Published by Oxford University Press on behalf of the International Epidemiological Association
International Journal of Epidemiology 2010;39:392–404
doi:10.1093/ije/dyp329

Comparative appraisal of educational inequalities in overweight and obesity among adults in 19 European countries

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Accepted 30 September 2009

Background In Western societies, a lower educational level is often associated with a higher prevalence of overweight and obesity. However, there may be important international differences in the strength and direction of this relationship, perhaps in respect of differing levels of socio-economic development. We aimed to describe educational inequalities in overweight and obesity across Europe, and to explore the contribution of level of socio-economic development to cross-national differences in educational inequalities in overweight and obese adults in Europe.

Methods Cross-sectional data, based on self-reports, were derived from national health interview surveys from 19 European countries ($N = 127\,018$; age range = 25–44 years). Height and weight data were used to calculate the body mass index (BMI). Multivariate regression analysis was employed to measure educational inequalities in overweight and obesity, based on BMI. Gross domestic product (GDP) per capita was used as a measure of level of socio-economic development.

Results Inverse educational gradients in overweight and obesity (i.e. higher education, less overweight and obesity) are a generalized phenomenon among European men and even more so among women. Baltic and eastern European men were the exceptions, with weak positive associations between education and overweight and obesity. Educational inequalities in overweight and obesity were largest in Mediterranean women. A 10 000-euro increase in GDP was related to a 3% increase in overweight and obesity for low-educated men, but a 4% decrease for high-educated men. No associations with GDP were observed for women.

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Conclusion In most European countries, people of lower educational attainment are now most likely to be overweight or obese. An increasing level of socio-economic development was associated with an emergence of inequalities among men, and a persistence of these inequalities among women.

Keywords Socio-economic inequalities, overweight, obesity, international overview, socio-economic development

Introduction

Socio-economic inequalities in overweight and obesity ('overweight' for short) have recently been reviewed[1] in order to update a paper that was previously published.[2] Although the observed patterns were less pronounced than in the mid-1980s, the review concluded that, for women, overweight was more common among women of lower socio-economic position (SEP). The results for men were less consistent. The magnitude of the inequalities in overweight varied, depending on what aspect of SEP was studied. Educational level usually showed the strongest relationships with overweight level.[1]

One factor that determines the size of the 'overweight gap' is the level of socio-economic development of a country.[1,3,4] Overweight, at least until recently,[5] is more common among people of higher SEP in developing countries, whereas in developed countries, the opposite is true. There are indications that, above a certain level of socio-economic development, the burden of overweight shifts to the socio-economically disadvantaged.[4,5] Similarly, inverse associations between SEP and overweight may become increasingly more common when the level of socio-economic development increases, while positive associations become increasingly less common.[1] The onset of the shift of overweight towards those of lower SEP occurs at an earlier stage of socio-economic development for women than it does for men.[5] In summary, socio-economic factors at the individual and societal levels appear to mutually interact. However, level of socio-economic development might not completely determine all international variations in inequalities in overweight.

A second factor relates to the sharp divide in health and mortality between central/eastern and western Europe;[6] a divide that has even widened shortly after the collapse of the communist regimes in 1989.[7] This divide also becomes manifest as a high prevalence of overweight in central/eastern Europe, which were estimated to be at ~80% in one study.[8] Unhealthy diet, alcohol use[6,9] and other behaviours may all be linked to the high levels of overweight in this region. Although economic hardship probably plays a role in this, a broad set of social circumstances may also be involved.[6] Those population groups with the smallest resources for coping with stress, such as those of lower SEP, may be most vulnerable to the effects of the social and political transition.[10]

The objectives of this study are to provide an up-to-date pan-European overview of inequalities in overweight, and to explore the contribution of socio-economic development to international variations in those inequalities. Key features of this study are that: (i) 19 countries are covered, including eastern European and Baltic countries; (ii) the surveys are relatively large; and (iii) comparatively recent surveys are used, which is important given the sharp rise in the prevalence of overweight during the past decades.[11] Our research questions were: (i) whether inverse gradients in overweight are currently a generalized phenomenon in Europe; (ii) whether there are important international differences in the size of these inequalities; and (iii) whether these variations were associated with the level of socio-economic development.

Methods

Data sampling and participants

Table 1 gives an overview of the cross-sectional interview survey data that were used in this study. The total sample size was $N = 127\,018$ and varied from $N = 635$ (Slovak Republic) to $N = 41\,613$ (Italy). Most surveys dated from after 2000. Data of height and/or weight were missing in 3.1% of all cases on average, ranging from 0.01% (Italy) to 7.0% (France). To reduce confounding by morbidity, we limited our analyses to participants aged between 25 and 44 years.

Variables

Sexes were always analysed separately. Country data were usually (except for pooled estimates) analysed separately. The 1999 Gross Domestic Product per capita (GDP/capita, in euros) was used as a measure for level of socio-economic development (International Monetary Fund, World Economic Outlook Database, September 2000). In this article, we will present the countries by descending GDP level.

Educational attainment was re-coded according to the International Standard Classification of Education (ISCED),[12] a classification designed to improve international comparability of educational classifications. This variable had four levels: (i) 'Tertiary, or *highest*, education' (corresponding to

Table 1 National surveys used in this study

Region and country	Name of survey and institute responsible	Year(s) of survey	GDP/capita (euro)	N_{total}	Non-response (%)
North					
Norway	Norwegian Survey of Living Conditions Statistics Norway, Oslo	2002	32 899	2529	27[a]
Denmark	Danish Health and Morbidity Survey (DHMS/SUSY) Danish National Institute of Public Health, Copenhagen	2000	31 459	5821	26[a]
Sweden	Swedish Survey of Living Conditions (ULF) Statistics Sweden, Stockholm	2000/2001	25 762	3990	23
Finland	Finbalt Health Monitor National Public Health Institute, Helsinki	1994/1996/1998 2000/2002/2004	24 326	8223	32
West					
Germany	German National Health Examination and Interview Survey Robert Koch Institute (RKI), Berlin	1998	24 720	2786	43
Ireland	Living in Ireland Panel Survey Economic and Social Research Institute (ESRI), Dublin	1995/2002	24 305	2064	37
The Netherlands	General social survey (POLS) Statistics Netherlands, Voorburg	2003/2004	23 990	5607	39
Belgium	Health Interview Survey Institute of Public Health (IPH), Brussels	1997/2001	23 769	6932	38[a]
England	Health Survey for England (HSE) Department of Health, London	2001	23 696	5583	26[a]
South					
France	French Health, Health Care and Insurance Survey (ESPS) IRDES, Paris	2004	23 614	6048	30
Italy	Health and health care utilization National Institute of Statistics (ISTAT), Rome	1999/2000	19 879	41 613	10
Spain	National Health Survey Ministry of Health and Consumption (MSC), Madrid	2001	14 735	7741	15
Portugal	National Health Survey Instituto Nacional de Saude Dr Ricardo Jorge (INSARJ), Lisbon	1998/1999	11 776	12 297	20
East					
Czech Republic	Health Interview Survey Institute of Health Information and Statistics of the Czech Republic	2002	4964	789	29
Hungary	National Health Interview Survey Hungary NPHMOS, Budapest	2000/2003	4614	3618	19
Slovak Republic	Health Monitor Survey Public Health Institute of Slovak Republic, Bratislava	2002	3355	635	50

(continued)

Table 1 Continued

Region and country	Name of survey and institute responsible	Year(s) of survey	GDP/capita (euro)	N_{total}	Non-response (%)
Estonia	Health Behavior among Estonian Adult Population National Institute for Health Development, Tallinn	2002/2004	3306	1740	34
Lithuania		1994/1996/1998/	2732	5465	33
	Finbalt Health Monitor (see under Finland)	2000/2002/2004			
Latvia		1998/2000/2002/2004	2412	3537	25

[a]Response rate on the household level; all others on the individual level.

Table 2 Age-adjusted prevalence (%) of overweight [body mass index (BMI) $\geqslant$ 25 kg/m^2] by educational level across the studied countries (men)

		Overweight/education						
Country	Proportion lowest educated	Overall	Highest	Second highest	Second lowest	Lowest	RII	95% CI
Norway	0.2	52.2	47.3	56.1	53.3	–	1.25	1.02–1.54
Ireland	9.7	58.7	59.8	54.9	62.9	57.0	1.02	0.84–1.24
Denmark	1.2	48.6	38.6	46.4	52.3	56.9	1.53	1.31–1.79
Sweden	2.5	53.8	39.7	52.1	60.1	63.4	1.62	1.37–1.93
The Netherlands	4.5	42.9	35.9	41.4	48.8	45.4	1.47	1.24–1.73
Finland	16.8	46.8	45.3	50.9	51.8	39.0	1.16	1.02–1.32
England	5.9	64.9	63.0	66.4	65.6	64.5	1.02	0.92–1.13
Belgium	8.6	44.3	37.6	46.4	50.5	42.5	1.38	1.21–1.58
Germany	10.3	61.7	50.1	61.8	65.8	69.2	1.25	1.08–1.45
France	2.6	39.3	31.8	39.9	43.2	42.3	1.63	1.31–2.02
Italy	6.1	44.2	33.3	42.3	49.0	52.0	1.46	1.38–1.54
Spain	11.6	54.8	47.3	54.3	58.1	59.5	1.23	1.11–1.37
Portugal	61.0	49.2	42.5	49.9	51.1	53.3	1.20	1.08–1.33
Czech Republic	7.4	51.3	43.0	59.3	53.7	49.0	1.05	0.76–1.46
Hungary	16.0	57.9	58.4	59.8	58.7	54.6	0.91	0.79–1.06
Estonia	4.2	45.7	48.5	48.5	43.9	41.9	0.83	0.63–1.09
Slovak Republic	12.7	58.5	70.4	60.4	62.7	40.6	0.64	0.46–0.89
Lithuania	3.4	47.0	53.2	46.8	46.1	41.7	0.84	0.72–0.98
Latvia	13.8	41.6	49.6	40.3	36.7	39.6	0.71	0.57–0.89
Total	*10.4*	*50.9*	*47.1*	*51.5*	*53.4*	*51.5*	*1.10*	*1.07–1.13*

RII: relative index of inequality, adjusted for age group (all) and country (only total). Dash indicates that data could not be calculated. CI: Confidence intervals.

ISCED 5–6); (ii) 'Upper secondary and post-secondary non-tertiary', or *second-highest*, education (ISCED 3–4); (iii) Lower secondary, or *second-lowest*, education (ISCED 2); and (iv) 'No or only primary', or *lowest*, education (ISCED 1).

The BMI was calculated from the self-reported weight (kg) divided by the squared height (m). It was dichotomized into overweight (BMI $\geqslant$ 25 kg/m^2) and obesity (BMI $\geqslant$ 30 kg/m^2). The educational distribution strongly differed between countries; e.g. the lowest category comprised 0.2% in Norway, but 59.8% in Portugal (Tables 2 and 3).

Statistical analyses

Prevalence rates were age standardized using the direct method. The European Standard Population of 1995 was used as a reference population. In pooled analyses, a weight for country size was used to simulate equal sample sizes for each country.

Table 3 Age-adjusted prevalence (%) of overweight (BMI $\geqslant$ 25 kg/m^2) by educational level across the studied countries (women)

Country	Proportion lowest educated	Overweight/education					RII	95% CI
		Overall	Highest	Second highest	Second lowest	Lowest		
Norway	0.2	32.3	25.0	34.2	37.6	–	1.67	1.19–2.35
Ireland	6.0	36.2	30.4	35.3	35.4	43.7	1.36	1.00–1.84
Denmark	1.6	34.4	23.4	30.5	40.5	43.1	1.95	1.57–2.44
Sweden	1.7	42.2	23.2	32.7	39.4	73.5	2.09	1.60–2.73
The Netherlands	2.6	37.1	24.0	35.5	40.9	48.0	2.12	1.75–2.56
Finland	17.0	29.2	24.1	32.2	35.4	25.1	1.65	1.37–1.98
England	7.0	51.4	39.3	51.0	54.7	60.5	1.62	1.40–1.87
Belgium	9.6	32.1	18.1	30.8	34.0	45.6	3.01	2.47–3.68
Germany	12.5	36.0	21.6	34.7	49.6	38.1	2.46	1.90–3.19
France	3.3	30.4	16.2	25.7	31.0	48.6	2.91	2.18–3.89
Italy	7.5	21.9	9.9	16.5	23.8	37.5	3.30	2.98–3.65
Spain	12.8	28.9	18.4	20.1	31.5	45.4	2.89	2.34–3.56
Portugal	58.6	28.6	18.0	24.2	27.6	44.6	3.72	3.17–4.37
Czech Republic	6.6	31.3	18.7	23.6	38.7	44.2	3.12	1.77–5.51
Hungary	21.5	36.9	28.5	35.0	42.1	41.8	1.46	1.20–1.77
Estonia	4.9	34.5	22.1	31.5	35.0	49.3	2.11	1.52–2.95
Slovak Republic	5.8	30.7	18.9	26.4	34.2	43.1	2.22	1.18–4.19
Lithuania	1.9	36.9	26.2	36.6	40.8	44.0	1.64	1.38–1.94
Latvia	8.2	34.3	29.0	36.5	36.2	35.4	1.28	1.02–1.60
Total	*10.0*	*34.1*	*22.9*	*31.2*	*37.3*	*45.1*	*1.98*	*1.91–2.06*

RII: relative index of inequality, adjusted for age group (all) and country (only total). Dash indicates that data could not be calculated.

The prevalence ratio (PR) expresses the prevalence of overweight in the group of interest relative to the prevalence of overweight in the highest educational level. PRs and their 95% CIs were estimated by regression analysis with the log link function[13] using the Genmod procedure.[14] PRs were always adjusted for 5-year age category and, where applicable, for country.

When model and data did not converge, PR estimates were calculated using the COPY Method,[15] using 1000 copies. This method consists of expanding the original data set to include 1000 copies of the original data set together with one copy of the original data set with cases and controls reversed. The estimated standard error of the PR on the expanded data set is then adjusted to obtain the correct estimate of the standard error of the PR.

We summarized the association between being overweight and educational level by calculating the Relative Index of Inequality (RII) and its 95% CIs.[16,17] The RII is a regression-based measure that assesses the linear association between being overweight and the relative position of each educational level separately. The relative position is measured as the cumulative proportion of each educational level within the educational hierarchy, with 0 and 1 as the extreme values. The resulting measure, the RII, can be interpreted as the risk of being overweight at the very top as compared with the very lowest end of the educational hierarchy. An RII >1 indicates a negative relationship between educational level and being overweight, whereas an RII <1 indicates a positive relationship. The RII could be used to make international comparisons, provided that a detailed and hierarchical educational classification is available for each country. The RII was expressed as PR.

We evaluated the relationship between GDP and overweight prevalence using linear regression analysis. The unstandardized regression coefficients and their 95% CIs are reported.

Results

Inequalities in overweight

Table 2 shows educational inequalities in overweight (BMI $\geqslant$ 25 kg/m^2) among men across Europe. Countries are presented by descending GDP. The inequalities are measured by means of prevalence rates according to educational level, and are

Table 4 Age-adjusted prevalence (%) and educational inequalities in obesity (BMI $\geqslant$ 30 kg/m^2) across the studied countries (men)

	Obesity/education						
Country	Overall	Highest	Second highest	Second lowest	Lowest	**RII**	**95% CI**
Norway	10.1	5.6	12.1	12.5	–	3.42	1.70–6.92
Ireland	10.6	8.1	10.9	9.8	13.5	1.34	0.67–2.65
Denmark	9.7	5.3	7.5	12.9	13.1	3.11	1.87–5.17
Sweden	11.6	4.4	10.6	12.6	18.8	4.33	2.39–7.83
The Netherlands	10.1	4.9	8.9	12.2	14.3	3.61	2.28–5.73
Finland	8.8	7.3	9.7	9.3	8.8	1.52	1.01–2.29
England	21.6	16.3	20.1	23.4	26.5	1.70	1.26–2.29
Belgium	10.1	6.5	11.1	11.3	11.3	2.17	1.48–3.19
Germany	14.5	9.1	16.0	17.9	15.0	1.66	1.06–2.61
France	6.0	4.4	6.0	9.7	3.9	3.28	1.74–6.19
Italy	7.0	4.1	6.0	8.1	9.7	2.31	1.90–2.79
Spain	10.4	6.4	8.3	11.6	15.4	2.72	1.88–3.93
Portugal	8.1	4.1	7.8	10.1	10.3	2.02	1.42–2.87
Czech Republic	11.1	7.7	4.6	12.3	19.6	3.64	1.09–12.16
Hungary	17.7	16.7	15.2	18.3	20.9	1.44	0.97–2.15
Estonia	13.3	9.6	12.3	15.3	15.7	1.69	0.84–3.38
Slovak Republic	10.3	12.8	9.1	19.5	–	1.58	0.53–4.76
Lithuania	8.6	8.5	8.9	8.4	8.7	0.96	0.59–1.56
Latvia	8.6	11.3	6.2	7.3	9.8	0.86	0.45–1.62
Total	*11.0*	*8.1*	*10.1*	*12.8*	*13.1*	*1.97*	*1.81–2.15*

RII: relative index of inequality, adjusted for age group (all) and country (only total). Dash indicates that data could not be calculated.

summarized by means of the RII. The prevalence of overweight among men ranged from 31.8% (France; high-educated men) to 70.4% (Slovak Republic; high-educated men). The size and the direction of the relationship between educational level and overweight prevalence showed considerable variation between countries. Estonia, Lithuania, Latvia, Slovak Republic and Hungary showed an increase in prevalence of overweight with an increasing level of education (RII $<$ 1). Of all other countries, France showed the largest educational inequalities in overweight (RII = 1.63).

Table 3 is similar to the previous table and displays results for women. The prevalence to be overweight ranged from 9.9% (Italian high-educated women) to 73.5% (Swedish low-educated women, $N = 32$). Everywhere in Europe, overweight was more common in low-educated women. Educational inequalities in overweight were smallest in Latvia (RII = 1.28) and largest in Portugal and Italy (RII $\geqslant$ 3.30), at least in relative terms. The latter two countries had the lowest overall prevalence of overweight among women.

Inequalities in obesity

Table 4 shows educational inequalities in obesity (BMI $\geqslant$ 30 kg/m^2) across Europe among men. The overall prevalence of obesity was 11%, and ranged from 6.0% (France) to 21.6% (England). Considerable international variation in inequalities among men could be observed. The RII indicated a positive relationship between educational level and obesity in Lithuania and Latvia. In all other cases, educational level and obesity prevalence were negatively related. Sweden, Czech Republic and The Netherlands showed the largest educational inequalities in obesity (RII $\geqslant$ 3.61) and Ireland, Latvia and Lithuania the smallest (RII $\leqslant$ 1.34).

Table 5 shows that, among women, the overall prevalence of obesity (BMI $\geqslant$ 30 kg/m^2) was 11%, and ranged from 5.0% (Italy) to 23.3% (England). Everywhere in Europe, obesity was more common in low-educated women. The educational inequalities in obesity were smallest in Latvia, Finland and Norway (RII $\leqslant$ 1.75) and largest in Portugal (RII = 6.78). However, the Czech, the Slovakian and the Belgian estimates were imprecise, as indicated by wide 95% CIs.

The relationship between inequalities in overweight and general welfare level

Figures 1 and 2 show the prevalence of overweight in relationship to GDP for high, low and intermediate educational levels. In Figure 1, countries are

Table 5 Age-adjusted prevalence (%) and educational inequalities in obesity (BMI $\geqslant$ 30 kg/m^2) across the studied countries (women)

Country	Obesity/education					RII	95% CI
	Overall	Highest	Second Highest	Second Lowest	Lowest		
Norway	6.8	5.9	8.2	6.4	–	1.75	0.76–4.01
Ireland	8.1	4.4	9.3	7.9	10.7	1.98	0.94–4.19
Denmark	12.2	7.0	9.0	13.8	19.1	2.70	1.70–4.29
Sweden	13.5	4.7	9.9	11.3	28.2	3.87	2.12–7.04
The Netherlands	11.4	6.4	9.7	12.6	17.0	2.87	1.89–4.34
Finland	7.4	6.9	9.4	11.0	2.2	1.59	1.06–2.37
England	23.3	15.6	22.2	26.1	29.4	2.19	1.66–2.87
Belgium	10.7	4.2	8.6	10.7	19.1	6.25	4.05–9.65
Germany	15.2	4.9	11.1	20.4	24.6	5.07	2.95–8.71
France	11.1	5.0	8.8	10.9	19.9	4.21	2.46–7.21
Italy	5.0	1.5	3.1	5.5	9.7	6.03	4.71–7.71
Spain	7.0	3.0	4.4	8.1	12.3	5.09	3.08–8.44
Portugal	6.6	3.0	4.2	7.1	12.0	6.78	4.55–10.10
Czech Republic	10.0	1.7	8.6	11.0	18.6	5.30	1.54–18.22
Hungary	13.9	6.2	14.6	15.3	19.8	2.28	1.57–3.31
Estonia	12.1	4.6	10.5	10.4	22.8	3.33	1.67–6.66
Slovak Republic	11.3	3.6	5.3	8.5	–	5.85	1.41–24.24
Lithuania	11.7	7.3	10.5	15.8	13.2	2.68	1.84–3.90
Latvia	9.7	8.0	10.8	12.7	7.2	1.50	0.92–2.45
Total	*11.0*	*5.5*	*9.4*	*11.9*	*17.4*	*2.99*	*2.75–3.26*

RII: relative index of inequality, adjusted for age group (all) and country (only total). Dash indicates that data could not be calculated.

plotted against the prevalence of overweight (BMI $\geqslant$ 25 kg/m^2; *y*-axis) and the level of socio-economic development (GDP/capita in euros; *x*-axis). In Figure 2, the same information is given for obesity.

In high-educated men, a 10 000-euro increase in GDP predicts a 4% point reduction in the prevalence of overweight [$B = -3.91$ (-8.52, 0.70)]. In intermediate-educated men, GDP was not related to the prevalence of overweight [$B = -0.24$ (-4.04, 3.55)]. Conversely, among men of the lowest two levels of education, a 10 000-euro increase in GDP translated into a 3% point increase in the prevalence of overweight [$B = 2.99$ (-0.60, 6.58)]. As a consequence of these differential effects, a switching occurred in the direction of inequalities in overweight from favouring less educated to favouring more educated as GDP increases. This pattern remained the same after the exclusion of the smaller samples of the eastern European countries [high education: $B = -2.12$ (-7.24, 3.01); low education: $B = 4.59$ (0.16, 9.02)]. For obesity prevalence, a similar picture emerged (Figure 2).

Women of all educational levels showed a slight increase in the prevalence of overweight with increasing level of socio-economic development, but the effect was not clear [high education: $B = 0.23$ (-2.84, 3.31); intermediate education: $B = 1.04$ (-2.57, 4.64); low education: $B = 1.01$ (-2.26, 4.27)]. As a result, for women, the level of inequality in overweight was independent of the level of socio-economic development. For obesity prevalence, a similar picture emerged (Figure 2).

Discussion

Summary of the results

The well-known phenomenon of inverse educational gradients in overweight (higher SEP, lower overweight prevalence) has occurred recently almost everywhere in Europe, especially among women. The exceptions were men in all Baltic and most eastern European countries of the study, where overweight was slightly more common among men with higher educational attainment. The inequalities were greatest among women of southern Europe. With increasing level of socio-economic development, overweight became increasingly more common among men of lower education, whereas the opposite was true for men of higher education. For women, the level of inequality in overweight was independent of the level of socio-economic development.

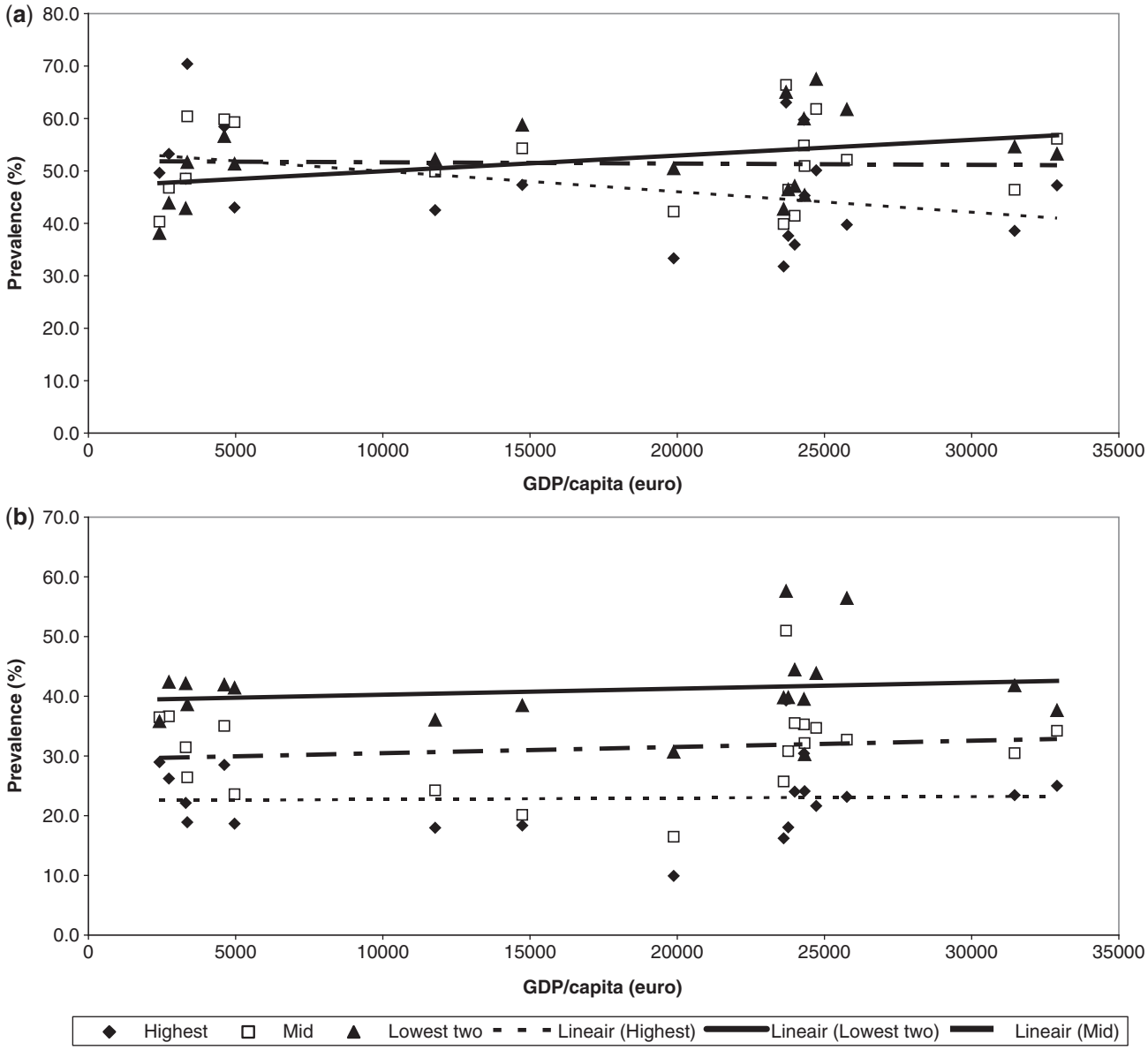

Figure 1 Educational inequalities in overweight (BMI $\geqslant$ 25 kg/m^2) by level of socio-economic development in Europe for men (a) and women (b). Solid line/triangle: lowest two educational levels; long and short dashes/square: intermediate educational level; short dash/rhombus: highest educational level

Evaluation of data and methods

Some limitations of this article must be acknowledged. People with a high true BMI have a tendency to under-report their weight, whereas most people over-report their height.[18] Data based on self-reported BMI may therefore underestimate the true prevalence of overweight and obesity.

Most studies found that people with lower education overestimated their height more than their higher educated counterparts, which would lead to underestimates of the size of inequalities in BMI.[19,20] However, other studies have supported an opposite pattern[21] or found no class pattern at all.[22] One study found that the mean difference between self-reported and measured height was 0.7 cm, which leaves little room for large socio-economic variations in the magnitude of bias.[23] Thus, although it may have influenced our inequality estimates, we estimate that, in absolute terms, the effect of self-report bias on inequality estimates is probably small.[24]

Misclassification of educational level is another potential source of bias. We applied the ISCED classification in order to make educational classification as comparable as possible between countries. This approach yielded population distributions that were similar to distributions according to European

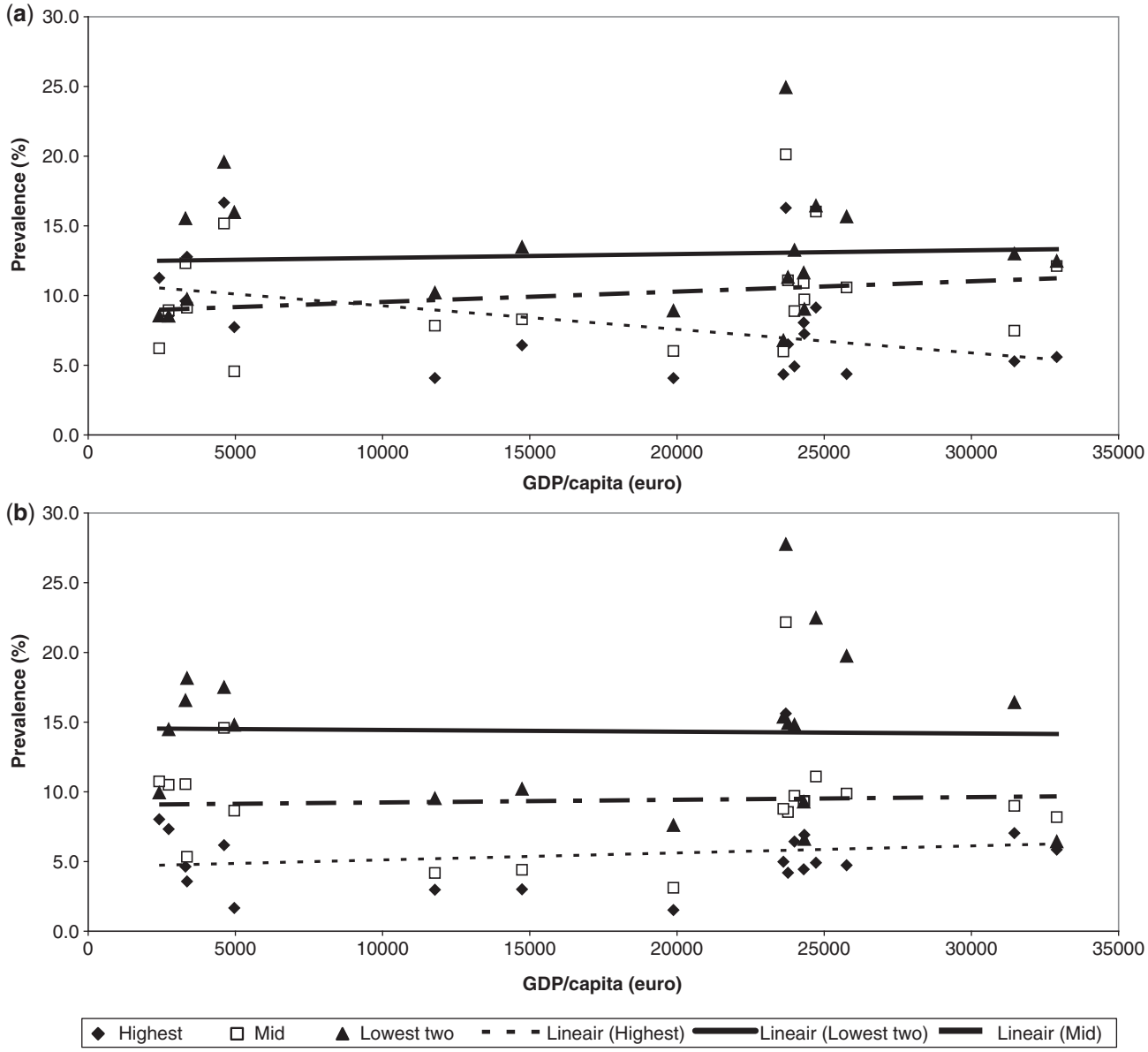

Figure 2 Educational inequalities in obesity (BMI $\geqslant$ 30 kg/m^2) by level of socio-economic development in Europe for men (a) and women (b). Solid line/triangle is the lowest two educational levels; long and short dashes/square is the intermediate educational level; short dash/rhombus is the highest educational level

statistics.[25] Nonetheless, some international comparability problems may have remained. However, we employed the RII, a measure that can be used to make international comparisons, provided that a detailed and hierarchical educational classification is available for each country. The educational classifications for all countries are all hierarchical in nature, and moreover are fairly detailed. Therefore, we deem it unlikely that any remaining problems with educational classifications would have substantially biased our international overviews of educational inequalities in overweight.

Data from Finland and the Baltic countries represented a pooled analysis of data for the years 1994–2004. Other studies that used the same data source found no indications of changes over time in the magnitude of inequalities in overweight. For example, a study on the three Baltic countries observed no differences in inequalities in the prevalence of obesity between 1994 and 1998.[26] Similarly, in Finland between 1982 and 1997, inequalities in BMI did not change markedly.[27]

Comparison with previous studies

The general finding of an inverse relationship between education and overweight among women has been shown many times. The international

literature provides a less consistent picture for men.[1,2] A cross-European study yielded similar results,[28] but did not look at individual European countries.

A worldwide MONICA-based study of 26 countries also showed an inverse association between educational level and BMI in almost all female, and about half of the male populations.[29] French, German, Belgian and Czech women showed the largest inequalities. As with our study, England showed small inequalities for both men and women. Educational inequalities in BMI were either absent or positive among Czech, Polish, Yugoslavian and Russian men. The latter finding coincides with the eastern European and Baltic results of this and a related study.[26]

Explanation of general patterns

In a recent review of studies across the world, a gradual 'shift' of the social gradient in BMI was observed. The proportion of countries with positive SEP–BMI associations decreased with an increasing level of development.[1] We found that these associations persisted among men within Europe in the early 21st century. The associations observed worldwide have been attributed to the fact that socio-economic development leads to an increase in the affordability of cheap, energy-dense foods, with the impact of these factors being larger among lower socio-economic groups. Socio-economic development may, in addition, lead to the dissipation of factors that had been protective of overweight among people of lower SEP, such as under nutrition and high levels of physical activity at work.[30]

Among women, the shift of obesity towards the lower SEP apparently generally occurred at earlier stages of the economic development.[5] Several factors have been suggested to explain why, at any given level of socio-economic development, inequalities in overweight are larger among women than among men.[1,2] For instance, among women, in most cultures, there is a stronger emphasis on thinness and dieting, especially among women of higher SEP. In contrast, for men, a large body size also represents prowess and physical dominance.[1] With a further increase in general welfare level, as the environment becomes increasingly obesogenic, it may, however, be increasingly difficult for women to maintain thinness, although women of higher SEP may still be more likely to value and pursue thinness.[1]

Another general observation is that countries with a high overall prevalence of overweight tend to have relatively small inequalities (e.g. England and Sweden). This pattern might reflect 'ceiling effects', i.e. the possibility that it may be more difficult for the prevalence of overweight to increase once that a high level is attained.[31] Ceiling effects may occur especially among the lowest socio-economic groups in countries with high overall prevalence rates.

Explanation of small inequalities in the east and Baltic

Previous studies indicated that low vegetable consumption and sedentary behaviour were only slightly more common among low-educated Baltic people.[32] People of higher SEP are generally the first to adopt the novel, modern behaviours that come with an increase in general welfare level.[33] Likewise, high-educated Baltic people tend to consume modern foods (such as cheese), whereas those with a lower level of education consume traditional, healthier foods.[34]

The region underwent a dramatic change after the collapse of state socialism. The economic reforms after the collapse of socialism had pronounced effects on the material and psychosocial conditions, compromising the living conditions of major parts of the population. In addition, for people of lower SEP, the economic changes of the transition to market economy have reduced the availability of certain foods.[35] The newly introduced western foods are not available for the less privileged. One study found that up to almost half of the Latvian respondents depended partially or entirely on home-grown or raised foods.[35] It is believed that home production is one reason why the caloric intake of people living in countries undergoing economic transition is not compromised.[36] Even so, reduced intakes of nutrient-dense foods, especially among poor people, have been observed.[34]

Explanation of large inequalities in the south

Another striking finding of this study is the observation of the largest educational inequalities in overweight among women (but not men) of the Mediterranean countries. With respect to inequalities in nutrition and physical activity, existing findings are unclear. Regarding energy intake, Spanish people of a lower SEP may have a *lower* intake of energy and nutrients.[37] Conversely, sedentary behaviour during leisure time may be twice as common among Spanish women (but not men) of lower educational levels,[38] although this is not a consistent finding.[39]

There has been some debate about a possible link between adherence to the Mediterranean Diet (MD) and overweight.[40] A recent study found evidence for an association with lower abdominal adiposity in men and women.[41] These findings are in line with other studies. Since adherence to the MD may be greater among people of lower SEP,[42] use of the MD would have a narrowing effect on the magnitude of inequalities in overweight.

The explanation of the large inequalities among southern women may ultimately be found in large education-related differences in labour force participation. Labour participation is generally higher among women of higher education, who generally have fewer children.[43] Lower educated women, on the other hand, often assume more traditional role patterns[44]

and conform to the Mediterranean 'male breadwinner model', which is maintained by gender inequities in social policies.[45] For example, it is scarcely possible for women to do part-time work and child support is less than generous.[46]

Inequalities in labour force participation may be linked to inequalities in overweight in several ways. The direct effects may be that higher parity itself is closely related to overweight[47] and that a lower degree of labour participation is related to smaller amounts of leisure time physical activity.[48] Secondly, the dual role of worker and mother that is disproportionately expected from women of higher education (and that is often not shared by their spouse), is (literally) more energy demanding than full-time motherhood.[48] Thirdly, working women, especially those of higher educational levels, work in a social environment where the social norm emphasizes thinness and healthy food patterns.[1]

Implications and conclusion

Society-level factors have hitherto received relatively little attention in studies on inequalities in overweight. This study underlines that educational inequalities in overweight must be viewed from an international perspective to understand their origins and explanations. Our results indicate that level of socio-economic development only partially explains international differences in educational inequalities in overweight. Future research may include cultural and institutional factors, as these factors may help explain why inequalities in overweight are larger in some countries and smaller elsewhere.

Supplementary data

Supplementary data are available at *IJE* online.

Funding

This work was supported by the Health & Consumer Protection Directorate-General of the European Union and was carried out as a part of the Eurothine project (contract number 2003125), the Eurocadet Project (contract number SP23-CT-2005-006528) and the HOPE project (contract number SP5A-CT-2006-044128). Access to data from the Health Survey for England was given through an agreement with the University of Essex via the Economic and Social Data Service (ESDS).

Acknowledgement

The authors are grateful to Mrs Gillian Storey for reviewing the manuscript.

Conflict of interest: None declared.

KEY MESSAGES

- In most European countries, overweight and obesity are now more common among people of a lower educational attainment.
- In Europe, in the early 2000s, there were important differences between countries in the magnitude of these educational differences.
- The inequalities in overweight and obesity were largest in Mediterranean women and smallest in the Baltic and eastern European countries.
- An increasing level of socio-economic development was associated with an emergence of inequalities among men, and a persistence of these inequalities among women.
- Future research may focus on cultural and institutional factors that may help explain why inequalities in overweight are larger in some countries and smaller elsewhere.

References

[1] McLaren L. Socioeconomic status and obesity. *Epidemiol Rev* 2007;**29:**29–48.

[2] Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989;**105:**260–75.

[3] Peytremann-Bridevaux I, Faeh D, Santos-Eggimann B. Prevalence of overweight and obesity in rural and urban settings of 10 European countries. *Prev Med* 2007;**44:** 442–46.

[4] Ezzati M, Vander Hoorn S, Lawes CM *et al*. Rethinking the "diseases of affluence" paradigm: global patterns of nutritional risks in relation to economic development. *PLoS Med* 2005;**2:**e133.

[5] Monteiro CA, Moura EC, Conde WL, Popkin BM. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bull World Health Organ* 2004;**82:**940–46.

[6] Bobak M, Marmot M. East-West mortality divide and its potential explanations: proposed research agenda. *BMJ* 1996;**312:**421–25.

[7] Fund UNCs. *Crisis in Mortality, Health, Nutrition. Central and Eastern Europe in Transition*. Public Policy and Social Conditions. Florence: UNICEF; 1994.

[8] James PT. Obesity: the worldwide epidemic. *Clin Dermatol* 2004;**22:**276–80.

[9] Yeomans MR. Effects of alcohol on food and energy intake in human subjects: evidence for passive and active over-consumption of energy. *Br J Nutr* 2004;**92 Suppl 1:**S31–34.

[10] Cockerham WC. The social determinants of the decline of life expectancy in Russia and eastern Europe: a lifestyle explanation. *J Health Soc Behav* 1997;**38:**117–30.

[11] World Health Organization. *Obesity: Preventing and Managing the Global Epidemic*. Geneva: WHO, 2000.

[12] UNESCO. *International Standard Classification of Education (ISCED)*. Paris: UNESCO Institute for Statistics, 1997.

[13] Skov T, Deddens J, Petersen MR, Endahl L. Prevalence proportion ratios: estimation and hypothesis testing. *Int J Epidemiol* 1998;**27:**91–95.

[14] SAS. *SAS/STAT User's Guide*. 8.2 ed. Cary, NC, USA: SAS Institute Inc., 1999.

[15] Deddens JA, Petersen MR, Lei X. Estimation of prevalence ratios when PROC GENMOD does not converge. *Proceedings of the 28th Annual SAS Users Group International Conference*. Seattle, Washington, 30 March to 2 April 2003;(Paper 270–28).

[16] Mackenbach JP, Kunst AE. Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe. *Soc Sci Med* 1997;**44:**757–71.

[17] Sergeant JC, Firth D. Relative index of inequality: definition, estimation, and inference. *Biostatistics* 2006;**7:** 213–24.

[18] Ziebland S, Thorogood M, Fuller A, Muir J. Desire for the body normal: body image and discrepancies between self reported and measured height and weight in a British population. *J Epidemiol Community Health* 1996; **50:**105–6.

[19] Stewart AL. The reliability and validity of self-reported weight and height. *J Chronic Dis* 1982;**35:**295–309.

[20] Jalkanen L, Tuomilehto J, Tanskanen A, Puska P. Accuracy of self-reported body weight compared to measured body weight. A population survey. *Scand J Soc Med* 1987;**15:**191–98.

[21] Niedhammer I, Bugel I, Bonenfant S, Goldberg M, Leclerc A. Validity of self-reported weight and height in the French GAZEL cohort. *Int J Obes Relat Metab Disord* 2000;**24:**1111–18.

[22] Rowland ML. Self-reported weight and height. *Am J Clin Nutr* 1990;**52:**1125–33.

[23] Bostrom G, Diderichsen F. Socioeconomic differentials in misclassification of height, weight and body mass index based on questionnaire data. *Int J Epidemiol* 1997;**26:** 860–66.

[24] Pomerleau J, MCKee M, Robertson A *et al*. *Nutrition And Lifestyle in the Baltic Republics*. Copenhagen: World Health Organization, 1999.

[25] Eurostat. *Eurostat Labour Force Survey*. Luxembourg: Office for Official Publications of the European Communities, 2001.

[26] Klumbiene J, Petkeviciene J, Helasoja V, Prattala R, Kasmel A. Sociodemographic and health behaviour factors associated with obesity in adult populations in Estonia, Finland and Lithuania. *Eur J Public Health* 2004; **14:**390–94.

[27] Lahti-Koski M, Vartiainen E, Mannisto S, Pietinen P. Age, education and occupation as determinants of trends in body mass index in Finland from 1982 to 1997. *Int J Obes Relat Metab Disord* 2000;**24:**1669–76.

[28] Martinez JA, Kearney JM, Kafatos A, Paquet S, Martinez-Gonzalez MA. Variables independently associated with self-reported obesity in the European Union. *Public Health Nutr* 1999;**2:**125–33.

[29] Molarius A, Seidell JC, Sans S, Tuomilehto J, Kuulasmaa K. Educational level, relative body weight, and changes in their association over 10 years: an international perspective from the WHO MONICA Project. *Am J Public Health* 2000;**90:**1260–68.

[30] Song YM. Commentary: varying relation of socioeconomic status with obesity between countries at different stages of development. *Int J Epidemiol* 2006;**35:**112–13.

[31] Houweling TA, Kunst AE, Huisman M, Mackenbach JP. Using relative and absolute measures for monitoring health inequalities: experiences from cross-national analyses on maternal and child health. *Int J Equity Health* 2007;**6:**15.

[32] Puska P, Helasoja V, Prattala R, Kasmel A, Klumbiene J. Health behaviour in Estonia, Finland and Lithuania 1994–1998. Standardized comparison. *Eur J Public Health* 2003;**13:**11–17.

[33] Bourdieu P. *Distinction: A Social Critique of the Judgment of Taste*. Cambridge: Harvard University Press, 1979.

[34] Petkeviciene J, Klumbiene J, Prattala R, Paalanen L, Pudule I, Kasmel A. Educational variations in the consumption of foods containing fat in Finland and the Baltic countries. *Public Health Nutr* 2007;**10:**518–23.

[35] Pomerleau J, McKee M, McKee M, Robertson A, Vaask S, Pudule I *et al*. Food security in the Baltic Republics. *Public Health Nutr* 2002;**5:**397–404.

[36] National Research Council. *Premature Death in the New Independent States*. Washington, DC: National Academy Press, 1997.

[37] Arija V, Salas Salvado J, Fernandez-Ballart J, Cuco G, Marti-Henneberg C. [Consumption, dietary habits and nutritional status of the Reus (IX) population. Evolution of food consumption, energy and nutrient intake and relationship with the socioeconomic and cultural level, 1983-1993]. *Med Clin (Barc)* 1996;**106:**174–79.

[38] Artazcoz L, Cortes I, Borrell C, Escriba-Aguir V, Cascant L. Gender perspective in the analysis of the relationship between long workhours, health and health-related behavior. *Scand J Work Environ Health* 2007;**33:**344–50.

[39] Schroder H, Rohlfs I, Schmelz EM, Marrugat J. Relationship of socioeconomic status with cardiovascular risk factors and lifestyle in a Mediterranean population. *Eur J Nutr* 2004;**43:**77–85.

[40] Alexandratos N. The Mediterranean diet in a world context. *Public Health Nutr* 2006;**9:**111–17.

[41] Romaguera D, Norat T, Mouw T *et al*. Adherence to the Mediterranean diet is associated with lower abdominal adiposity in European men and women. *J Nutr* 2009 sep;**139:**1728–37.

[42] Rodrigues SS, Caraher M, Trichopoulou A, de Almeida MD. Portuguese households' diet quality (adherence to Mediterranean food pattern and compliance with WHO population dietary goals): trends, regional disparities and socioeconomic determinants. *Eur J Clin Nutr* 2008 nov;**62:**1263–72 (Epub 2007, aug 1).

[43] Schoenmaeckers RC, Lodewijckx E. Demographic behaviour in Europe: some results from FFS country reports and suggestions for further research. *Eur J Population* 1999;**15:**207–40.

[44] Rindfuss RR, Bumpass L, St John C. Education and fertility: implications for the roles women occupy. *Am Sociol Rev* 1980;**45:**431–47.

[45] Aassve A, Mazzuco S, Mencarini L. Childbearing and well-being: a comparative analysis of European welfare regimes. *J Eur Soc Policy* 2005;**15:**283–99.

[46] Vlasblom JD, Schippers JJ. Increases in females labour force participation in Europe: similarities and differences. *Eur J Population* 2004;**20:**375–92.

[47] Heliovaara M, Aromaa A. Parity and obesity. *J Epidemiol Community Health* 1981;**35:**197–99.

[48] Artazcoz L, Borrell C, Benach J, Cortes I, Rohlfs I. Women, family demands and health: the importance of employment status and socio-economic position. *Soc Sci Med* 2004;**59:**263–74.

Published by Oxford University Press on behalf of the International Epidemiological Association
 Advance Access publication 28 December 2009

International Journal of Epidemiology 2010;**39**:404–405
doi:10.1093/ije/dyp366

Commentary: Tipping the balance: wider waistlines in men but wider inequalities in women

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Accepted 12 November 2009

Obesity is concentrated in the most deprived sections of the community in most high-income countries in both adults[1] and children.[2] This is also increasingly true of low- and middle-income countries (where historically the inequality has operated in the opposite direction), particularly amongst women.[3] Diet and physical activity and their socio-economic patterning are likely to be affected by individual factors, local social context (including family, peers, workplace, community and so on) and by wider societal influences (such as food pricing and availability, provision of facilities for physical activity, welfare state policies and so on).

The paper by Roskam and colleagues, published in this issue of *International Journal of Epidemiology*, compares educational inequalities in overweight and obesity across 19 countries in Europe.[4] Of particular interest in Roskam's paper are the gender differences in the observations. Women had a lower prevalence of overweight and obesity [body mass index (BMI) $\geqslant$ 25] compared with men in all 19 of the included surveys, although roughly equal numbers of surveys showed higher prevalence of obesity (BMI $\geqslant$ 30) in women and men. Inequalities were wider for women than for men in all surveys for overweight and obesity combined and in 15 of the 19 surveys for obesity. Thus, whilst socio-economic inequalities in overweight and obesity tend to be wider for women, the public health burden of overweight and obesity is concentrated in men in many of the countries of Europe. Interestingly, the prevalence of overweight in the lowest educational groups is similar in men and women (slightly lower in women). Thus, gender differences in overweight in this study are driven by women with high education. Highly educated women seem to be behaving in a way that men of similar education do not. Trying to understand the factors that generate this gender difference may provide clues on how to intervene to reduce the much higher overall burden of overweight among men.

It is often hypothesized that women are more influenced by ideals of thinness and dieting than men, and that these influences are stronger in high socio-economic groups.[1] Furthermore, it has been postulated that, in many societies, larger body size remains a sign of 'power and dominance' amongst men.[1] If these are the main mechanisms explaining thinness in highly educated women, it is unlikely that we want to submit men to these same pressures (or do we?).