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# The effect of obesity on wages and employment: The difference between having a high BMI and being fat*

by

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March 2007

Abstract

In this paper, we re-examine the relationship between overweight and labour market success, using indicators of individual body composition along with BMI (Body Mass Index). We use the dataset from Finland in which weight, height, fat mass and waist circumference are not self-reported, but obtained as part of the overall health examination. We find that waist circumference, but not weight or fat mass, has a negative effect on wages for women, whereas all measures of obesity have negative effects on women's employment probabilities. For men, the only obesity measure that is significant for men's employment probabilities is fat mass. One interpretation of our findings is that the negative wage effects of overweight on wages run through the discrimination channel, but that the negative effects of overweight on employment have more to do with ill health. All in all, measures of body composition provide a more refined picture about the effects of obesity on wages and employment.

JEL classification: I12, J31

Keywords: Wages; Employment; BMI; Overweight; Obesity; Fatness; Adiposity

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## 1. Introduction

Several empirical studies document the negative effects of obesity on labour market success measured by wages and employment. The relevant papers include Baum and Ford (2004), Brunello and d'Hombres (2007), Cawley (2004), Cawley and Danziger (2005), Conley and Glauber (2006), Garcia and Quintana-Domeque (2006), Kennedy and Garcia (1994), and Sarlio-Lähteenkorva et al. (2004). An excellent summary of the existing research can be found in Cawley (2007). It is possible that the negative effects are due to overweight individuals being discriminated against in the labour market. For the reasons of data availability, this literature has used body mass index (BMI) as a measure of obesity.[1] However, by using BMI alone as a measure of overweight, it is difficult to determine whether labour market penalties owing to obesity are due to discrimination or other reasons such as the limited ability to work, or other health reasons[2]. The most important reason for this is that BMI ignores the distinction between fat and fat-free mass such as muscle and bone (Cawley and Burkhauser, 2006). Hence, a muscular individual with a high BMI will be misclassified as overweight if more accurate measures of obesity are not available. Not surprisingly, in the medical literature, BMI alone is not considered to be a particularly valid measure of obesity nor a sufficient predictor for obesity-related health outcomes (e.g. Cawley and Burkhauser, 2006; Yusuf et al., 2005).

In this paper, we re-examine the relationship between overweight, wages and employment, using indicators of individual body composition along with BMI. In doing so, we produce new knowledge about the reasons put forward as to why overweight has been found to be associated with lower earnings in earlier studies. The new indicators we use are fat mass expressed as kilograms of fat that an individual's body contains, and waist circumference. Fat mass distinguishes high-BMI individuals who have a high BMI because they have a lot of muscle from high-BMI individuals who have a high BMI because they are fat. Waist circumference distinguishes individuals that have a high fat mass and the bulk of the fat concentrated around the waist compared to those with a lot of fat that is more evenly distributed around the body. The idea here is that a long waist circumference in relation to height may be interpreted by employers as a non-attractive physical appearance, which has earlier been found to be associated with lower earnings (e.g. Hamermesh and Biddle, 1994). Furthermore, we contrast our results on the effect of overweight from our wage regressions with the results that stem from the effect of overweight on employment probability. Taken together, our paper demonstrates that conclusions based on BMI vs. more accurate measures of obesity may differ in some important respects.

We use data from the "Health 2000 in Finland" dataset, a cross-section of about 8000 Finns above the age of 30. (Aromaa and Koskinen, 2004, provide a description of the dataset.) This dataset contains information on individual fat mass obtained from eight-polar bioelectrical impedance analysis, which is performed by running a small constant current through the body (e.g. Scharfetter et al., 2001). 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. Furthermore, in our dataset, weight, height, waist circumference, and other relevant measures are not self-reported, but obtained as part of the overall health examination, and hence they can be considered more reliable than self-reported measures obtained from household surveys that have been very frequently used in the previous empirical studies within the social sciences.

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

The paper unfolds as follows. Section 2 contains a description of our data and empirical approach. Section 3 reports our results and the last section concludes.

## 2. Data and empirical approach

This study is based on the "Health 2000" population survey dataset. This dataset has been constructed in order to give a comprehensive picture of the health and functional ability of the working-age and old-age Finnish population. The basic dataset comes from a random sample of 10 000 individuals 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. In particular, all measures of obesity originate from professional health examinations conducted at local health centres. Supplementary information has been obtained from various government registers. Due to the fact that the dataset includes results from clinical examinations, the sampling design had to include 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 was a total of 249 regional clusters in the population. 15 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 was 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. About 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.

In our empirical research, we have limited the focus to individuals aged between 30 and 65, because in this paper we are interested in labour market outcomes. The reason for the lower limit on age is due to the nature of the data. In addition, we have limited the sample to those who are wage and salary earners. We define full-time work as at least 30 hours of work per week.

Descriptive information on important variables can be found in Table 1. From that table it can be seen that men have higher annual wages than women. Both men and women are, on average, overweight, with BMI exceeding 25. Women are, on average, better educated than men, with some 18% of women and 15% of men having a tertiary degree. Measures for obesity are correlated (Tables 2 and 3). For instance, the correlation coefficient between fat mass and weight is 0.94 for women and 0.85 for men. The correlation coefficient between waist circumference and weight is 0.90 for women and 0.88 for men. On the other hand, none of the body composition measures are particularly correlated with height. For women, the correlation between fat mass and height is even slightly negative (Table 2). The same type of information can be found in graphical form in Figure 1. In summary, measures are, by and large, highly correlated.

The purpose of this paper is to distinguish the relationship between various measures of obesity on individual wages and employment. In doing so, we first estimate wage regressions where we, in different specifications, add measures of obesity to a traditional wage regression. In all estimations, we account for the sampling structure by using the appropriate survey estimation methods and weights that are available in our data. We investigate men and women separately, because poor physical appearance may discriminate against women more. Accordingly, several earlier studies report that the negative wage effects of obesity are larger for women (e.g. Cawley, 2007).[3] For the analysis of various measures of obesity on employment, we estimate probit models where the dependent variable takes the value 1 if the individual is working and 0 otherwise.

The first-best empirical specification for this type of analysis would probably be one where the various measures for obesity would be entered simultaneously in the regression. It would then be possible to disentangle the effect of, say, fat mass from weight or waist circumference. However, because of the high correlation between the measures for obesity, the results of such regressions become unreliable, and preclude reliable interpretation.[4] Therefore, the different measures of obesity are entered one at a time in separate regressions.

## 3. Results

The results for our baseline specification for women can be found in Table 4. BMI is insignificant as an explanatory variable for wages in our sample. This is unlike the situation in many other studies in the field, including Brunello and d'Hombres (2007), who also include Finland in their analysis of the European Community Household Panel (ECHP) data.[5] However, the rest of the table reveals that the measures of body composition matter more. In particular, waist circumference is negative and on the borderline of being statistically significant. On the other hand, fat mass does not have any influence on wages.

The other explanatory variables reveal well-known patterns from earlier research. Well-educated individuals have higher wages, and the effect of age displays an inverted U-shape form. The control for part-time work is also, expectedly, negative.

Table 5 presents the corresponding results for men. The only variable apart from the control variables that actually has an impact on wages is height. That height has an impact on wages is consistent with earlier research (e.g. Persico et al., 2004; Hübler, 2006).

Table 6 probes further into the question for women by using indicators for our measures of obesity. This is done in order to examine whether there are nonlinearities in the effects on wages. Indeed, being seriously obese, i.e. having a BMI over 35, is associated with some 9.8% lower wages. More surprising is the fact that the overweight category, with BMI between 25 and 30, is also associated with some 4.2% lower wages, whereas we find no effect regarding the obese category with BMI between 30 and 35 (Column 1). This may be an indication that BMI alone is a rather unreliable measure of obesity. The other obesity measures, weight, fat mass, and waist circumference, have been divided into quintiles, and indicator variables using the quintile bounds have been constructed. The reference category is the second quintile in Columns 2-4. In these columns we also control for height, in the same fashion as in Table 4. The weight indicators are not significant predictors for the logarithm of annual wages (Column 2), neither are the fat mass indicators (Column 3). However, having a waist circumference that is in the $5^{th}$

quintile is associated with a wage penalty of some 4.4%, and this effect is significant at the 10% level.

Table 7 presents the same type of evidence for men. The table by and large confirms the picture given in Table 5. However, we can see that moderate overweight, i.e having a BMI between 25 and 30, actually has a positive effect on wages. This finding is consistent with some earlier evidence (e.g. Cawley, 2004; McLean and Moon, 1980). Apart from that it is obvious that height is important. The coefficients in Columns 2-5 imply that 10 cm of extra height for a man is associated with a higher annual wage of about 6%. Apart from that, it does not seem to matter whether a man has a lot of fat mass, or a long waist circumference.

Tables 8 and 9 present the results for the effects on employment of the same measures of obesity used in the wage regressions for women and men. It is useful to compare our wage regressions to employment regressions, as one may suspect that bad health affects employment probabilities more than it affects wages. Obviously, those working can, on good grounds, be assumed to be, on average, healthier than those not working (e.g. Arrow, 1996). Therefore, we would be more inclined to suppose that the effects of various measures of obesity on employment have more to do with overweight being a symptom of bad health than discrimination, as in the case of the effects on wages.

In Table 8, the overall picture of women is that all measures of obesity or weight have a negative association with employment probability. Overweight or obesity, regardless of how it is measured, is bad for women's employment probabilities. It is also interesting to note the difference in the coefficients for weight and fat mass, which are both measured in kilos, as the coefficient for fat mass (Column 3) is almost double the size of the weight coefficient (Column 2). One interpretation of this finding is that fat mass measures ill health to a greater extent than weight, and that ill health negatively affects employment probabilities. This conclusion is in keeping with the medical evidence according to which fat mass is associated with health problems (e.g. Kopelman, 2000).

In Table 9, the situation for men is dramatically different. By and large, weight or overweight seems considerably less important for men than for women. Indeed, the only variable that matters except for height is fat mass, which has a negative and statistically significant effect on employment probability. Again, one interpretation of this is that fat mass, controlling for height, is the measure of obesity which is most strongly correlated with ill health, out of the three measures that we are using in this paper.

## 4. Summary and concluding remarks

Previously, empirical studies have used BMI alone as a measure of obesity when examining the effects on wages and employment. BMI does not distinguish between muscle and fat, however. Overall, our paper demonstrates that conclusions based on BMI vs. more accurate measures of obesity that describe body composition may differ in some important respects. First, overweight decreases wages for women, but not for men. Second, when more refined measures of obesity are used to investigate the effects on women's wages, we find that waist circumference is the most important measure. Although this type of analysis cannot totally write off alternative explanations, this finding points in the direction of women being discriminated against based on physical appearance. Third, height is an important predictor of wages and employment, particularly for men. Fourth, at least for women, obesity, measured in any fashion, has much more severe effects on employment than on wages. The explanation for this is most likely due to obesity being associated with ill health. As those working are a selection of more healthy individuals than those not working, ill health measures are not as relevant for wages as they are for employment probabilities. Fifth, for men, the only obesity measure that is significant for men's employment probabilities is fat mass. This gives further weight to the argument that fat mass is the measure of obesity which perhaps best of all the measures used in this paper determines ill health.

The negative effects of overweight on labour market success may be due to either discrimination on the basis of physical appearance or health problems associated with overweight (Cawley and Burkhauser, 2006). This analysis gives some more weight to the hypothesis that potential wage penalties for women because of overweight has to do with physical appearance, as we cannot find evidence that weight or fat mass is associated with lower wages. On the other hand, the findings give reason to believe that negative health effects because of obesity are very important for employment probabilities, at least for women. Having said this, it should be emphasized that it is also possible that discrimination also plays a role for women's employment probabilities.

The final comment concerns the cross-sectional nature of our data. As we are operating with cross-sectional data, we cannot dig deeper into the question of causality. Thus, if the wage penalty were due to discrimination because of physical appearance, we could not distinguish between whether overweight led to discrimination or vice versa. This would require an instrumental variables strategy, involving instruments that would predict weight but not wages (e.g. Cawley et al., 2005). The same goes for employment; the causal effect of overweight on employment probability needs to be investigated using instrumental variables techniques. Nevertheless, our paper shows that the analysis of the wage and employment effects of obesity using more refined measures than BMI alone can go some way in explaining why overweight affects employment outcomes.

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Table 1: Descriptive statistics for important variables

| Variable | Women | | Men | |
|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. |
| Annual wage (€) | 15395 | 5934 | 19841 | 19657 |
| Height (m) | 1.64 | 0.06 | 1.77 | 0.06 |
| Weight (kg) | 69.6 | 13.2 | 84.4 | 13.8 |
| Waist circumference (cm) | 85.1 | 12.3 | 96.1 | 10.9 |
| Fat mass (kg) | 21.8 | 9.0 | 18.0 | 7.7 |
| BMI | 25.8 | 4.8 | 26.7 | 3.8 |
| Weekly hours | 38.7 | 3.9 | 40.73 | 5.1 |
| High education | 0.18 | | 0.15 | |
| Middle education | 0.56 | | 0.45 | |
| Low education | 0.24 | | 0.38 | |
| Age (years) | 44.0 | 8.0 | 43.4 | 8.1 |

Note: 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.

Table 2: Correlation coefficients, women

| | Height | Weight | Waist circumference | Fat mass |
|---|---|---|---|---|
| Height | 1.0000 | | | |
| Weight | 0.2650 | 1.0000 | | |
| Waist circumference | 0.0222 | 0.8957 | 1.0000 | |
| Fat mass | -0.0110 | 0.9367 | 0.9080 | 1.0000 |

Table 3: Correlation coefficients, men

| | Height | Weight | Waist circumference | Fat mass |
|---|---|---|---|---|
| Height | 1.0000 | | | |
| Weight | 0.4424 | 1.0000 | | |
| Waist circumference | 0.1486 | 0.8816 | 1.0000 | |
| Fat mass | 0.0328 | 0.8485 | 0.9090 | 1.0000 |

Figure 1: The relationship between fat mass, weight and waist circumference

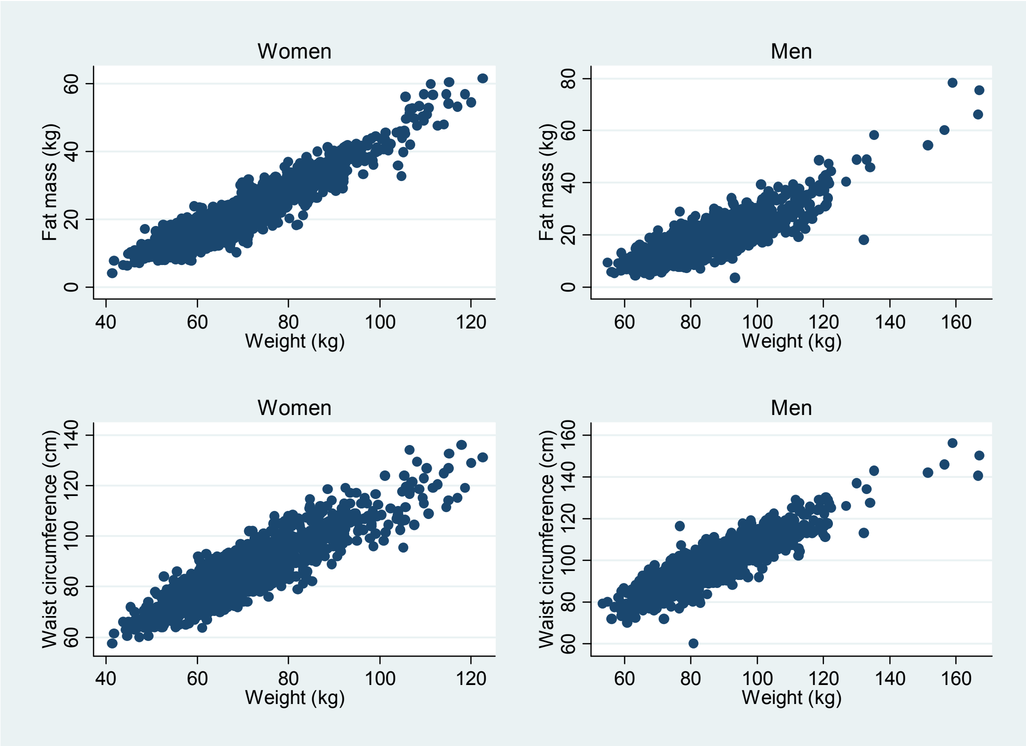

Table 4: The relationship between wages and overweight: women. Dependent variable; log of annual wages

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| BMI | -0.001 | | | |
| | (0.82) | | | |
| Weight | | -0.000 | | |
| | | (0.55) | | |
| Fat mass | | | -0.000 | |
| | | | (0.36) | |
| Waist circumference | | | | -0.088 |
| | | | | (1.60) |
| Height | | 0.374 | 0.452 | 0.390 |
| | | (2.83)** | (3.58)** | (3.15)** |
| High education | 0.371 | 0.363 | 0.374 | 0.364 |
| | (14.34)** | (13.83)** | (13.50)** | (13.78)** |
| Middle education | 0.084 | 0.081 | 0.089 | 0.080 |
| | (5.50)** | (5.29)** | (5.48)** | (5.21)** |
| Age | 0.030 | 0.031 | 0.034 | 0.032 |
| | (3.32)** | (3.41)** | (3.73)** | (3.51)** |
| Age squared | -0.025 | -0.026 | -0.030 | -0.027 |
| | (2.61)** | (2.67)** | (3.03)** | (2.75)** |
| Part-time work | -0.189 | -0.186 | -0.157 | -0.189 |
| | (3.43)** | (3.44)** | (3.00)** | (3.52)** |
| Constant | 8.716 | 8.054 | 7.844 | 8.055 |
| | (43.09)** | (24.69)** | (23.45)** | (25.06)** |
| Observations | 1420 | 1420 | 1331 | 1407 |
| R-squared | 0.19 | 0.19 | 0.20 | 0.20 |

Note: Absolute value of t statistics in parentheses. * significant at 5%; ** significant at 1%. Part-time work refers to individuals who work less than 30 hours per week.

Table 5: The relationship between wages and overweight: men. Dependent variable; log of annual wages

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| BMI | 0.003 | | | |
| | (0.77) | | | |
| Weight | | 0.001 | | |
| | | (0.66) | | |
| Fat mass | | | 0.001 | |
| | | | (0.73) | |
| Waist circumference | | | | 0.041 |
| | | | | (0.35) |
| Height | | 0.633 | 0.618 | 0.679 |
| | | (3.52)** | (3.99)** | (4.31)** |
| High education | 0.470 | 0.455 | 0.465 | 0.461 |
| | (12.56)** | (12.33)** | (12.89)** | (12.69)** |
| Middle education | 0.119 | 0.114 | 0.118 | 0.114 |
| | (5.40)** | (5.20)** | (5.21)** | (5.22)** |
| Age | 0.014 | 0.011 | 0.009 | 0.008 |
| | (0.88) | (0.67) | (0.58) | (0.54) |
| Age squared | -0.009 | -0.004 | -0.003 | -0.002 |
| | (0.50) | (0.24) | (0.19) | (0.10) |
| Part-time work | -0.257 | -0.237 | -0.240 | -0.240 |
| | (2.31)* | (2.17)* | (2.20)* | (2.20)* |
| Constant | 9.164 | 8.105 | 8.200 | 8.094 |
| | (25.99)** | (20.06)** | (20.24)** | (19.91)** |
| Observations | 1376 | 1376 | 1309 | 1373 |
| R-squared | 0.15 | 0.16 | 0.16 | 0.16 |

Note: Absolute value of t statistics in parentheses * significant at 5%; ** significant at 1%.

Table 6: Additional results, women. Dependent variable; log of annual wages

| | BMI | Weight | Fat mass | Waist circumference |
|---|---|---|---|---|
| Height | | 0.347 | 0.365 | 0.381 |
| | | (2.50)* | (2.99)** | (3.06)** |
| BMI: below 20 | -0.027 | | | |
| | (0.72) | | | |
| BMI: 25 to 29.99 | -0.042 | | | |
| | (2.41)* | | | |
| BMI: 30 to 34.99 | 0.008 | | | |
| | (0.40) | | | |
| BMI: 35 or over | -0.098 | | | |
| | (2.32)* | | | |
| 1st quintile | | -0.008 | -0.019 | -0.016 |
| | | (0.28) | (0.69) | (0.60) |
| 3rd quintile | | 0.008 | -0.016 | -0.036 |
| | | (0.35) | (0.63) | (1.52) |
| 4th quintile | | 0.006 | -0.032 | -0.016 |
| | | (0.25) | (1.32) | (0.74) |
| 5th quintile | | -0.010 | -0.027 | -0.044 |
| | | (0.40) | (1.29) | (1.81) |
| Constant | 8.730 | 8.075 | 8.080 | 8.047 |
| | (41.28)** | (23.48)** | (24.91)** | (24.43)** |
| Observations | 1448 | 1421 | 1421 | 1421 |
| R-squared | 0.19 | 0.19 | 0.19 | 0.19 |

Note: Absolute value of t statistics in parentheses.* significant at 5%; ** significant at 1%. Regressions include controls for age, age squared, three education levels, and for part-time work. The reference category for Column 1 is BMI between 20 and 24.99. The reference for columns 2 to 4 is weight, fat mass, or waist circumference in the 2nd quintile.

Table 7: Additional results, men. Dependent variable; log of annual wages

| | BMI | Weight | Fat mass | Waist Circumference |
|---|---|---|---|---|
| Height | | 0.553 | 0.714 | 0.696 |
| | | (3.34)** | (4.59)** | (4.48)** |
| BMI: below 20 | -0.164 | | | |
| | (1.72) | | | |
| BMI: 25 to 29.99 | 0.068 | | | |
| | (2.68)** | | | |
| BMI: 30 to 34.99 | 0.047 | | | |
| | (1.18) | | | |
| BMI: 35 or over | -0.032 | | | |
| | (0.71) | | | |
| 1st quintile | | -0.023 | -0.058 | -0.032 |
| | | (0.65) | (1.70) | (0.92) |
| 3rd quintile | | 0.052 | 0.032 | 0.023 |
| | | (1.50) | (1.03) | (0.64) |
| 4th quintile | | 0.052 | 0.059 | -0.001 |
| | | (1.57) | (1.78) | (0.02) |
| 5th quintile | | 0.024 | -0.009 | -0.011 |
| | | (0.59) | (0.22) | (0.33) |
| Constant | 9.215 | 8.315 | 8.090 | 8.087 |
| | (27.83)** | (21.52)** | (19.89)** | (20.43)** |
| Observations | 1425 | 1376 | 1376 | 1376 |
| R-squared | 0.15 | 0.16 | 0.16 | 0.16 |

Note: See notes to Table 6.

Table 8: The relationship between employment and overweight: women

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Height | | 1.581<br>(3.19)** | 0.942<br>(1.85) | 1.364<br>(2.79)** |
| BMI | -0.021<br>(3.97)** | | | |
| Weight | | -0.008<br>(3.99)** | | |
| Fat mass | | | -0.014<br>(5.18)** | |
| Waist circumference | | | | -1.336<br>(6.29)** |
| Constant | -8.024<br>(12.24)** | -10.671<br>(10.97)** | -10.103<br>(9.45)** | -10.145<br>(10.31)** |
| Observations | 2631 | 2631 | 2418 | 2605 |

Note: Dependent variable is binary, taking the value 1 if the individual is working and 0 otherwise. Estimation method: probit. Regressions also contain controls for age, age squared, and education levels.

Table 9: The relationship between employment and overweight: men

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Height | | 1.632<br>(2.73)** | 1.530<br>(2.74)** | 1.777<br>(3.29)** |
| BMI | 0.003<br>(0.32) | | | |
| Weight | | 0.001<br>(0.19) | | |
| Fat mass | | | -0.011<br>(2.44)* | |
| Waist circumference | | | | -0.403<br>(1.27) |
| Constant | -4.199<br>(5.75)** | -7.036<br>(5.84)** | -7.088<br>(5.57)** | -7.036<br>(6.02)** |
| Observations | 2385 | 2385 | 2212 | 2371 |

Note: See notes to Table 8.

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

[2] See Kopelman (2000) for an exstensive review of the relationship between overweight and bad health.

[3] 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.

[4] 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).

[5] 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 (2006) does not find any negative effects of obesity on wages for either men or women. Both of these studies use BMI alone as a measure of obesity.

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