-1.71	1.57
Share predicted correctly by the model	0.79	0.79		0.79	0.79	
Log likelihood	-2,068	-2,063		-1,963	-1,960	
N	**3,605**	**3,605**		**3,605**	**3,605**	

[1] The following co-variates are also included but not reported: age, foreign nationality, marital status, children less than 6 years old, children above 6 years old, and education

Table A6: Fixed effect estimates of the probability of being employed[1]

	Men		Women	
	Balanced panel	Unbalanced panel	Balanced panel	Unbalanced panel
FE estimate (Std err.)	$-1.58 * 10^{-7}$ $(3.19*10^{-8})$***	0.14 (0.10)	$-2.49 * 10^{-7}$ $(2.51*10^{-8})$***	-0.04 (0.07)
Pseudo-R^2	0.24	0.10	0.33	0.32
N	**552**	**250**	**992**	**378**