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The physical strenuousness of work is slightly associated with an upward trend in the BMI

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Abstract

This paper examines the relationship between the physical strenuousness of work and the BMI in Finland, using individual microdata at 5-year intervals over the period 1972–2002. Data came from the National FINRISK Study which contains self-reported information on the physical strenuousness of a respondent's occupation. Our estimates show that the changes in the physical strenuousness of work explain around 7% at most of the increase in BMI for Finnish males observed over a period of 30 years. The main reason for this appears to be the effect of the physical strenuousness of work on BMI which is rather moderate. According to the point estimates, BMI is 2.4% lower when a male's occupation is physically very demanding and involves lifting and carrying heavy objects compared with a sedentary job (reference group of the estimations), other things being equal. Furthermore, it is very difficult to associate the changes in the occupational structure with the upward trend in BMI for females, and the contribution of the changes in the occupational structure is definitely even smaller for females than it is for males. All in all, we show that the changes in self-reported occupation show a slight association with the changes in the logarithm of the BMI scores.

Keywords: Finland; Body mass index (BMI); Obesity; Overweight; Occupational structure; Physical strenuousness; Longitudinal

Introduction

One of the most striking global health trends is that the prevalence of overweight and obesity is increasing rapidly. This trend markedly applies to industrialised countries such as Finland (e.g. Audretsch & DiOrio, 2007). Several severe chronic health problems have been shown to be related to increased relative weight in medical research (National Institutes of Health, 1998). Consequently, research on the sources of the obesity epidemic is vital. A number of explanations for the upward trend in overweight have been presented in the literature (e.g. Bleich, Cutler, Murray, & Adams, 2007; Chou, Grossman, & Saffer, 2004; Cutler, Glaeser, & Shapiro, 2003; Finkelstein, Ruhm, & Kosa, 2005).

At the macro-level, one promising hypothesis, which has not been studied much, links the upward trend of overweight to the changes in occupational structure. The rationale for this hypothesis is that the proportion of physically strenuous occupations has declined significantly in the developed countries during the past few decades. In contrast, the employment share of light office work that is not physically very demanding has

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increased dramatically at the same time. This change may have positively contributed to the observed upward trend in overweight, because the amount of physical exercise required and consequent calorie consumption during the typical working day has decreased (e.g. Philipson, 2001; Popkin & Gordon-Larsen, 2004). By and large, no exact information on the contribution of the occupational trends on relative weight exists, however.

This paper examines the relationship between the physical strenuousness of work and measured BMI in Finland, using individual microdata at 5-year intervals over the period 1972–2002. The National FINRISK Study that we are using contains self-reported information on the physical strenuousness of a respondent's occupation. In this paper, we provide an estimate of the amount by which the changes in occupational structure have contributed to the upward trend in BMI over a period of 30 years. The Finnish case is of particular interest from a broader perspective, because the structural change in the economy and in the labour market started late compared with most other European countries and has been very intensive since the early 1970s (e.g. Hjerppe & Jalava, 2006). The share of agriculture and other primary production sectors has declined rapidly. Moreover, the share of heavy manufacturing industries has dropped significantly. The share of the service sector has increased, instead. As occupations in the service sector are considerably less strenuous physically than those in primary production or manufacturing, the Finnish case offers an excellent chance to test the above-mentioned hypothesis.

The existing evidence of the relationship between the physical strenuousness of work and BMI is sparse. Mummery, Schofield, Steele, Eakin, and Brown (2005) documented the fact that individuals in physically strenuous occupations are thinner. The evidence is based on a moderately sized ($N = 1579$) Australian sample, but the measure was valid, as the physical strenuousness of occupations was determined on the basis of daily sedentary work hours. Previously, Martínez-González, Martínez, Hu, Gibney, and Kearney (1999) reported the connection between the amount of time spent sitting and BMI by using a cross-sectional sample of the 15 member states in the European Union. Helmchen (2001) analysed the contribution of the changes in occupational structure to the prevalence of obesity, using the Union Army Veterans Data over the period 1900–1988. That data does not contain information on the physical strenuousness of work, however. Helmchen (2001) estimated that the changes in occupational structure are able to explain around 10% of the increase in obesity prevalence in the United States over the period 1900–1988. The changes in the occupational structure have not therefore been a factor of great importance for the upward trend in BMI, at least not in the United States. There are two very recent studies on the issue. Lakdawalla and Philipson (2007) report that a man spending 18 years in the most physical fitness-demanding occupation is about 14% lighter than his peer in the least demanding occupation. They take advantage of the panel data from the National Longitudinal Survey of Youth over the period 1982–2000. Furthermore, Bleich et al. (2007), by using various surveys, attribute only a very small share to the contribution of the changes in highly active work to the rise of obesity in the OECD countries over the period 1990–2001.[1]

We are in a somewhat better position to analyse the effects of physical strenuousness of work on the increase in BMI, as our data contains a large sample of Finns at 5-year intervals over the period 1972–2002. Accordingly, the data that we are using in this paper is not a single cross-section as in Martínez-González et al. (1999) or in Mummery et al. (2005). Moreover, the data at hand contains self-reported information about the physical strenuousness of a respondent's occupation that was not available in Helmchen (2001). Although our data covers a much shorter time period than the one in Helmchen (2001), the period is still long enough to give a reliable basis for the analysis of the contribution of the changes in occupational structure, because the structural change in the economy started late in Finland. Additionally, we do not rely on self-reported information regarding weight and height, which is likely to be biased, as Lakdawalla and Philipson (2007) do, and we include a period of observation for the analysis which is almost three times longer than the one in Bleich et al. (2007).

Data

The National FINRISK Study is based on surveys and anthropometric and clinical measures that probe population risk factors related to cardiovascular diseases.[2] Survey rounds have been done in 5-year intervals since 1972 by the use of stratified random

[1] Bleich et al. (2007) record small changes in highly active work in the developed countries over the period 1990–2001. As they argue, this is in line with expectations, because in the majority of the developed countries the shift away from manual labour occurred in the 1960s and 1970s.

[2] There are earlier papers that have used the National FINRISK Study to analyse the relationship between obesity and physical activity (e.g. Barengo, Nissinen, Tuomilehto, & Pekkarinen, 2002; Borodulin, 2006), but they focus on physical activity during leisure time. Lahti-Koski, Harald, Männistö, Laatikainen, and Jousilahti (2007) and Lahti-Koski, Jousilahti, and Pietinen (2001) use the same data to document the changes in obesity among adults in Finland.

samples of 8000–13,500 on each occasion (25- to 64-year-old individuals). The latest available round of the survey for the analyses is from the year 2002 (Borodulin, 2006). Depending on the round, 72–96% of those targeted have responded.[3] The survey was carried out in two provinces of Eastern Finland first, but its geographical scope was later widened to cover other parts of the country. In this paper, we use information only from those regions in Eastern Finland that were included in the first round (the provinces of North Karelia and Kuopio), because otherwise the results would reflect the changing composition of regions over the period 1972–2002 and their different industry structures.

Basic information on persons in this repeated cross-section data is gathered by the use of postal questionnaires. Anthropometric information is based on measurements at local health centres leading to low measurement error in relative weight, as weight was measured to 100 g and height to 0.5 cm. As a measure of relative weight, we use the index, which is calculated as a person's weight in kilograms divided by height in meters squared. The measurement methods have remained the same at all time points. In addition to weight and height, the data contains information on a respondent's relevant background factors (gender, age, marital status, and the level of education in three categories) that are being used as control variables.

For this paper, the most important fact is that the National FINRISK Study contains self-reported information on the physical strenuousness of respondents' work in which they were mostly employed during the 12-month period preceding the study. Therefore, the data that we are using does not contain duration of the occupation measure, but this particular aspect has been taken into account in the construction of the occupation measure when the data is gathered. Because we are using repeated cross-section data, we are not able to construct occupation measure that would include individuals' employment history over several years. Four fixed answering alternatives with examples of typical occupations in each of them were given to the respondents – the same throughout the whole study period 1972–2002. The first alternative was chosen if the person had a *sedentary job*: a job involving little walking during a typical working day. (The examples include watchmaking and office work.) The second alternative involved jobs entailing quite a lot of walking, but no lifting or carrying heavy objects. (The examples include supervising and *light manufacturing work*.) The third alternative was meant for jobs involving a lot of walking and lifting. (The examples include carpentry and *heavy manufacturing work*.) The fourth alternative included *physically very demanding* jobs involving lifting and carrying heavy objects. (The examples include logging and heavy farm work.)

Because we examine the association of the physical strenuousness of a respondent's occupation with BMI, we use data only from those persons who were employed. We use a rather loose definition for employed, because we classify all persons who have been employed at some point of time during the past 12 months as employed. This is the very same group of persons for which there is information available on the physical strenuousness of a respondent's work. The number of persons for which there is no information available on the physical strenuousness of a respondent's work was 717 over the period 1972–2002. As a result, the total number of observations was 44,227. Owing to missing information on some study variables for some individuals, the sample size shrank to 42,185 observations for the whole period. Consequently, the amount of missing information on study variables may be deemed moderate (4.6% of all available observations).[4]

Methods and the results

We report all results separately for males and females, because of biological, social norm and occupational structure differences between males and females. By pooling all observations together in the estimation of the models, we would impose the restriction that the determination process of overweight is exactly the same between males and females. Consequently, by estimating the models separately for males and females, we allow that the same independent variables have different coefficients between males and females.

The prevalence of overweight has increased significantly in Finland, as revealed by, for example, the National FINRISK Study (Table 1). The average level of BMI rose in the total population from 25.9 in the year 1972 to 27.2 in the year 2002.[5] The upward trend

[3] Harald, Salomaa, Jousilahti, Koskinen, and Vartiainen (2007) report that the lower socio-economic groups are over-represented among non-respondents in both males and females. However, as Harald et al. (2007) argue, non-participation should not be a particularly serious problem with the National FINRISK surveys.

[4] We have looked in detail at the issue of missing information on study variables. It turns out that most of the missing observations emerge because the education level is not recorded.

[5] We include only employed persons in the analyses, as noted earlier. The time pattern of BMI is almost similar when we include all the persons from the data. It is interesting to note that for both males and females the variation of the BMI scores has increased over the period 1972–2002.

Table 1
Mean values of BMI (and the number of observations in parentheses), over the period 1972–2002

Year	Total population	Males	Females
1972	25.9 (10,990)	25.6 (5389)	26.1 (5601)
1977	26.1 (11,995)	26.0 (5809)	26.3 (6186)
1982	26.2 (5957)	26.3 (2983)	26.1 (2974)
1987	26.5 (4688)	26.8 (2237)	26.3 (2451)
1992	26.6 (3049)	26.9 (1419)	26.4 (1630)
1997	26.9 (3414)	27.2 (1719)	26.6 (1695)
2002	27.2 (2998)	27.4 (1400)	27.1 (1598)
Change, 1972–2002	1.3	1.8	1.0

applies to both males and females. The changes in the physical strenuousness of work assessed using self-reported information with four fixed alternatives are given for both genders in Table 2. The change has been dramatic, especially for males. In particular, the share of sedentary work increased for males from 24.9% in the year 1972 to 48.3% in the year 2002. In contrast, the share of physically very demanding work declined from 31.5% to 10.2% over the same period. Our data is therefore able to capture in this respect an episode of substantial structural change in the labour market. One important difference between males and females is that the share of physically very demanding occupations for females was at a very low level compared with males even at the beginning of the observation period, their share being only 3.6% in the year 1972. Concurrently, the share of sedentary jobs has also increased substantially for females over the period because of the decline in light and heavy manufacturing work. These differences demonstrate that the segregation of genders into occupations constitutes one essential motivation to estimate the models separately for males and females.

We employed the OLS regression model where a logarithm of the BMI was set as the dependent variable and the self-assessed physical strenuousness of a respondent's occupation as one of the independent variables covering all the years of the National FINRISK Study with year controls and the relevant individual-level covariates (age and its square, marital status and the level of education in three categories). We use this particular specification of the model, because it is simple and transparent. The earlier literature has applied similar models. We use linear model, because it allows us to calculate the contribution of the changes in occupational structure on the increase in the BMI over the period. Our variable of interest, the physical strenuousness of a respondent's work, is included among the explanatory variables as separate dummy variables and we have chosen a sedentary job to be the reference category of the estimations to which another type of occupation is compared. We report the results as unstandardized estimates, because it is more convenient when we quantify the effect of the changes in occupational structure. The coefficients of occupational variables in Table 3 can be interpreted as the percentage difference in the outcome variable between different occupation groups, because the occupation variables are included

Table 2
Physical strenuousness of work, % shares, over the period 1972–2002

	Sedentary job	Light manufacturing work	Heavy manufacturing work	Physically very demanding work	Total
Males					
1972	24.9	20.6	23.0	31.5	100
1977	32.3	23.1	22.4	22.2	100
1982	33.0	21.9	21.9	23.2	100
1987	37.9	20.3	22.6	19.2	100
1992	46.5	19.9	23.1	10.5	100
1997	56.4	14.5	18.7	10.4	100
2002	48.3	19.9	21.5	10.2	100
Change, 1972–2002	23.4	−0.7	−1.4	−21.3	
Females					
1972	28.4	33.5	34.5	3.6	100
1977	37.8	32.8	25.9	3.5	100
1982	40.7	31.2	25.1	3.0	100
1987	41.5	29.3	25.4	3.8	100
1992	50.8	26.9	20.8	1.5	100
1997	53.5	25.5	18.3	2.7	100
2002	52.9	26.5	18.2	2.3	100
Change, 1972–2002	24.5	−7.0	−16.2	−1.3	

in the models as separate dummy variables, and the outcome variable of the models is the logarithm of the BMI. Logarithmic transformation of the BMI is used because of the skewness of its distribution. Furthermore, we estimated OLS regression models separately for the year 1972 and the year 2002 in order to record the possible changes in the relationship over the period.

The results for the whole period 1972–2002 reveal that Finnish males are somewhat thinner in the occupations that are physically strenuous (Table 3). Encouragingly, the coefficients of the occupational variables show a pattern that exactly matches the order in terms of physical strenuousness levels. According to the point estimates, BMI is 2.4% lower when a male's occupation is physically very demanding and involves lifting and carrying heavy objects compared with a sedentary job (reference group of the estimations), other things being equal.[6] Moreover, males involved in light manufacturing work and heavy manufacturing work have 1.1% and 2.2% lower levels of BMI, respectively, compared with males in sedentary jobs. OLS regression models are therefore able to provide consistent estimates for males based on self-reported information on occupations.[7] The findings are different for females. In particular, for the small share of females who work in physically very demanding occupations, the level of BMI is actually 1.4% higher compared with those in a sedentary job. In addition, females who are involved in light manufacturing work have somewhat lower level of BMI, but those in heavy manufacturing work do not differ from those in a sedentary job. The models estimated separately for the year 1972 and the year 2002 show that for both males and females the impact of the physical strenuousness of a respondent's occupation on BMI has broken down over the period. Hence, the models that are estimated separately for the year 2002 reveal that the physical strenuousness of work has no longer a statistically significant association with BMI.[8] Our estimations also reveal that education has become a more relevant determinant of BMI for females at the end of the observation period.

As we are quantifying the effect of the changes in the physical strenuousness of work on BMI, we are interested in the year effects. The first set of estimates for genders in Table 4 report the year effects without controlling for the changes in the physical strenuousness of work, but by including individual-level controls (age and its square, marital status, and the level of education in three categories). The coefficients of the year effects for males show a similar pattern that was reported earlier in Table 1. Consequently, the year dummy for 2002 has a clear positive association with BMI. In contrast, the year dummy for 2002 for females is not statistically significant when we include all individual-level controls. The second set of estimates for genders in Table 4 include the physical strenuousness levels of occupations as control variables in addition to the year dummies and individual-level controls.[9] The physical demands of occupations are included in the models as separate dummy variables as in Table 3.

The association between the decreasing physical strenuousness of work and the rising trend of BMI can be evaluated by comparing the year effects in these two models. This comparison reveals that the changes in the occupational structure (statistically) explain a rather small share of the overall increase in BMI.

[6] The results regarding the control variables are in line with the ones reported in Böckerman et al. (2007).

[7] We have estimated the models for males by using quantile regression methods. Estimating several quantiles makes it possible to explore the shape of the conditional distribution, not just its mean. We have estimated the models for the 10th, 25th, 50th and 75th quantiles. The effect of occupation is larger in the highest BMI quantiles than at the lower tail of the distribution. This pattern is consistent with the results by Lakdawalla and Philipson (2007). Our data does not contain information about workers' tenure. For this reason, we have estimated the models by using age as a proxy for tenure. In particular, we have estimated separate models for males above 40 years. The effect of occupation on BMI is somewhat larger for males above 40 years than in the whole sample for males. Lakdawalla and Philipson (2007) point out that gaining weight is a dynamic process and they provide evidence according to which the effects of occupation accumulate over workers' careers, with small initial effects ballooning to large ultimate effects.

[8] The use of F-test statistics confirms this conclusion. Hence, the coefficients of the occupational variables can be constrained to zero at the standard 5% level in the models for the year 2002 in Table 3. (The significance level of the test is 18.7% for the model of males in the year 2002, i.e. we cannot reject the null hypothesis that the coefficients of the occupational variables are zero; the significance level of the test is 88.6% for the model of females in the year 2002.) This is not possible in the models that are estimated for the year 1972. (The significance level of the tests is 0.0% for both models that are estimated for the year 1972 in Table 3, i.e. we can clearly reject the null hypothesis that the coefficients of the occupational variables are zero in the models.) Moreover, we have estimated the models for the year 2002 by including observations from all regions (not only those from two provinces that were included in the first round of the National FINRISK Study). The result remains the same.

[9] We have tested by using F-test statistics to see whether the occupational variables are jointly significant. The results show that the occupational variables are jointly significant in the latter models for both genders in Table 4. The significance level of the tests is 0.0% for both models, i.e. we can clearly reject the null hypothesis that the coefficients of the occupational variables are zero in the models. This finding is not surprising, because the occupational variables are, with one exception, all individually highly significant in the models that are estimated for the whole period 1972–2002 in Table 3.

Table 3
OLS regression results (dependent variable:log of BMI)

	Males			Females		
	Pooled, 1972–2002	1972	2002	Pooled, 1972–2002	1972	2002
The physical strenuousness of work						
Sedentary job (reference)	–	–	–	–	–	–
Light manufacturing work	−0.011 (4.31)***	−0.006 (1.16)	0.002 (0.22)	−0.020 (7.36)***	−0.011 (2.12)**	−0.008 (0.74)
Heavy manufacturing work	−0.022 (8.48)***	−0.018 (3.43)***	−0.016 (1.43)	0.001 (0.44)	0.005 (0.92)	−0.001 (0.10)
Physically very demanding work	−0.024 (8.88)***	−0.023 (4.65)***	0.013 (0.96)	0.014 (2.34)**	0.021 (1.86)*	0.004 (0.11)
Controls						
Age	0.012 (18.20)***	0.014 (8.92)***	0.007 (3.05)***	0.013 (16.00)***	0.012 (6.13)***	0.006 (2.25)**
Age squared	−0.000 (14.47)***	−0.000 (7.62)***	−0.000 (2.10)**	−0.000 (7.71)***	−0.000 (2.15)**	−0.000 (0.66)
Married	0.022 (8.33)***	0.029 (6.25)***	0.010 (0.75)	0.027 (7.11)***	0.037 (5.53)***	−0.019 (1.04)
Divorced	0.010 (1.74)*	0.002 (0.12)	−0.027 (1.46)	0.009 (1.48)	0.025 (1.69)*	−0.021 (0.90)
Widowed	0.026 (2.76)***	0.020 (0.81)	0.016 (0.39)	0.028 (5.07)***	0.025 (2.24)**	0.019 (0.70)
Middle education level	−0.002 (0.91)	0.010 (2.00)**	0.000 (0.00)	−0.018 (6.83)***	−0.016 (3.13)***	−0.024 (2.16)**
High education level	−0.020 (7.98)***	−0.008 (1.60)	−0.019 (1.98)**	−0.046 (16.98)***	−0.039 (7.43)***	−0.062 (5.59)***
Observations	20553	5282	1378	21632	5475	1566
R-squared	0.0925	0.0579	0.0582	0.2025	0.2178	0.1249
Year controls	Yes	No	No	Yes	No	No

Notes: *significant at 10%; **significant at 5%; ***significant at 1%. Robust *t* statistics in parentheses. Reference category: Sedentary job, single, low education level, 1972. Year controls are included as indicated.

Table 4
OLS regression results (dependent variable:log of BMI)

	Males		Females	
	Year effects (controls for the changes in occupational structure excluded)	Year effects (controls for the changes in occupational structure included)	Year effects (controls for the changes in occupational structure excluded)	Year effects (controls for the changes in occupational structure included)
1972 (reference)	–	–	–	–
1977	0.006 (2.57)**	0.004 (1.85)*	−0.016 (5.64)***	−0.016 (5.44)***
1982	0.017 (5.66)***	0.015 (4.98)***	−0.023 (6.53)***	−0.023 (6.40)***
1987	0.034 (10.26)***	0.032 (9.45)***	−0.014 (3.66)***	−0.014 (3.69)***
1992	0.035 (8.67)***	0.030 (7.51)***	−0.011 (2.33)**	−0.011 (2.37)**
1997	0.041 (10.32)***	0.036 (9.09)***	−0.021 (4.50)***	−0.021 (4.48)***
2002	0.048 (11.13)***	0.043 (10.06)***	−0.003 (0.56)	−0.003 (0.52)
Observations	20553	20553	21632	21632
R-squared	0.0877	0.0925	0.1995	0.2025

Notes: *significant at 10%; **significant at 5%; ***significant at 1%. Robust *t* statistics in parentheses. The models include the same unreported individual-level control variables as the ones in Table 3.

The difference between the largest positive effect (2002) and the smallest positive effect (1977) is 4.2 percentage points for Finnish males when only year dummies are included (with individual-level controls) and 3.9 percentage points after adjusting for the changes in occupational structure. Accordingly, the changes in occupational structure explain around 7% at most of the increase in BMI for males observed over a period of 30 years.[10]

Overall, our estimates for females are not in accordance with the hypothesis of this paper for a number of reasons. First, the upward trend in BMI has been more modest for Finnish females over the period (Table 1). In particular, the time profile of the upward trend in BMI for females has been such that around half of the total increase was realised between the years 1997 and 2002, while the share of sedentary jobs has increased for females up to the year 1997 and the share of light manufacturing work has slightly increased over the years 1997–2002 (Table 2). In contrast, for males the increase in BMI has been rather smooth over the years. Second, as noted earlier, the share of physically very demanding occupations has been very low for females even at the beginning of our observation period in the year 1972 (Table 2), and females who work in physically very demanding occupations have actually higher BMI than those in a sedentary job (Table 3). Consequently, it is very difficult to associate the changes in the occupational structure with the upward trend in BMI for females, and the potential contribution of the changes in the occupational structure is definitely even smaller for females than it is for males. Third, an increase in the share of highly educated females dilutes the year effects on BMI in the models that are reported in Table 4, because education has become a much more important determinant of BMI for females at the end of the observation period, as documented in Table 3. In other words, for females the upward trend in BMI is largely captured by the variables for education levels.[11]

For the above-mentioned reasons, the estimates for males are much more persuasive when one considers the effect of occupational changes on BMI. Keeping these caveats in mind, we note that, calculated in the same way as for males using estimates from Table 4, we find that the changes in occupational structure account for none (0%) of the increase in BMI for females over the period. Accordingly, our reading of the evidence is that the changes in occupational structure have been an even less important contributor to the upward trend in BMI for females than they have been

[10] This estimate can be calculated from the information that is reported in Table 4 as follows: $[((0.048-0.006)-(0.043-0.004))/(0.048-0.006)]\times 100=7\%$. We have repeated the calculations with a linear specification of the dependent variable. The results are almost similar. By using a linear specification of the dependent variable, we discover that the changes in the physical strenuousness of work explain around 6% at most of the increase in BMI for Finnish males observed over a period of 30 years.

[11] For females, education is also much correlated with age, because younger cohorts are substantially more educated than the older ones. This particular pattern is especially strong in two provinces of Eastern Finland that are included in the analyses. Accordingly, when the variables that capture a respondent's education level and age are removed from among the explanatory variables from Table 4, the estimated year effects reveal largely the same upward trend in BMI that was reported in Table 1 for females.

for males, at least in Finland. Interestingly, the difference in the contribution of occupational structure between males and females is, in principle, in keeping with the stylised fact according to which the attachment of males is tighter to the labour market and this makes their overall health more dependent on the labour market conditions.

Discussion and conclusions

This paper examines the relationship between the physical strenuousness of work and the BMI in Finland, using individual microdata at 5-year intervals over the period 1972–2002. The National FINRISK Study that we are using contains self-reported information about the physical strenuousness of a respondent's occupation. We are in a good position to analyse the issue, because the National FINRISK Study covers an episode of substantial increase in BMI and a large change in the physical strenuousness of a typical occupation in the labour market. This change applies to two provinces of Eastern Finland that we include in the analyses. Consequently, there is enough variation in the data that can be used to identify the relationship and quantify the magnitude of this particular source of influence.

Our estimates reveal that the changes in occupational structure explain around 7% at most of the increase in BMI for Finnish males over a period of 30 years. The main reason for this appears to be that the quantitative magnitude of the effect of the physical strenuousness of work on BMI is rather moderate. According to the point estimates, BMI is around 2.4% lower when a male's occupation is physically very demanding and involves lifting and carrying heavy objects compared with a sedentary job (reference group of the estimations), other things being equal. This finding is broadly in line with the ones reported by Martínez-González et al. (1999) and Mummery et al. (2005). Furthermore, it is very difficult to associate the changes in the occupational structure with the upward trend in BMI for females and the contribution of the changes in the occupational structure is definitely even smaller for females than it is for males. The difference in the results between males and females is particularly interesting, because the earlier literature has not addressed this issue. Therefore, further research on the difference is clearly needed. The models estimated separately for the years 1972 and 2002 reveal that the association of the physical strenuousness of a respondent's occupation with BMI has diluted for both males and females over the period. In particular, the models that are estimated separately for the year 2002 reveal that the physical strenuousness of work no longer had a statistically significant association with BMI. Our estimate (7%) for Finnish males is of a somewhat lower magnitude than the one reported by Helmchen (2001) for the United States over the period 1900–1988. In summary, the most important finding of this paper is that the changes in self-reported occupation show a slight association with the changes in the logarithm of the BMI scores.

Some limitations of the National FINRISK Study are important to take into account when one interprets the results. First, our estimations contain the same basic control variables that have typically been used in earlier research (e.g. Mummery et al., 2005). Many other factors that affect obesity may also have changed in response to changes in the occupational structure. For example, in response to increasing sedentary work individuals may perform more physical activity during their leisure time or they may have changed their eating habits. The omitted variables may therefore have some effect on our estimates. The direction of the potential effect of the last mentioned variables is largely ambiguous in the Finnish context, however. In particular, Virtanen et al. (2006) report using data from other representative Finnish population surveys that the individuals involved in sedentary work are indicated as being engaged at the same level of physical activity during their leisure time as the rest of employed persons in Finland. Socio-economic status has a bearing on eating habits, among other things. It is unfortunate, though, that at present there is no Finnish evidence about the possible variation of energy intake in different occupational groups, but there is a substantial body of evidence from other countries about the inverse relationship between socio-economic status and overweight (e.g. Sobal & Stunkard, 1989). In response to this research, we included education levels as control variables in all models. In Finland, education has proven to be the most significant single indicator of socio-economic status as far as health and lifestyle are concerned (e.g. Valkonen, Sihvonen, & Lahelma, 1997), because education is related to the general level of information, ease of adopting new information, valuable personal characteristics such as self-control, position in work, and income and wealth level.

Second, our estimates of the occupational variables do not present a causal relation, but rather a correlation between variables of interest, because occupational choice may be endogenous due to unobserved factors that affect both occupational choice and overweight. As we are operating with repeated cross-sectional data, we cannot dig deeper into the question of the direction of causality. Consequently, we cannot distinguish between whether occupational choice leads to overweight or *vice versa*. Revealing causality would require an instrumental variables strategy, involving instruments that would predict occupation but not overweight. This limitation of our approach, however, applies to almost all earlier studies in this particular strand of research.

Third, it is possible that people are working different numbers of hours in sedentary occupations compared with those in physically demanding occupations, and this might have some influence on BMI. The hours of work are not recorded in the National FINRISK Study and we cannot therefore control for the variation in working time when we estimate the models for BMI. However, this is not a particularly important limitation in the Finnish context, because part-time work has been very rare in Finland compared with almost all other OECD countries over our observation period. For example, the share of part-time workers of all employed persons was 12% in the year 2000, according to the Labour Force Survey by Statistics Finland. In particular, weekly working hours that have been agreed upon in collective labour agreements typically involve a more or less equal number of standard weekly hours of work for all major occupations. This system has been in place through the study period 1972–2002. Moreover, paid overtime covers only a small part of the total weekly hours in Finland. For blue-collar manufacturing workers, which is the only sector for which there is information available about the amount of paid overtime, it covers around 3% of the total weekly hours of work. Consequently, the assumption of the estimations according to which each respondent is working the same number of hours across each occupational group is not particularly unreasonable in the Finnish case and it should not have a major impact on our results.

Fourth, BMI ignores the distinction between fat and fat-free mass such as muscle and bone. Hence, a muscular individual with a high BMI will be misclassified as overweight if more accurate measures of obesity are not available (e.g. Cawley & Burkhauser, 2006). In particular, this could explain the fact that we observe that a small number of Finnish females who work in physically very demanding occupations have actually higher BMI compared with those in sedentary jobs. This caveat applies to all earlier studies in this field of research as well, because they also use BMI as a measure of relative weight.

Fifth, information on the physical strenuousness levels of occupations is based on self-assessments even though four fixed answering alternatives with examples of typical occupations have been the same through the whole study period 1972–2002. Self-reported information about occupations is clearly useful, because there are no apparent reasons for the systematic bias in the answers. Accordingly, OLS regression models are able to provide consistent estimates for Finnish males based on self-reported information on occupations. This demonstrates that the internal validity of self-reported information about occupations is high. Nevertheless, since measuring the strenuousness of work is based on self-assessments one may surmise that individuals reporting their situation base their evaluations on how they see occupations at the time of the study stand in relation to each other. For example, occupations that individuals describe in the year 2002 as physically very strenuous may, in fact, be less strenuous objectively than the ones in the year 1972. The fact that differences in the objective strenuousness of jobs in different positions of the occupational structure have decreased may be one of the reasons for the lack of association between the occupational structure and BMI found in the year 2002. The problem is that it is almost impossible to obtain reliable objective information about the strenuousness of work covering a period long enough to evaluate the contribution of occupational changes to the upward trend in BMI. It remains to be a challenge for future research.

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