Sex Differences in the Association of Socioeconomic Status With Obesity

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Objectives. This study investigated socioeconomic predictors of obesity in men and women.

Methods. Data from the 1996 Health Survey for England were used to compare odds ratios for obesity by education, occupation, and 2 economic markers after control for age, marital status, and ethnicity.

Results. Obesity risk was greater among men and women with fewer years of education and poorer economic circumstances and among women, but not men, of lower occupational status.

Conclusions. Higher educational attainment and higher socioeconomic status were associated with a lower risk of obesity in both men and women, whereas higher occupational status was associated with a lower risk only for women. The implications of these findings for understanding causes and prevention of obesity are discussed. (*Am J Public Health.* 2002;92:1299–1304)

In recent years there has been considerable interest in describing and explaining socioeconomic variations in the prevalence of weight problems. Sobal and Stunkard's[1] seminal review showed that, across all industrialized nations, groups of lower socioeconomic status (SES) were more at risk of becoming obese. The effect was highly consistent among women but less consistent among men, and the authors suggested that such patterns may vary according to the measure of SES being used. The inconsistent pattern of findings for men has persisted in studies carried out since the Sobal–Stunkard review.[2–5]

SES is most often measured via 1 of 3 indicators: income, occupational status, and education.[6] It is plausible that obesity patterns could vary according to the component of SES used as the basis for classifying a sample. Income primarily affects resources available to buy food and to participate in leisure-time physical activities. Occupational status, the most commonly used marker of SES in the United Kingdom, is likely to affect obesity risk in a slightly different way than is income. Low-status jobs are associated with lack of autonomy, which might make it more difficult for one to manage time effectively or to adopt a healthy lifestyle.

On the other hand, low-status occupations are likely to involve more physical activity than do high-status occupations,[7] particularly in the case of men, and this could be protective against obesity. Occupation is also indicative of social status and may be a marker of shared beliefs regarding, for example, the acceptability of obesity.[8]

Education, the third commonly used indicator, is associated with the acquisition of beliefs and knowledge. Mirowsky and Ross[9] have suggested that education enables people to integrate healthy behaviors into a coherent lifestyle, gives them a sense of control over their health, and makes them more likely to pass on healthy habits to their children.

Given that these 3 variables might operate in subtly different ways, the relationship between sex, SES, and obesity may vary according to the index being used. Occupational status is the most likely SES indicator to show sex differences in associations with weight, because both entry into and characteristics of occupations vary considerably for men and women.

A US study[10] compared the relative usefulness of education, income, and occupation in predicting risk factors for cardiovascular disease. Although univariate analyses showed that all 3 indicators had a significant association with 1 or more of the risk factors, education was found to be the most consistent predictor in multivariate analyses. However, sex differences were not explicitly addressed, and obesity was not one of the risk factors measured.

In Finland, Sarlio-Lähteenkorva and Lahelma[11] found sex differences in the relationship between various measures of socioeconomic deprivation and obesity, but they were primarily interested in weight status as a predictor of socioeconomic outcomes rather than vice versa. Recent analyses of data from the World Health Organization's MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) Project showed that the association between educational level and obesity was stronger among women than among men; during the 1980s and 1990s, however, the male pattern came to more closely resemble the female pattern.[12]

In the present study, we examined the association between obesity and 3 SES indicators. The data were derived from the 1996 Health Survey for England,[13] which included measured weights and heights, information on education and occupation, and data on housing status and eligibility for government benefit payments, which can be considered indicators of economic position. In analyses of these data, occupation is normally used as an indicator of SES; to our knowledge, no study has explicitly compared education, occupation, and economic circumstances. We examined the relationship of occupational status, educational level, government benefits eligibility, and housing status with obesity, controlling for other demographic factors that have been shown to be associated with obesity.

METHODS

Data

The Health Survey for England is an annual survey intended to provide a representative sample of the population living in private households.[13] A stratified random sample of households is drawn from the Postcode Address File, and those residing in eligible households are asked to participate in 2 stages: a home interview and a nurse visit. In 1996, 11 776 eligible households were identified, 16 443 adults (16 years or older) were interviewed, and 14 440 participated in the nurse visit. Overall response rates were 75% for the interview and 66% for the nurse visit.

All of the data used in the present study were gathered during the interview. Survey details were provided in the published report and are available on the Internet.[13] Here we report on 15 061 respondents (92.5% of those interviewed) for whom valid measures of height and weight were available. Reasons for missing body mass index (BMI) data were as follows: refusal (2.4% of respondents), no measurement attempted (2.0%), and failure to obtain a reliable measurement (3.1%). Pregnant women (n=25) were excluded from the study.

Measures

Obesity. A portable stadiometer was used in measuring height (without shoes). Weight was measured with Soehnle electronic bathroom scales, participants having been asked to remove their shoes and any heavy outer garments beforehand. BMI (weight [kg]/height [m^2]) was calculated, and obesity was defined as a BMI of 30 or more.

Indicators of socioeconomic status. Respondents were asked the age at which they left *full-time education.* Ages were categorized into 7 groups relating to years of full-time education (Table 1). Those who reported never having attended school (n=60) were excluded from analyses involving education.

Occupational status was coded, via the Registrar General's classification of occupations,[14] as falling into the following categories: professional, managerial, skilled nonmanual, skilled manual, semiskilled manual, and unskilled manual. Subsidiary analyses also examined occupation of the head of household as an indicator of socioeconomic status. In these analyses, married women living with a husband were coded according to the husband's occupation.

The 1996 Health Survey for England did not include direct questions on income; therefore, 2 indicators of *economic status* were used. As an indicator of low income, participants were categorized dichotomously in terms of whether they received 1 or more types of government financial benefits (available on a means-tested basis only to low-income households); as a marker of wealth, they were categorized dichotomously in regard to housing situation (owned vs rented accommodations).

Age. Participants were asked their age at their most recent birthday. Ages were grouped into 10-year segments ranging from 16–24 years to 75 years or older.

Marital status. Participants were coded into one of 3 marital status categories: (1) married or cohabiting, (2) single, or (3) separated, divorced, or widowed.

Ethnicity. Respondents were asked to classify themselves as White, Black Caribbean, Black African, Black "other," Indian, Pakistani, Bangladeshi, Chinese, or none of these categories. Because of the small samples of respondents from many of these groups, only the following 4 classifications were used: White, Black, Asian, and "other."

Smoking status. During the interview, participants were asked about their smoking habits, and blood samples were taken during the nurse visit to validate smoking status with serum cotinine.

Statistical Analyses

Logistic regression analyses (SPSS version 10.0; SPSS, Inc, Chicago, Ill) were used to investigate the effect of each of the variables on odds ratios for obesity. First, separate analyses were carried out for men and women, after which the significance of sex interaction effects was examined. To test formally for sex interactions, we constructed logistic regression models that included only main effects for sex and the variable of interest. We then added an interaction term for the variable of interest

TABLE 1—Height, Weight, Body Mass Index (BMI), and Obesity Prevalence, by Selected Characteristics: Health Survey for England, 1996

	Occupational Status						Age Completed Education, y							Housing status		Receipt of Benefits	
	Professional	Managerial	Skilled Nonmanual	Skilled Manual	Semiskilled Manual	Unskilled Manual	Still in School	≥19	18	17	16	15	14	Owns	Rents	No	Yes
Men																	
Mean height, cm	176.4	175.5	175.2	173.2	172.9	172.5	175.5	176.5	176.2	175.5	175.3	173.2	169.8	174.6	173.5	174.6	173.0
Mean weight, kg	81.1	82.4	80.4	80.5	78.1	77.3	71.4	80.5	80.9	81.2	80.7	82.1	78.0	80.6	78.4	80.4	78.3
Mean BMI	26.0	26.7	26.1	26.8	26.1	26.0	23.1	25.8	26.0	26.4	26.2	27.3	27.0	26.4	26.0	26.4	26.1
Obese, %	12.4	17.5	15.8	19.2	15.1	16.4	5.8	11.4	14.0	17.3	15.5	22.1	21.0	16.2	17.1	15.8	19.5
No.	468	1932	736	2196	943	329	378	1246	470	474	1931	1421	1057	5209	1781	5719	1278
Women																	
Mean height, cm	164.8	162.1	161.3	159.9	159.9	158.2	163.7	163.3	162.8	162.0	161.5	160.2	156.5	161.2	160.1	161.3	159.5
Mean weight, kg	64.4	68.1	66.9	68.1	68.5	67.9	61.1	66.4	67.1	67.9	67.5	69.0	67.1	67.3	67.3	67.2	67.6
Mean BMI	23.7	25.9	25.7	26.6	26.8	27.2	22.8	24.9	25.3	25.9	25.9	26.9	27.3	25.9	26.3	25.8	26.6
Obese, %	6.1	16.8	16.0	24.1	22.1	27.4	4.4	11.9	14.3	17.7	18.3	21.5	27.0	17.0	22.0	16.7	24.1
No.	131	1744	2762	666	1503	612	410	1099	665	715	2139	1624	1351	5775	2255	6222	1817

and sex and tested whether this change led to a significant increase in the model likelihood ratio χ^2.

Second, multivariate analyses were carried out to examine the independent predictive effects of each of the variables and, again, of interactions with sex. Sample sizes varied between analyses as a result of missing data, and sample sizes were lower in the multivariate analyses than in the univariate analyses.

RESULTS

Univariate Analyses

Weight, height, BMI, and percentage of each group classified as obese in relation to each of the 3 SES variables are shown separately for men and women in Table 1. Overall, 18.7% of women and 16.5% of men were obese, but percentages varied substantially across the SES categories.

Table 2 shows, separately for men and women, the results of the logistic regression analyses used to calculate odds ratios for the risk of obesity associated with each SES variable. Odds ratios for age, ethnicity, and marital status, which could have confounded the SES, sex, and obesity effects, are also shown.

The odds of being obese increased with decreasing age at leaving school for both men and women, although the relationship was more clearly linear for women. Relative to women classified into the nonmanual occupational categories, women classified in the manual occupational categories had a significantly elevated risk of obesity; among men, occupation was significantly associated with obesity, but the pattern was not linear. Receiving benefits was predictive of obesity for both men and women, whereas living in rented accommodations was associated with an increased risk only among women.

In terms of the potential confounding variables examined in the univariate analyses, age was associated with obesity among both women and men, with risk increasing up to the ages of 55 to 64 years and then decreasing slightly. Being single was associated with a decreased likelihood of obesity among both men and women, whereas being separated, divorced, or widowed (vs married/cohabiting) was associated with an increased risk among women. Finally, Black women exhibited a substantially higher risk of obesity than did White women, whereas among men, all of the ethnic groups were at significantly lower risk than were White men.

These initial univariate analyses appeared to show similar patterns of odds ratios among men and women for education and different patterns for the occupational and economic indicators, as well as for ethnicity; thus, we examined interactions with sex for each of these variables. Significant interaction effects were found between sex and occupational status (Wald statistic=38.8, $P<.001$), sex and receipt of benefits (Wald statistic=4.2, $P=.04$), and sex and housing status (Wald statistic=7.5, $P=.006$) but not between sex and education. There was also a significant Ethnicity × Sex interaction (Wald statistic=19.8, $P<.001$), but there were no interactions between sex and age or sex and marital status.

Multivariate Analyses

Multivariate logistic regression analyses were used to assess the independent effects of each of the SES variables; separate models were used for men and women, and other SES effects were controlled. Potential confounders (age, marital status, and ethnicity) were entered in the model as control variables. The odds ratios across different levels of education were slightly reduced, but the overall pattern of results was the same as in the univariate analyses. The effects of housing status and benefits receipt also remained almost unchanged. However, there was a large change in regard to occupational status; this variable was no longer significant for men, whereas for women there was a significant independent effect of being in the higher (vs lower) occupational class groups.

We examined the data by means of a stepwise regression procedure to determine the variables that reduced the male occupational status effect apparent in the univariate analyses. This procedure showed that when age was included in the analysis, the occupational status effect among men became nonsignificant.

Among the control variables, the multivariate analyses showed that the odds ratios for age remained fairly similar to the univariate results but that marital status became nonsignificant for both men and women, principally because it had been confounded with age in the univariate analyses. A significantly greater risk of obesity persisted among Black women, but no significant effect was found for men.

To test for sex differences in obesity patterns in the multivariate analyses, we entered all of the variables (including sex) into a model, together with the interaction effects of each SES variable with sex. There was a significant Sex × Occupational Status interaction (Wald statistic=21.2, $P=.002$), but the apparent sex difference for housing status was not significant. In regard to the control variables, the pattern of obesity by age was similar in men and women, and marital status had no association with obesity; however, there was a much greater risk of obesity among Black women than among White women, whereas among men there appeared to be no such race/ethnicity effect. Tests of the interaction term showed a significant Sex × Ethnicity interaction (Wald statistic=20.0, $P=.001$).

Two subsidiary analyses (data not shown) were carried out. Repeating the analyses with the occupation of the head of household (rather than participant's own occupation) did not substantially affect the odds ratio patterns. Controlling for smoking status slightly sharpened the SES gradients; overall, however, the pattern remained the same.

DISCUSSION

Data from the 1996 Health Survey for England showed differences in the ways in which education, occupational status, and economic status are associated with obesity. Men and women who left school at an early age were more likely to be obese than were those with more education, with a graded effect across years of education. Multivariate analyses showed that this effect was similar in men and women, was independent of other SES effects, and was independent of the control variables of age, ethnicity, and marital status. This observation is in line with results of other studies conducted in the United States,[15,16] Sweden,[3] and Finland[17] showing similar linear associations between education and obesity.

By contrast, the association between occupational status and obesity differed between

TABLE 2—Odds Ratios for Risk of Obesity From Univariate and Multivariate Logistic Regression Analyses

	Women					Men				
		Univariate Results		Multivariate Results			Univariate Results		Multivariate Results	
	No.	Odds Ratio	95% CI	Odds Ratio	95% CI	No.	Odds Ratio	95% CI	Odds ratio	95% CI
Age at leaving education, y										
≥19	1104	1.0		1.0		1246	1.0		1.0	
18	669	1.22	0.92, 1.62	1.29	0.96, 1.74	470	1.27	0.93, 1.73	1.32	0.96, 1.82
17	717	1.58***	1.21, 2.06	1.55**	1.17, 2.05	474	1.62**	1.21, 2.18	1.66****	1.23, 2.26
16	2149	1.65***	1.33, 2.04	1.52***	1.20, 1.91	1931	1.43**	1.15, 1.77	1.43**	1.14, 1.81
15	1628	2.03***	1.63, 2.52	1.44**	1.12, 1.85	1421	2.20***	1.77, 2.72	1.63***	1.27, 2.09
≤14	1351	2.63***	2.12, 3.28	1.81***	1.36, 2.41	1057	2.07***	1.64, 2.60	1.77***	1.30, 2.40
Still in school	410	0.32***	0.19, 0.54	0.52*	0.29, 0.94	378	0.48**	0.30, 0.77	1.45	0.79, 2.65
Occupational status										
Professional	131	1.0**		1.0		468	1.0		1.0	
Managerial	1747	3.11**	1.50, 6.42	2.38*	1.14, 4.98	1932	1.50**	1.11, 2.02	1.29	0.94, 1.75
Skilled nonmanual	2768	2.93**	1.42, 6.02	2.02	0.96, 4.25	736	1.32	0.94, 1.85	1.16	0.81, 1.66
Skilled manual	669	4.92***	2.35, 10.28	3.11**	1.46, 6.65	2196	1.67***	1.24, 2.24	1.25	0.90, 1.72
Semiskilled manual	1509	4.37***	2.12, 9.03	2.65**	1.25, 5.61	943	1.25	0.85, 1.74	0.96	0.67, 1.38
Unskilled manual	613	5.79*	2.77, 12.10	3.02*	1.41, 6.47	329	1.38	0.93, 2.07	0.98	0.34, 1.26
Receipt of benefits										
No	6237	1.0		1.0		5719	1.0		1.0	
Yes	1827	1.58***	1.39, 1.80	1.37***	1.16, 1.61	1278	1.29**	1.11, 1.51	1.37***	1.13, 1.65
Housing status										
Owns	5782	1.0		1.0		5209	1.0		1.0	
Rents	2273	1.39***	1.23, 1.57	1.19*	1.02, 1.38	1781	1.07	0.92, 1.23	1.10	0.93, 1.31
Age, y										
16–24	1016	1.0		1.0		908	1.0		1.0	
25–34	1500	2.02***	1.54, 2.64	1.44*	1.06, 1.96	1290	2.21***	1.61, 3.04	1.90***	1.31, 2.75
35–44	1493	2.43***	1.86, 3.17	1.76***	1.29, 2.42	1348	3.00***	2.20, 4.08	2.53***	1.73, 3.68
45–54	1385	2.73***	2.10, 3.56	2.00***	1.44, 2.76	1247	4.15***	3.06, 5.63	3.26***	2.23, 4.78
55–64	1007	4.38***	3.35, 5.72	3.04***	2.18, 4.22	938	4.73***	3.46, 6.46	3.58***	2.42, 5.30
65–74	986	3.76***	2.87, 4.93	2.22***	1.56, 3.16	831	3.76***	2.72, 5.19	2.65***	1.74, 4.05
≥75	677	2.89***	2.15, 3.88	1.61**	1.10, 2.36	435	2.97***	2.04, 4.32	1.99***	1.24, 3.19
Ethnicity[a]										
White	7588	1.0		1.0		6547	1.0		1.0	
Black	151	2.38*	1.69, 3.36	2.98***	2.06, 4.30	117	0.57	0.31, 1.03	0.64	0.35, 1.18
Asian	239	0.82	0.57, 1.17	0.80	0.53, 1.21	243	0.49**	0.32, 0.77	0.66	0.42, 1.05
Other	81	0.64	0.33, 1.25	0.78	0.39, 1.55	87	0.36*	0.16, 0.83	0.44	0.19, 1.03
Marital status										
Married/cohabiting	5053	1.0		1.0		4833	1.0		1.0	
Single	1436	0.53*	0.44, 0.63	0.82	0.65, 1.02	1543	0.54***	0.45, 0.64	0.96	0.77, 1.19
Separated/divorced/widowed	1574	1.23*	1.07, 1.41	0.91	0.77, 1.06	621	1.06	0.86, 1.31	0.91	0.72, 1.13

Note. CI = confidence interval.
[a]"Black" includes Black Caribbean, Black African, and Black "other." "Asian" includes Indian, Pakistani, Bangladeshi, and Chinese.
*P < .05; **P < .01; ***P < .001.

men and women, as has also been found in the United States.[5] Among women, lower occupational status was associated with an increased risk of obesity, independent of other SES and control variables. Among men, the pattern of association between occupational status and obesity in the univariate analysis was nonlinear, although those in the highest status group were at least risk of obesity; when age was entered in the model, however, occupational status was no longer significantly associated with obesity.

Living in rented accommodations was a significant obesity risk factor for women but not for men; the interaction between sex and housing status, however, was not significant, suggesting that the apparent sex difference in odds ratios may have been a chance effect. Receipt of state benefits was associated with a higher level of increased risk for women than for men in the univariate analysis and increased the odds for both men and women in the multivariate analysis, with no sex differences in the magnitude of the association. Economic predictors of obesity have attracted the least attention in the literature, with some studies revealing an association between low income and obesity (but not in multivariate analyses)[11] and others indicating less clear-cut patterns.[5,15,16]

The present results could be considered informative about the mechanisms through which different aspects of SES might influence obesity. The similarities of risk patterns for different levels of education reflect the similar effect of education for both men and women. If education affects activity and eating behavior in the ways suggested by Mirowsky and Ross[9]—that is, by empowering people to integrate healthy lifestyle choices into their everyday lives—we might expect equivalent effects for men and women.

The male–female differences in relation to occupational status are important and might have a number of different explanations. Lower occupational status is associated with restrictions in time and opportunity to make healthy eating and activity choices as well as with higher levels of work stress, either of which could affect obesity risk,[18] but further research is necessary to determine whether these processes could account for the sex difference in risk. It has been shown that people in higher occupational status groups are more concerned about body shape and engage in more efforts to lose weight,[8] perhaps reflecting shared beliefs about the unacceptability of obesity; although there are sex differences in level of weight concern, however, the occupational gradient is similar in men and women.

Manual occupations tend to be more physically demanding, especially for men. Whereas men's physical activity rates show strong occupational gradients (a moderate or vigorous activity rate of 32% among men in semi-skilled/unskilled manual occupations, as compared with 9% among men in professional/managerial occupations), women's rates show much smaller gradients (18% vs 13%).[19] These higher activity rates could contribute to prevention of weight gain among men in manual occupations. Alternatively, reverse causation could be in operation, such that female obesity is more discouraged than is male obesity in higher-SES occupations.

Without a direct measure of income, it is difficult to be precise about the effect of income on obesity risk, but it does appear that economic deprivation is associated with an increased risk of being obese. There is a good deal of rhetoric but comparatively little research on the effects of poverty on food choices, and it is important to note that any such effects appear to function independently of the effects of education and occupational status.

Ethnic differences in obesity risk were not an explicit focus of the present study, and the sample of Black women was small, reflecting the proportions in the British population. However, there was a strikingly high obesity risk among the Black women in our sample, and this risk was independent of all of the SES indicators included and was not shared by Black men. This apparent race/ethnicity effect was similar to that observed in the 1999 Health Survey for England, which showed a strong risk of obesity in Black women, independently of SES.[20] The effect deserves further investigation to determine whether it can shed light on the mechanisms involved with obesity.

In view of the well-established differences in the patterns of obesity and SES in developed as compared with developing countries,[1] our results can be generalized only to industrialized nations similar to England. The present findings are somewhat limited by the lack of a direct measure of income, although the economic markers used provided a good indication of income and wealth. Because of the size and representativeness of the sample, the use of measured rather than self-reported heights and weights, and the inclusion of potentially confounding variables in multivariate analyses, the observed pattern of obesity by SES and sex can confidently be assumed to reflect true patterns in many Western societies.

The finding that education is so significantly associated with obesity among men and women, independent of income and occupation, is encouraging, in that education is one of the SES variables that should be most amenable to change. Other studies have demonstrated the importance of educational level in predicting weight-related behaviors (diet[21] and physical activity[22]) and have suggested that knowledge might play an important role in a range of health-related behaviors. Although many other mechanisms are likely to be involved, these results suggest that raising levels of understanding of the diet and activity choices that might protect against weight gain could make a substantial contribution toward tackling the public health problem of obesity. Targeting education interventions to lower-SES groups could also assist in reducing the increasingly wide inequalities in health. ■

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Contributors

J. Wardle and M.J. Jarvis conceived the study. J. Waller and M.J. Jarvis carried out the analyses. All 3 authors contributed to writing the article.

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Human Participant Protection

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