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Obesity and labour market success in Finland: The difference between having a high BMI and being fat

Edvard Johansson [a,*], Petri Böckerman [b], Urpo Kiiskinen [c], Markku Heliövaara [c]

[a] The Research Institute of the Finnish Economy, Lonnrotinkatu 4B, 00120 Helsinki, Finland
[b] Labour Institute for Economic Research, Helsinki, Finland
[c] National Institute for Health and Welfare, Helsinki, Finland

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A B S T R A C T

This paper examines the relationship between obesity and labour market success in Finland, using various indicators of individual body composition along with body mass index (BMI). Weight, height, fat mass and waist circumference are measured by health professionals. We find that only waist circumference has a negative association with wages for women, whereas no obesity measure is significant in the linear wage models for men. However, all measures of obesity are negatively associated with women's employment probability and fat mass is negatively associated with men's employment probability. We also find that the use of categories for waist circumference and fat mass has a substantial influence on the results. For example, the category for high fat mass is associated with roughly 5.5% lower wages for men. All in all, the results indicate that in the absence of measures of body composition, there is a risk that labour market penalties associated with obesity are measured with bias.

1. Introduction

Many studies document the negative effects of obesity on labour market success measured by wages and employment (Atella et al., 2008; Baum and Ford, 2004; Brunello and D'Hombres, 2007; Cawley, 2004, 2007; Cawley and Danziger, 2005; Conley and Glauber, 2006; Garcia and Quintana-Domeque, 2006; Han et al., in press; Härkönen, 2007; Morris, 2007; Kennedy and Garcia, 1994; Sarlio-Lähteenkorva et al., 2004). For reasons of data availability, this literature has used body mass index (BMI) as a measure of obesity.[1] However, it is difficult to determine whether the labour market penalties for obesity are due to discrimination or health reasons such as the limited ability to work. One reason for this is that BMI blurs the distinction between fat and fat-free mass such as muscle and bone (Burkhauser and Cawley, 2008). In the medical literature, BMI alone is not considered to be a valid measure of obesity nor a sufficient predictor of obesity-related health outcomes (Burkhauser and Cawley, 2008; Yusuf et al., 2005).

This paper re-examines the relationship between obesity, wages and employment, using indicators of individual body composition along with BMI. The indicators we use are fat mass expressed as kilograms of fat and waist circumference. Waist circumference distinguishes individuals who have a high fat mass with the bulk of the fat concentrated around the waist compared with those with a lot of fat that is more evenly distributed around the body. A large waist circumference in relation to height may be interpreted by employers as a non-attractive physical appearance, which has been found to be associated with

* Corresponding author. Tel.: +358 9 60990214; fax: +358 9 601753.
E-mail address: edvard.johansson@etla.fi (E. Johansson).

[1] Body mass index is calculated as a person's weight in kilograms divided by height in meters squared.

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lower earnings (Hamermesh and Biddle, 1994). The reason for this is that the fat concentrated around the waist is more visible than fat in general. Moreover, waist circumference measures fat that is visceral (i.e. around the internal organs), which is especially harmful to health (Kopelman, 2000). Therefore, it is challenging to distinguish different channels of influence even with the use of measures of body composition.

We use data from the "Health 2000 in Finland" data set, a cross-section of about 8000 people above the age of 30. (Aromaa and Koskinen, 2004, provide a description of the data set.[2]) This data set contains information on individual fat mass measurements obtained from an eight-polar bioelectrical impedance analysis, which is performed by running a small constant current through the body (Scharfetter et al., 2004). Resistance, or impedance, is higher in fat than in other types of tissue, which makes it possible to calculate the proportion of fat mass in the body.

An advantage of the data is that it contains information not only on fat mass but also on other measures of obesity. The few existing studies of fat mass and labour market success (Burkhauser and Cawley, 2008; Heineck, 2007; Wada and Tekin, 2007) have almost exclusively relied on prediction equations for the measures of body composition as a function of electrical resistance as well as height and weight and some other variables.[3] This approach is not as accurate as one based on actual measurements.[4]

Annual individual wage data originating from the Finnish tax authorities have been linked to the Health 2000 data set, using the personal identification number that every person residing in Finland has.[5] This is another advantage over most of the earlier studies in this field of research, because almost all of them have used survey-based information on earnings that is prone to non-response and reporting bias.

Nonetheless, our data has two shortcomings. First, we are using a cross-sectional data. Thus, we cannot estimate fixed effects models that would account for unobservable heterogeneity at the individual level. Second, we lack a valid instrument.[6] Hence, we cannot estimate causal effects and address the possibility that the obesity measures may be endogenous (Averett and Korenman, 1996; Cawley, 2004; Wada and Tekin, 2007). Accordingly, this paper documents associations or correlations between different measures of obesity and labour market success.[7] The Finnish evidence is of broader interest, because the prevalence of overweight and obesity has increased rapidly among both men and women during the past few decades (Böckerman et al., 2008). The increase in obesity in Finland has not been as rapid as in USA. Despite this, the share of obese adults is higher in Finland than in other Nordic countries (Audretsch and DiOrio, 2007).

2. Data and empirical approach

The "Health 2000" population survey data set was collected in order to give a comprehensive picture of the health and functional ability of the working-age and old-age Finnish population. The data set is a random sample of 10,000 adults from the entire country, and the information was collected between September 2000 and June 2001 by means of personal interviews, telephone interviews, and professional health examinations. Importantly, all measures of obesity originate from professional health examinations conducted at local health centres. Supplementary information has been obtained from various government registers.

The sampling design included regional clustering. A stratified two-stage sampling design was used with local Health Centre Districts (comprising one or several municipalities) as the first-stage sampling units (i.e. regional clusters). There were a total of 249 regional clusters in the population. Fifteen certainty strata (the 15 largest towns) in total were first formed as clusters with a probability of one. The remaining 234 clusters were then divided into five regional strata, covering the whole of (mainland) Finland. A total of 65 clusters were drawn from these strata by systematic probability proportional to size (PPS) sampling with inclusion probabilities proportional to the size of the target population in a cluster. Thus, the total number of strata and first-stage sample clusters was 20 and 80, respectively (Aromaa and Koskinen, 2004). The second-stage sample (8028 people aged 30 years or over) was allocated proportionally to the strata. People aged 80 or over were over-sampled with a double inclusion probability relative to the younger age groups. Finally, individual persons were selected from each stratum with systematic sampling from an implicitly stratified frame register. Roughly 88% of the sample persons were interviewed, 80% attended a comprehensive health examination and 5% attended a condensed examination at home. The most essential information on health and functional capacity was obtained from 93% of the subjects.

We have limited the focus to individuals aged between 30 and 54, because we are interested in labour market

[2] The data set is available from the National Public Health Institute in Finland (see http://www.terveys2000.fi/indexe.html).

[3] Burkhauser and Cawley (2008) use a data set (NHANES III) that includes measures of bioelectrical impedance analysis those are available in the same data set as the other measures of obesity. Their paper also estimates models of fatness and employment that are related to our models of employment.

[4] There are problems with this type of prediction approach. Firstly, there is some disagreement in the literature about what the best prediction equation for the measures of body composition is (Willett et al., 2006). Secondly, imputed body fat measures may not differ much from BMI, because imputed body fat is usually calculated as a non-linear transformation of weight and height (and their squares and cubes) and some other variables. Thirdly, the imputation equation may contain some of the same variables as the wage equation, which makes it rather hard to interpret the correlations observed in the wage equation.

[5] The data set originates from the Finnish tax administration (see http://www.vero.fi/).

[6] For example, in our case it is not possible to use area-level obesity as instrument (Morris, 2007), because the number of individuals in the data for each region (249 regional clusters) is too small in order to construct a valid and powerful instrument.

[7] Rooth (in press) provides experimental evidence about the discrimination of obese applicants in hiring.

Table 1
Descriptive statistics and variable definitions.

Variable	Women		Men	
	Mean	St. Dev.	Mean	St. Dev.
Hourly wage (€)	7.39	1.15	8.58	1.56
Log of hourly wage (€)	2.00	0.31	2.15	0.39
Height (cm)	165.0	6.20	178.1	6.6
Weight (kg)	69.2	13.25	84.6	14.0
Waist circumference (cm)	84.4	12.2	95.8	11.0
Fat mass (kg)	21.4	9.0	17.8	7.8
High fat mass (%)	0.48		0.21	
High waist circumference (%)	0.34		0.25	
BMI	25.6	4.8	26.7	3.9
Underweight (%)	0.07		0.01	
Normal weight (%)	0.47		0.34	
Overweight (%)	0.30		0.48	
Obese (%)	0.16		0.17	
Age (years)	42.8	7.1	42.1	7.2
High education (%)	0.19		0.16	
Middle education (%)	0.57		0.45	
Low education (%)	0.24		0.39	
Good health (%)	0.81		0.77	
Number of observations	1170		1163	

Note: A woman is classified as having high fat mass if a percent body fat exceeds 30 and having a high waist circumference in the case when waist circumference exceeds 88 cm. A man is classified as having high fat mass if a percent body fat exceeds 25 and having a high waist circumference in the case when waist circumference exceeds 102 cm. BMI classifications: underweight ($BMI \leq 18.5$), normal weight ($18.5 < BMI \leq 24.99$), overweight ($25 \leq BMI \leq 29.99$), obese ($BMI \geq 30$). High education refers to tertiary education, according to the ISCED 1997 classification. Middle education refers to at least upper secondary education, but not tertiary education. Low education refers to less schooling than upper secondary education. "Good health" takes the value 1 if the individual has reported that she has "good" or "fairly good" health, and 0 if the individual has responded that she has "average", "fairly poor" or "poor" health.

success. The upper limit of 54 was chosen because the actions of individuals older than 54 may be affected by retirement decisions.[8] Hence, persons older than 54 could be non-employed, because they are retired. Therefore, our sample contains older persons than the US data sets such as National Longitudinal Survey of Youth (NLSY) (see Cawley, 2007) or National Health and Nutrition Examination Survey (NHANES) (see Burkhauser and Cawley, 2008) that have been used in the literature. Furthermore, we have limited the sample to those who are wage and salary earners excluding the self-employed.[9] The size of the working data set is reduced from 8000 to around 3500.[10]

We include both full-time and part-time workers. The hours of work are self-reported. The information on working hours refers to the average weekly working hours (including overtime) during the past year.[11] Part-time work is very rare in Finland compared with almost all OECD countries: 12% in 2000, according to the Labour Force Survey by Statistics Finland. Most of the part-time workers are young and are excluded from our data, by construction. The data set does not contain information about occupation or industry. The fact that we do not control for job characteristics may obscure self-selection into jobs that reward leanness (see Han et al., in press).

Both men and women are, on average, overweight, with BMI exceeding 25 (Table 1). Women are, on average, better educated than men, with 19% of women and 16% of men having an academic degree.

Different measures of obesity are, by and large, highly correlated (Table 2). For instance, the correlation coefficient between fat mass and BMI is 0.97 for women and 0.92 for men. The correlation coefficient between waist circumference and BMI is 0.91 for both genders. In contrast, the body composition measures are not particularly correlated with height.

We first estimate models in which we add measures of obesity in different specifications to a traditional log of hourly wage regression.[12] We account for the sampling structure by using the appropriate survey estimation methods and weights that are available in our data.[13] We estimate the models for men and women separately, because poor physical appearance may discriminate more against women. Several earlier studies report that the negative wage effects of obesity are larger for women (Cawley, 2007).[14] We do not take into account the selection for employment when estimating wage models.

In addition, for the analysis of different measures of obesity on employment, we estimate probit models in which the dependent variable takes the value 1 if the individual is working and 0 otherwise. To make it easier to understand the estimates, we report marginal effects for the employment models. The different measures of obesity are entered one at a time in separate models, because of the

[8] The official retirement age in Finland is 64. However, the actual retirement age is approximately 60 years.

[9] The share of the self-employed in the labour force in Finland is 7%. The inclusion of self-employed persons could help to "identify" whether the effect of the obesity variables is working either through a bad health channel or a discrimination channel. If the discrimination channel is important at the labour market entry level, the negative effect of obesity should be more important for employees than for self-employed. That being said, obese self-employed persons may face discrimination by consumers.

[10] We also have excluded some individuals from the sample for whom information on fat mass or waist circumference is missing.

[11] The data do not contain information about the number of months that a person has been employed during the past year. This most likely explains the low level of hourly wages observed in the data.

[12] The hourly wage is calculated as an individual's annual wage divided first by 52, and then by the individual's self-reported number of weekly working hours. The problem with part-time as a control variable would be that part-time work can be seen as an obesity outcome.

[13] We use svy commands in Stata that make it possible to take into account the strata, sampling units and sample weights. The difference between using Stata's svy commands and the standard commands in Stata is that the svy commands can handle stratified sampling. The effect of using the standard commands with population weights and clustering rather than the svy commands is that accounting for stratified sampling usually makes standard errors smaller. Thus, ignoring stratification usually leads to conservative estimates (StataCorp, 2005). However, using the same Health 2000 in Finland data set, Johansson et al. (2007) show that the difference between taking stratification into account and not taking stratification into account is very small.

[14] This is not the case in all studies. For instance, Brunello and D'Hombres (2007) report that the negative wage effects are larger for men than for women in Europe by using the European Community Household Panel (ECHP) data.

Table 2
Correlation coefficients.

	Height	Weight	Waist circumf.	Fat mass	BMI	Good health
Panel A: Women						
Height	1.000					
Weight	0.281*	1.000				
Waist circumf.	0.046	0.900*	1.000			
Fat mass	0.008	0.937*	0.910*	1.000		
BMI	−0.118*	0.918*	0.913*	0.965*	1.000	
Good health	0.042	−0.190*	−0.223*	−0.221*	−0.213*	1.000
Panel B: Men						
Height	1.000					
Weight	0.446*	1.000				
Waist circumf.	0.170*	0.887*	1.000			
Fat mass	0.046	0.852*	0.905*	1.000		
BMI	−0.005	0.891*	0.906*	0.923*	1.000	
Good health	0.044	−0.096*	−0.163*	−0.141*	−0.129*	1.000

Note: *indicates significance at the 1% level.

high correlation between the measures of obesity.[15] We standardize weight, fat mass and waist circumference by using height as a control variable. However, we do not control for fat-free mass in our models, as Wada and Tekin (2007) do.[16]

3. Results

3.1. Wages

In contrast to many other studies for women BMI and the square of BMI are insignificant (Table 3, Columns 1 and 5).[17] However, the effect of waist circumference is negative and statistically significant at the 10% level (Table 3, Column 4). The size of the coefficient implies that one additional centimeter of waist circumference is associated with roughly a 0.1% reduction in the hourly wage rate. An increase in waist circumference by one standard deviation, i.e. by some 12 cm is associated with a reduction in hourly wage by around 1.2%. This translates into roughly €0.1 lower hourly wage.[18] On the other hand, fat mass does not have any influence on women's wages (Table 3, Column 3).

The estimates change when we also add a dummy variable among the explanatory variables that captures self-reported health (Table 3, Columns 6–7). These results highlight the fact that obesity, however measured, is negatively correlated with good health (Table 2). In particular, waist circumference is no longer statistically significant (Table 3, Column 7).

All the models show that height increases women's wages (Table 3).[19] This result is not affected by the inclusion of self-reported health as an additional explanatory variable.[20]

The only variable apart from the control variables that is correlated significantly with men's wages is height (Table 4). The fact that height has a positive association with wages is consistent with earlier research (Heineck, 2007; Hübler, 2006; Persico et al., 2004). The coefficient for height becomes slightly smaller when a dummy variable for good health is added (Table 4, Columns 6–7).

Next we examine whether there are non-linearities by using discrete categories for measures of obesity (Tables 5 and 6). Being overweight, i.e. having a BMI between 25 and 29.99 is associated with 4.7% lower wages for women (Table 5, Column 1). This translates into roughly €0.35 lower hourly wage. However, we find no association regarding the obese category. For men, we find that overweight is associated with a wage *premium* of 5% (Table 6, Column 1). This is consistent with some earlier evidence (Cawley, 2004; McLean and Moon, 1980).

[15] We have performed some experiments to include several different measures of obesity simultaneously in the wage equations. The problems that arise from multicollinearity among the explanatory variables are confirmed by the tests of variance inflation factors (Fox and Monette, 1992).

[16] We do not include fat-free mass to the models as one of the explanatory variables, because fat-free mass is highly negatively correlated with fat mass, by construction.

[17] See Brunello and D'Hombres (2007), who also include Finland in their analysis of the European Community Household Panel (ECHP) data. Previously, Sarlio-Lähteenkorva et al. (2004) have reported that for Finnish women obesity is associated with low individual earnings, particularly among women with higher socioeconomic status. Their data is derived from a nationwide survey on living conditions that was collected by Statistics Finland in 1994. For Denmark, Greve (2008) finds some negative effects of obesity on wages in the private sector. Both of these studies use BMI alone as a measure of obesity. Our wage equation results may differ from the ones in Sarlio-Lähteenkorva et al. (2004), because the effect of BMI on the labour market outcomes might not be particularly robust in cross-sectional data sets. In contrast, Brunello and D'Hombres (2007) use panel data (ECHP) and they also are able to use IV estimation to detect causal effects, which most likely explains the differences in the results. Perhaps most importantly, our sample constitutes of older wage and salary earners than those used in many previous studies. The difference in age could explain some of the differences in the results.

[18] This estimate is calculated by using the mean value of hourly wage for women in Table 1 as follows: €7.39 × 0.012 ≈ €0.1.

[19] We also reran the regression results that are presented in Table 3 without the control for height. (The results are available upon request.) The removal of the height variable from the regressions makes all obesity measures insignificant. Furthermore, we reran our regressions limiting the sample to those with BMI above 23. This moderates the association between obesity and labour market success.

[20] Subjective measures of health have been proven to have considerable value in predicting objective health outcomes (e.g. Idler and Benyamini, 1997; Franks et al., 2003).

Table 3
The relationship between overweight and wages for women. Estimation method: OLS, dependent variable is log of hourly wages.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BMI	−0.002 (1.03)				0.011 (0.10)		
BMI squared					−0.000 (0.27)		
Height		0.004** (3.23)	0.004** (3.26)	0.004** (3.36)		0.004** (3.23)	0.004** (3.32)
Weight		−0.001 (0.84)					
Fat mass			−0.001 (0.71)			−0.000 (0.35)	
Waist circumf.				−0.001* (1.84)			−0.001 (1.47)
Good health						0.039* (1.90)	0.034* (1.69)
Age	0.023 (1.45)	0.026 (1.65)	0.026 (1.63)	0.027* (1.70)	0.023 (1.45)	0.025 (1.59)	0.026 (1.64)
Age squared	−0.018 (0.98)	−0.021 (1.13)	−0.021 (1.11)	−0.022 (1.16)	−0.018 (0.98)	−0.020 (1.05)	−0.020 (1.09)
High education	0.378** (13.80)	0.371** (13.49)	0.371** (13.50)	0.368** (13.36)	0.378** (13.77)	0.367** (13.40)	0.364** (13.29)
Middle education	0.086** (4.64)	0.083** (4.45)	0.083** (4.46)	0.083** (4.44)	0.086** (4.63)	0.079** (4.26)	0.080** (4.27)
N	1170	1170	1170	1170	1170	1170	1170

Note: Robust *t*-statistics are in parentheses. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Table 4
The relationship between overweight and wages for men. Estimation method: OLS, dependent variable is log of hourly wages.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BMI	0.001 (0.35)				0.016 (0.51)		
BMI squared					−0.000 (0.48)		
Height		0.006** (2.99)	0.006** (3.33)	0.006** (3.42)		0.005** (3.21)	0.005** (3.20)
Weight		0.000 (0.38)					
Fat mass			0.001 (0.74)			0.002 (1.27)	
Waist circumf.				−0.002 (0.19)			0.000 (0.43)
Good health						0.094** (3.28)	0.090** (3.13)
Age	0.036* (1.82)	0.030 (1.48)	0.030 (1.48)	0.030 (1.48)	0.036* (1.83)	0.028 (1.36)	0.027 (1.36)
Age squared	−0.036 (1.52)	−0.028 (1.16)	−0.028 (1.17)	−0.028 (1.15)	−0.036 (1.53)	−0.024 (1.36)	−0.024 (0.99)
High education	0.420** (11.41)	0.410** (11.25)	0.409** (11.28)	0.409** (11.22)	0.421** (11.35)	0.400** (11.06)	0.402** (11.05)
Middle education	0.098** (4.15)	0.095** (4.03)	0.095** (4.03)	0.095** (4.07)	0.099** (4.16)	0.094** (3.99)	0.095** (4.04)
N	1163	1163	1163	1163	1163	1163	1163

Note: Robust *t*-statistics are in parentheses. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Table 5
The relationship between overweight and wages for women. Estimation method: OLS, dependent variable is log of hourly wages.

	(1)	(2)	(3)	(4)	(5)	(6)
Underweight (BMI $\leq$ 18.5)	−0.031 (0.77)			−0.030 (0.75)		
Overweight (25 $\leq$ BMI $\leq$ 29.99)	−0.047** (2.58)			−0.044** (2.42)		
Obese (BMI $\geq$ 30)	−0.017 (0.67)			−0.008 (0.34)		
High fat mass (percent body fat $\geq$ 30)		−0.017 (1.01)			−0.013 (0.74)	
High waist circumference ($\geq$88 cm)			−0.027* (1.66)			−0.022 (1.37)
Height		0.004** (3.13)	0.004** (3.33)		0.004** (3.15)	0.004** (3.30)
Good health				0.039* (1.93)	0.038* (1.87)	0.036* (1.78)
Age	0.022 (1.40)	0.025 (1.62)	0.027 (1.68)	0.022 (1.35)	0.025 (1.58)	0.026 (1.62)
Age squared	−0.017 (0.92)	−0.021 (1.11)	−0.021 (1.15)	−0.016 (0.85)	−0.019 (1.04)	−0.020 (1.08)
High education	0.377** (13.82)	0.370** (13.43)	0.370** (13.52)	0.373** (13.70)	0.367** (13.35)	0.366** (13.43)
Middle education	0.085** (4.60)	0.083** (4.44)	0.084** (4.51)	0.082** (4.40)	0.080** (4.25)	0.080** (4.32)
N	1170	1170	1170	1170	1170	1170

Note: Robust *t*-statistics are in parentheses. The reference group for BMI categories is normal weight. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Table 6
The relationship between overweight and wages for men. Estimation method: OLS, dependent variable is log of hourly wages.

	(1)	(2)	(3)	(4)	(5)	(6)
Underweight (BMI ≤ 18.5)	−0.101 (1.55)			−0.092 (1.42)		
Overweight (25 ≤ BMI ≤ 29.99)	0.050* (1.90)			0.055** (2.06)		
Obese (BMI ≥ 30)	−0.007 (0.18)			0.013 (0.33)		
High fat mass (percent body fat ≥ 25)		−0.056* (1.60)			−0.047 (1.32)	
High waist circumference (≥102 cm)			−0.030 (0.95)			−0.017 (0.52)
Height		0.005** (2.95)	0.006** (3.76)		0.005** (2.92)	0.006** (3.57)
Good health				0.092** (3.19)	0.082** (2.95)	0.085** (2.95)
Age	0.034* (1.69)	0.029 (1.41)	0.029 (1.39)	0.031 (1.56)	0.027 (1.31)	0.027 (1.31)
Age squared	−0.033 (1.40)	−0.026 (1.06)	−0.026 (1.05)	−0.029 (1.23)	−0.022 (0.92)	−0.022 (0.93)
High education	0.419** (11.35)	0.409** (11.22)	0.407** (11.55)	0.411** (11.17)	0.400** (11.05)	0.400** (10.98)
Middle education	0.098** (4.18)	0.096** (4.10)	0.095** (4.06)	0.098** (4.14)	0.096** (4.07)	0.094** (4.04)
N	1163	1163	1163	1163	1163	1163

Note: Robust *t*-statistics are in parentheses. The reference group for BMI categories is normal weight. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Table 7
The relationship between overweight and employment probability for women. Estimation method: Probit regressions, dependent variable is 1 if employed.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BMI	−0.009** (4.10)				−0.008 (0.48)		
BMI squared					−0.000 (0.05)		
Height		0.005** (2.84)	0.003* (1.94)	0.004** (2.35)		0.003* (1.67)	0.003** (2.02)
Weight		−0.003** (4.08)					
Fat mass			−0.005** (4.43)			−0.004** (3.79)	
Waist circumference				−0.005** (4.80)			−0.004** (4.29)
Good health						0.137** (3.98)	0.140** (4.12)
Age	0.037 (1.42)	0.038 (1.50)	0.035 (1.43)	0.043 (1.60)	0.037 (1.43)	0.034 (1.41)	0.041 (1.56)
Age squared	−0.035 (1.17)	−0.037 (1.24)	−0.033 (1.17)	−0.041 (1.32)	−0.035 (1.18)	−0.030 (1.10)	−0.036 (1.23)
High education	0.120** (3.47)	0.112** (3.27)	0.106** (3.20)	0.110** (3.10)	0.120** (3.48)	0.094** (2.93)	0.096** (2.81)
Middle education	0.112** (4.04)	0.107** (3.88)	0.102** (3.77)	0.107** (3.86)	0.112** (4.04)	0.090** (3.47)	0.095** (3.52)
N	1856	1856	1856	1856	1856	1856	1856

Note: Reported coefficients are marginal effects, evaluated at variable means. For dummy variables, the reported coefficient is the effect of changing the dummy from 0 to 1. Robust *t*-statistics are in parentheses. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Moreover, it is obvious that height is important. The coefficients imply that 10 cm extra height for a man is associated with a higher hourly wage of 5–6% (Table 6, Columns 2–3), and for women the corresponding estimate is somewhat lower at 4% (Table 5, Columns 2–3). These estimates translate into roughly €0.45 and €0.3 higher hourly wages, respectively. The results for height are robust to the inclusion of a dummy variable for good self-reported health (Tables 5 and 6, Columns 5–6).

The other obesity measures, waist circumference and fat mass, have been divided into discrete categories based on the medical evidence of what is considered to be unhealthy (National Institutes of Health, 1998, 2006).[21] For women, we find a negative and statistically significant correlation of roughly 2.7% between hourly wages and having a waist circumference of 88 cm or more that is statistically significant at the 10% level (Table 5, Column 3). This estimate corroborates the earlier findings (Table 3, Column 4), according to which waist circumference is negatively associated with women's wages.

Moreover, we discover an association for men between wages and having a percent body fat of 25 or more (Table 6, Column 2). The category for high fat mass is associated with roughly 5.5% (∼0.45€) lower hourly wages. This is important, because the use of BMI alone would not suggest the prevalence of a negative association between obesity and wages for men.

The associations for women and men are attenuated by the introduction of a dummy variable for self-reported health, such that they are no longer statistically significant at the 10% level (Tables 5 and 6, Columns 5–6).

3.2. Employment

The estimations for employment probability use the same measures of obesity as the wage regressions. It is useful to compare the significance of the results, as one might suspect that health affects employment probability more strongly than it affects wages. Obviously, those working can, on good grounds, be assumed to be, on average, healthier than those not working (Arrow, 1996; Böckerman and Ilmakunnas, 2009).

[21] The definitions are documented in Table 1.

Table 8
The relationship between overweight and employment probability for men. Estimation method: Probit regressions, dependent variable is 1 if employed.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BMI	−0.003 (0.89)				0.056** (2.68)		
BMI squared					−0.001** (2.83)		
Height		0.008** (3.28)	0.007** (2.90)	0.007** (3.03)		0.006** (2.42)	0.006** (2.45)
Weight		−0.003 (1.00)					
Fat mass			−0.005** (2.84)			−0.003* (1.88)	
Waist circumference				−0.003** (1.98)			−0.001 (0.94)
Good health						0.204** (5.61)	0.204** (5.46)
Age	0.030 (0.89)	0.024 (0.87)	0.023 (0.82)	0.023 (0.86)	0.030 (1.07)	0.017 (0.63)	0.017 (0.66)
Age squared	−0.043 (1.28)	−0.036 (1.06)	−0.034 (0.99)	−0.034 (1.03)	−0.044 (1.29)	−0.023 (0.72)	−0.023 (0.75)
High education	0.135** (3.44)	0.135** (3.28)	0.139** (3.33)	0.129** (3.16)	0.139** (3.48)	0.115** (3.09)	0.110** (2.99)
Middle education	0.022 (0.86)	0.017 (0.64)	0.020 (0.72)	0.016 (0.61)	0.025 (0.96)	0.009 (0.35)	0.007 (0.28)
N	1733	1733	1733	1733	1733	1733	1733

Note: Reported coefficients are marginal effects, evaluated at variable means. For dummy variables, the reported coefficient is the effect of changing the dummy from 0 to 1. Robust *t*-statistics are in parentheses. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

The overall pattern regarding women is that all measures of obesity have a significant and negative association with employment probability (Table 7). Therefore, the results differ from the wage regressions for women. The only specification that does not reveal a negative association is the one in which the square of BMI is entered together with BMI (Table 7, Column 5).

It is useful to compare the marginal effects for weight and fat mass, which are both measured in kilos (Table 7, Columns 2–3). A one kilo increase in weight is associated with a decrease in employment probability of some 0.3 percentage points, whereas an increase in fat mass of one kilo is associated with a decrease in employment probability of 0.5 percentage points. One interpretation is that fat mass measures ill health to a greater extent than weight, and that ill health negatively influences employment probability. This conclusion would be in keeping with the medical evidence according to which fat mass is associated with serious health problems (e.g. Kopelman, 2000). Other interpretations of these correlations are obviously possible like the one based on the discrimination of obese job seekers.

The inclusion of a dummy variable controlling for self-reported health somewhat reduces the size of the marginal effects for the measures of body composition (Table 7, Columns 6–7). However, they remain highly statistically significant. This pattern suggests that obesity also influences women's employment probability through other channels than bad health.

The situation for men is different (Table 8). The variable that matters most is fat mass, which has a negative and statistically significant association with men's employment probability (Table 8, Column 3). In contrast to the results for women, BMI entered alone is not a statistically significant determinant of men's employment probability. However, BMI entered together with the square of BMI produces statistically significant results (Table 8, Column 5).

Our findings for Finnish women and men are largely consistent with the observations by Burkhauser and Cawley (2008), who have documented that the correlation of obesity with employment is sensitive to the definition of obesity for men but not as much for women. They find that, for white males, employment is not

Table 9
The relationship between overweight and employment probability: women. Estimation method: Probit regressions, dependent variable is 1 if employed.

	(1)	(2)	(3)	(4)	(5)	(6)
Underweight (BMI ≤ 18.5)	−0.022 (0.52)			−0.013 (0.31)		
Overweight (25 ≤ BMI ≤ 29.99)	−0.079** (2.95)			−0.067** (2.64)		
Obese (BMI ≥ 30)	−0.132** (4.05)			−0.099** (3.15)		
High fat mass (percent body fat ≥ 30)		−0.068** (3.33)			−0.053** (2.66)	
High waist circumf. (≥88 cm)			−0.102** (4.06)			−0.083** (3.59)
Height		0.002 (1.32)	0.004** (2.10)		0.002 (1.17)	0.003* (1.79)
Good health				0.146** (4.32)	0.148** (4.21)	0.141** (4.14)
Age	0.034 (1.35)	0.036 (1.43)	0.041 (1.56)	0.033 (1.34)	0.034 (1.41)	0.038 (1.52)
Age squared	−0.031 (1.09)	−0.034 (1.17)	−0.038 (1.30)	−0.029 (1.02)	−0.030 (1.10)	−0.034 (1.21)
High education	0.117** (3.48)	0.113** (3.35)	0.108** (3.20)	0.103** (3.12)	0.091** (3.03)	0.095** (2.89)
Middle education	0.108** (3.93)	0.104** (3.78)	0.104** (3.82)	0.095** (3.56)	0.091** (3.44)	0.092** (3.47)
N	1856	1865	1856	1856	1856	1856

Note: Reported coefficients are marginal effects, evaluated at variable means. For dummy variables, the reported coefficient is the effect of changing the dummy from 0 to 1. Robust *t*-statistics are in parentheses. The reference group for BMI categories is normal weight. The reference group for the education dummies is low education.
** Significant at the 5% level.
* Significant at the 10% level.

Table 10
The relationship between overweight and employment probability: men. Estimation method: Probit regressions, dependent variable is 1 if employed.

	(1)	(2)	(3)	(4)	(5)	(6)
Underweight (BMI $\leq$ 18.5)	−0.459** (5.53)			−0.409** (4.34)		
Overweight (25 $\leq$ BMI $\leq$ 29.99)	0.014 (0.49)			0.033 (1.26)		
Obese (BMI $\geq$ 30)	−0.076** (1.94)			−0.04 (1.03)		
High fat mass (percent body fat $\geq$ 25)		−0.119** (3.64)			−0.087** (2.66)	
High waist circumf. ($\geq$102 cm)			−0.108** (3.17)			−0.070** (2.07)
Height		0.006** (2.34)	0.008** (3.26)		0.005** (2.17)	0.006** (2.67)
Good health				0.202** (5.55)	0.201** (5.51)	0.201** (5.52)
Age	0.028 (0.98)	0.019 (0.70)	0.018 (0.67)	0.020 (0.78)	0.014 (0.53)	0.014 (0.55)
Age squared	−0.040 (1.20)	−0.029 (0.88)	−0.028 (0.84)	−0.028 (0.91)	−0.019 (0.62)	−0.019 (0.63)
High education	0.135** (3.41)	0.140** (3.40)	0.130** (3.15)	0.114** (3.19)	0.116** (3.16)	0.109** (2.98)
Middle education	0.017 (0.64)	0.020 (0.75)	0.015 (0.57)	0.007 (0.29)	0.010 (0.37)	0.006 (0.25)
N	1733	1733	1733	1733	1733	1733

Note: Reported coefficients are marginal effects, evaluated at variable means. For dummy variables, the reported coefficient is the effect of changing the dummy from 0 to 1. Robust *t*-statistics are in parentheses. The reference group for BMI categories is normal weight. The reference group for the education dummies is low education.
** Significant at the 5% level.

significantly correlated with obesity defined using BMI, but it is significantly correlated with obesity defined using percent body fat.

The introduction of a dummy variable for self-reported health further reinforces the finding that fat mass matters most for men's employment probability (Table 8, Columns 6–7). The relationship between waist circumference and employment probability is non-existent when one is controlling for self-reported health, whereas the relationship between fat mass and employment probability is still significant at the 10% level. The size of the marginal effect implies that an additional kilo of fat mass reduces employment probability by some 0.3 percentage points.

Furthermore, we have estimated models to examine the relationship between overweight and employment probability using the same cut-off points for obesity as in Tables 5 and 6. All three measures of obesity are negatively correlated with employment for both women and men (Tables 9 and 10). The category for high waist circumference is associated with approximately 10 percentage points lower employment probability for women (Table 9, Column 3). Moreover, the obese category has a significant negative association with men's employment probability (Table 10, Column 1).

The inclusion of self-reported health as an additional explanatory variable reduces the magnitude of the estimates (Tables 9 and 10, Columns 5–6). Finally, it is worth noting that height is statistically significant in almost all models for employment probability even when one includes self-reported health as an additional explanatory variable. For women, one additional centimeter of height would imply some 0.3 percentage points higher employment probability. For men, the corresponding figure is somewhat higher at 0.5–0.6 percentage points.

4. Conclusions

There is increasing concern among medical researchers about the reliability of BMI as a measure of obesity because of its inability to distinguish between body fat and fat-free mass. Recently, economists have also recognized these concerns and started utilizing alternative measures to study the effects of obesity on economic outcomes (Burkhauser and Cawley, 2008; Heineck, 2007; Wada and Tekin, 2007). The obesity measures used in this paper are BMI, weight, fat mass and waist circumference. An advantage of our data set is that all measures of obesity originate from professional health examinations conducted at local health centres and information on fat mass is based on bioelectrical impedance analysis.

Our paper demonstrates that conclusions based on BMI vs. more accurate measures of obesity may differ in some important respects. Waist circumference alone has a significant and negative association with wages for women, while none of the other measures of obesity including BMI are significant. In contrast, none of the obesity measures are significant in the linear wage models for men (Table 4). In addition, height is as an important determinant of wages for both women and men.

Obesity predicts labour force participation. All measures of obesity are negatively associated with women's employment probability and fat mass is negatively associated with men's employment probability.

We also find that the use of categories for waist circumference and fat mass has a substantial influence on the results. For example, the category for high fat mass is associated with roughly 5.5% lower wages for men despite the fact that the linear specification of the model does not produce statistically significant results for fat mass.

The introduction of a control for self-reported health attenuates the association between the measures of obesity and labour market success in almost all models. This arises because obesity and good health are negatively correlated. The use of objective measures of health (such as legal disability status and diseases) would be an important avenue for the future research.

The general lesson stemming from the estimates is that persons with a high BMI are not necessarily worse off in the labour market in Finland. If body weight, however, is concentrated around the waist or mostly consist of fat instead of muscle, we find in some cases negative associations with labour market success, even when BMI is not significant. Hence, data sets should include these more accurate measures of fatness. This would allow researchers to evaluate which of the different measures of fatness is most appropriate to predict the outcome of interest.

We did not explore the question of causality. This would require an instrumental variables strategy, involving instruments that would predict weight but not wages (Cawley et al., 2005). The same is true for employment; the causal effect of overweight on employment probability needs to be investigated using instrumental variables techniques. Another limitation of our approach is that the estimates may suffer from omitted-variables bias, because the data do not contain variables such as labour market experience. The patterns could also differ in age categories. In particular, BMI may matter most among young workers. Research on these issues would provide additional insights about the relevance of measures of body composition in the labour market.

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