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Determinants of Obesity in Relation to Socioeconomic Status among Middle-Aged Swedish Women[1]

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Background. **It has been previously demonstrated that obesity is common among women with low socioeconomic status (SES), but the factors accounting for this association are not well known. According to our hypothesis, low SES is associated with psychosocial stress, an unhealthy lifestyle, and reproductive history, which may increase the likelihood of women with low SES to be overweight or obese.**

Methods. **We examined overweight and obesity in relation to SES among 300 healthy women ages 30–65 years, who constitute the control group of the Stockholm Female Coronary Risk Study, a population-based case–control study of women with coronary heart disease. This control group was compared with a large population-based sample and found to be representative of healthy Swedish women ages 30–65 years. We used an aggregate of education and occupation as a measure of SES and defined overweight as body mass index (BMI) between 23.8 and 28.6 kg/m^2 and obesity as BMI > 28.6 kg/m^2.**

Results. **Low SES was a strong determinant of overweight and obesity among middle-aged healthy Swedish women. The odds of being overweight or obese increased with lower social position. After adjustment for age, the odds ratios for overweight and obesity among women in a low vs high position were 2.2 [95% confidence interval (CI) 1.1 to 4.4) and 2.7 (95% CI 1.1 to 6.7), respectively. Both low social position and obesity were related to reproductive history (higher parity and earlier age at menarche), unhealthy dietary habits, and unfavorable psychosocial factors (poor quality of life, low self-esteem, and job strain). These factors together explained 53% of the low-SES–obesity association.**

Conclusions. **Reproductive history, unhealthy dietary habits, and psychosocial stress accounted for a large part of the association between low SES and obesity. Dietary habits and psychosocial stress are potentially modifiable factors, which should be taken into account in intervention programs among women with low SES.**

Key Words: **socioeconomic status; obesity; psychosocial stress; reproductive history; dietary habits; lifestyle; women.**

INTRODUCTION

Obesity is reported to be a risk factor for cardiovascular and other diseases, as well as for psychosocial problems [*1–3*]. Body weight is related to social rank or position in many studies [*4,5*]. The strength of the relationship may differ [*6,7*], but results are consistent in that they show lower socioeconomic status (SES) to be strongly associated with a higher prevalence of obesity among women [*7–21*]. Among men, the relationship is weaker and less consistent [*22,23*]. Although the authors mentioned above have established the SES–obesity relationship among women, very few have examined the factors that may explain this relationship.

In previous studies, body weight has been associated with marital status [*19,24–26*], smoking [*13,19,27*], alcohol consumption [*28–30*], dietary habits [*6,13,31*], physical exercise [*13,19,32,33*], reproductive history [*17–19,34–36*], and psychosocial stress [*11,37,38*]. Unhealthy dietary habits, reproductive history, and psychosocial stress are also known to be associated with low SES [*14,15,17*]. In general, however, no attempts have been made to analyze the role of these factors in explaining the association between low SES and obesity. It has been demonstrated that gender and ethnicity [*7*] and health behaviors (smoking, exercise patterns, and dietary habits) [*13*] may account for some of the SES differences in body mass index (BMI), but that those health behaviors only explain away some of the social gradient in BMI.

Our study examined overweight and obesity in relation to SES and several factors which may explain the social gradient in obesity among middle-aged women in a Western society. These factors included unhealthy lifestyle [smoking, physical inactivity (at work and at leisure), alcohol consumption, unhealthy dietary hab-

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its], intentional dieting, psychosocial stress (lack of self-esteem, poor coping, poor quality of life, lack of social support, and job strain), and reproductive history (early menarche, high parity, and early menopause).

Our hypothesis is that low SES is associated with psychosocial stress, an unhealthy lifestyle, and reproductive history, which may increase the likelihood of women with low SES to be overweight or obese.

MATERIALS AND METHODS

The study group comprised 300 healthy women ages 30–65 years. They constitute the control subjects of the Stockholm Female Coronary Risk Study, which is a population-based case–control study of psychosocial and biological risk factors for coronary heart disease (CHD) among women. All female cases 65 years of age or younger hospitalized in greater Stockholm for an acute event of CHD between February 1991 and February 1994 were included in the patient group. Healthy control subjects were chosen from the population register of greater Stockholm. This population register includes the person identification numbers (based on birth date and gender) of the residents in Stockholm. "Healthy" was defined as being free from symptoms of heart disease and without hospitalization for any illness during the prior 5-year period.

The subjects were compared on educational level with a random sample of 2,500 women of the same age range from the general population of Stockholm [*39*]. No differences in educational level were found. In our study, the proportion of women with less than high school education (mandatory) was 53%, that with high school was 20%, and that with college/university education was 27%. In the Stockholm population-based study, the proportions were 52, 21, and 27%, respectively ($P = 0.75$). In our study, 18% of the women were in the range 30 to 49 years, 40% in the range 50 to 59 years, and 42% were 60 years and above. Although older women are overrepresented due to our study design, the study group can be considered representative of healthy women ages 30–65 years in the Swedish population, regarding educational characteristics.

The subjects were contacted by a letter explaining the objectives of the study and inviting them to participate. Those who did not call the clinic spontaneously were then contacted by phone. Among all contacted women, 17% declined to participate, mainly due to difficulties in arranging time off from work to participate in the study. There were no significant differences in the mean age between participants and nonparticipants. More detailed information about recruitment of subjects has been given elsewhere [*40*].

Socioeconomic Status

Socioeconomic status was measured using the Hollingshead Index of social position [*41*]. This index consists of an aggregated sum of educational and occupational measures. Social position was a better discriminator between SES and BMI than education alone. Furthermore, since we are considering psychosocial characteristics including job strain and life quality as possible factors associated with weight, and which are influenced by occupation, a combined index of education and occupation was found to be an appropriate measure of SES. The Hollingshead scale has been previously used among Swedish cardiac patients and found to be a discriminatory predictor of mortality [*42*].

Educational level was reported by the subjects. Occupational level was based on the question: "What is your current occupation? If no longer employed, state your previous job." Sixty-three women were not currently employed. Of these, 51 women had early pension due to some disability, 11 women were currently unemployed, and only 1 woman had been a homemaker her entire life. The homemaker was excluded from all analyses, and for the other 62 women, their previous occupation was used. We tested the differences in BMI levels between women who were currently working and those who were not. The BMI level for currently working women was 25.5 and for non-currently working women was 25.8 ($P = 0.66$).

According to the Hollingshead's method, occupational grade (I–VII) was multiplied by 7 and educational level(I–VII) by 4. For both occupational grade and educational level, I corresponded to highest grade or level, while VII corresponded to the lowest. This aggregated score of education and occupational grade (social position) ranged from 11 to 77. It was further classified into tertiles using distribution of the score in the study group: low (53–77), intermediate (38–52), and high ($\leq$37). This trichotomization has been previously used as a measure of SES among women [*13,19*].

Outcome Variable

Body fatness, the primary outcome variable in this report, was based on BMI. This is the most widely used measure of obesity and it was used because it is considered a highly reliable measure of body fat and obesity [*43*]. BMI was computed as weight (kg)/[height(m)]^2 [*43*].

Weight and height were measured by one and the same research nurse at examination. Height was measured to the nearest 0.5 cm with subjects standing without shoes, heels together, and head straight. Body weight was measured to the nearest 0.1 kg, using a calibrated balance scale. Subjects were wearing ordinary light clothes, and 0.5 kg was deducted from each woman to exclude the weight of clothes. The body mass index values were categorized as follows: normal weight, <23.8 kg/m^2; overweight, 23.8–28.6 kg/m^2; and obesity, >28.6 kg/m^2, according to the criteria recommended by the FAO/WHO/UNU expert consultation in

1985 [44]. The cutoff points have been used in previous Swedish studies [10].

Covariates

Background factors. Age (years) at examination was obtained from the date of birth given in the person number of the census register. Marital status was categorized as single, widowed, divorced, or cohabiting. Women were defined as cohabiting if they reported being married or living with a male companion.

Lifestyle-related factors. Smoking was dichotomized as 0 = never smoked or previously smoked and 1 = currently smoking.

Physical activity at work and at leisure was assessed according to the World Health Organization criteria and graded I to IV. For physical activity at work, I corresponded to work where one was sitting most of the time and did not need to walk a lot, and IV corresponded to physically strainful work which required one to carry heavy things. For leisure-time physical activity, I corresponded to reading, watching television, or other sedentary leisure activities, and IV corresponded to hard training or participation in competitive sports regularly, several times per week. In the analyses, physical activity both at work and at leisure time was dichotomized into physically inactive (I) or physically active (II to IV).

Data on intentional dieting were obtained by the research nurse during interview. Subjects were asked two questions, "Have you ever dieted in your life time? If so, how many times?"

Dietary habits. Diet was assessed using an 88-food item frequency questionnaire (FFQ) with relative portion sizes [45]. Variables derived from the dietary habits questionnaire included total energy intake, total fat, carbohydrate, sucrose, total fiber, and protein intake. For foods usually eaten on a daily basis such as milk (5 types), bread (4 types), cheese (6 types), coffee, sugar, and fat on sandwiches, open questions about number of glasses of milk, slices of bread, slices of cheese, cups of coffee, and teaspoons of sugar per day or week were asked. For fat on sandwiches, the participants were asked whether they usually used a thick or a thin layer. For the other 58 food items listed in the questionnaire, participants were asked to estimate frequency of consumption and indicate what portion size they usually ate (small, medium, or large) in relation to specified standard portions for each food item. These standard portions correspond to "natural" units (e.g., one orange, two eggs) or typical serving size, derived from the weight tables for foods and dishes prepared by the Swedish Food Administration [46]. In the FFQ there were nine predefined frequency categories, ranging from "never or less than once per month" to "three or more times per day". The questionnaire also included additional questions about type of fat on the table (5 types), fat usually used in cooking (8 types), portion of visible fat from meat, and part of skin from chicken/poultry usually consumed ("all," "only a part," "as much fat/skin removed as possible").

Daily energy and nutrient intake was calculated by multiplying the frequency of use of each food by the indicated portion size and by the nutrient content of each food item (or a weighted average nutrient composition of each food group) and then summing across all foods. The nutrient composition data used for calculations are derived from the Swedish Food Administration food data base PC Version 1992 [47]. For nutrient calculations, missing frequency answers were treated as "never or less than once per month" category.

Information about consumption of five alcoholic beverages (beer 2.8% alcohol, beer 4.5%, wine 10–15%, sherry 20%, and hard liquor 40%) was obtained by open-ended questions about frequency per year, per month, per week, and per day and about the usual number of specified servings (bottles, cans, or glasses) consumed at each occasion. The total average amount of alcohol (100% ethanol) consumed was calculated in grams per day taking into account frequency, amount, and content of alcohol in specific beverages [48].

Subjective assessment of quality of dietary data was done by the research nurse and was based on the examination of the questionnaires for obvious errors and inconsistencies. These problematic answers in the food questionnaire were then corrected during interview.

Reproductive history. Reproductive history was assessed based on subjects' own reports in a gynecological interview, which was carried out by the research nurse. Reproductive factors included age at menarche, parity, menopausal status, and age at menopause. Menopausal status was categorized as pre- or postmenopausal. Postmenopausal status was defined as having had no menses for at least 6 months prior to examination.

A history of gynecological operations was obtained, and surgical menopause was defined as present if bilateral oophorectomy had occurred. A complete history was also obtained on hormone replacement therapy, and when it had been instituted in relation to menopause. Women who were started on estrogen before menopause were regarded as postmenopausal if they were >50 years of age.

Psychosocial factors. Previously validated questionnaires were used to obtain data on job strain, social support, self-esteem, coping, and global quality of life.

Psychosocial job strain was derived from the quotient of psychosocial demand and decision latitude at work, according to Karasek [49], the largest ratio corresponding to increased job strain. Psychosocial demand at work refers to the psychological demand one experiences at work. The scale included five well-validated questions (scores ranging from 1 to 20). The highest score corresponded to a high level of psychosocial demand at work. Decision latitude refers to the control and power that one has at work, describing a person's ability to control her/his own work activities. The scale included six well-validated questions (scores ranging from 1 to 24) on intellectual discretion and authority to make decisions on how and what to do in one's job. The highest score corresponded to a high level of decision latitude.

Social support was based on a measure of quality of social support that has been modified for use in population studies [*50*]. This instrument consists of two scales, one describing deep emotional relationships (attachment) and the other describing the more peripheral contacts of social networks (social integration). Both consist of 6-item continuous scales with ranges from 0 to 6 and 6 to 36, respectively. For this report we used social integration as a measure of social support.

Pearlin's short instruments for self-esteem and coping was used [*51*]. The self-esteem scale had scores ranging from 10 to 40, with higher score corresponding to better self-esteem. The coping instrument had scale scores ranging from 7 to 28, with higher score corresponding to better coping.

Global quality of life was based on the scale developed by Andrew and Withey [*52*]. The scale is represented by a ladder of life, which is presented as a 10-grade scale, defining expectations for the present and the future. The 1st grade represents the worst possible and the 10th the best possible life. For this report we used quality of life as it was expected to be in the future.

Statistical Analyses

The distributions of study variables were calculated as means, standard errors, minimum and maximum values, and proportions. Analysis of variance using Wilcoxon signed rank tests were used for continuous variables, and χ^2 tests were used for discrete variables.

Logistic regression analysis was used to test the effect of social position on overweight and obesity. Estimates of odds ratios and 95% confidence intervals (CI) were computed. A test for linear trend was used to assess the association between social position and the odds of being overweight or obese [*53*]. Multivariable logistic regression techniques were performed to assess correlates of obesity. In order to examine clearly the correlates of obesity, overweight women were excluded from the explanatory logistic models of obesity. In this analysis normal weight was the reference category. Explained gradient was examined by taking each factor at a time in an age-adjusted logistic model together with social position.

Percentage of reduction (explained gradient) in the excess risk for obesity in relation to social position, after inclusion of each explanatory factor, was calculated as follows:

$$\partial = \frac{\text{odds ratio}_{(\text{age+social position})} - \text{odds ratio}_{(\text{age, social position, +explanatory factor})} \times 100}{\text{odds ratio}_{(\text{age+social position})} - 1}$$

All statistical tests were two-tailed. Stata 5.0 for Macintosh [*54*] and JMP Statistics for the Apple Macintosh Version 3.1 were used to run the analyses [*55*].

The study was approved by the Ethical Committee at the Karolinska Hospital, Stockholm.

RESULTS

The mean age of the participants was 56 ± 7.0 years. Thirty percent were premenopausal and 70% were postmenopausal women. The mean value for BMI for the whole group was 25.6 ± 4.8, median 24.6, with a range 17.6 to 48.6 kg/m^2. Using the recommended BMI categories, 41% (124) had normal weight, 40% (119) were overweight, and 19% (56) were obese. Social position was distributed as follows: 34% (102) were in a high social position, 37% (110) were in an intermediate social position, and 29% (87) were in a low social position.

Associations of BMI with Covariates

Statistically significant associations for BMI categories were found with social position ($P = 0.01$), age ($P = 0.02$), and such reproductive factors as menopausal status ($P = 0.01$) and age at menarche ($P = 0.02$) (Table 1). Women who were older, who had lower social position, who were postmenopausal, or who had early menses were heavier than others. Also, women who had high parity or had early menopause were likely to be heavier than others, although these associations did not reach statistical significance (Table 1).

Among the psychosocial factors, statistically significant associations for BMI categories were found with global quality of life ($P = 0.04$) and self-esteem ($P = 0.05$). Women who reported poor quality of life or low self-esteem were heavier than others. Associations for BMI categories with job strain, coping, and social support did not reach statistical significance, although there was a tendency for women with high job strain, poor coping, or poor social support to be obese.

Among the lifestyle factors, smoking status ($P = 0.03$); intentional dieting ($P < 0.001$); alcohol consumption ($P = 0.02$); and total fiber ($P = 0.02$), carbohydrate ($P = 0.04$), protein ($P = 0.05$), and sucrose intake ($P = 0.03$) were positively associated with BMI categories (Table 2). Women who reported physical inactivity at leisure or higher total energy or total fat intake were likely to be heavier than others, although

TABLE 1

Associations of BMI Categories with Background Variables, Reproductive Factors, and Psychosocial Factors

Variable	Normal[a] $n = 124$	Overweight $N = 119$	Obese $n = 56$	P
Background factors				
Marital status (%)				
Single	13%	7%	10%	
Cohabiting	60%	68%	62%	
Divorced	20%	17%	15%	
Widowed	7%	8%	13%	0.60
Age (years) (mean ± SEM)[b]	55.1 ± 0.7	57.2 ± 0.6	57.9 ± 0.9	0.02
Reproductive factors				
Age at menarche (years) (mean ± SEM)	13.7 ± 0.1	13.6 ± 0.1	13.0 ± 0.2	0.02
No. of pregnancies (mean ± SEM)	2.0 ± 0.2	2.4 ± 0.1	2.6 ± 0.2	0.06
Age at menopause (years) (mean ± SEM)	49.4 ± 0.6	48.8 ± 0.4	48.1 ± 0.8	0.20
Postmenopausal (%)	60%	78%	76%	0.01
Psychosocial factors				
Global quality of life (scales) (mean ± SEM)	7.4 ± 0.2	7.0 ± 0.2	6.4 ± 0.3	0.04
Self-esteem (scales) (mean ± SEM)	32.9 ± 0.4	31.0 ± 0.5	30.4 ± 4.6	0.05
Coping (scales) (mean ± SEM)	22.4 ± 0.3	22.2 ± 0.3	22.1 ± 3.3	0.98
Social integration (scales) (mean ± SEM)	22.2 ± 0.5	21.5 ± 0.5	21.5 ± 5.2	0.76
Attachment (scales) (mean ± SEM)	5.6 ± 0.1	5.5 ± 0.1	5.4 ± 0.2	0.51
Job strain (ratio) (psychosocial demand/decision latitude at work)	0.69 ± 0.03	0.70 ± 0.03	0.71 ± 0.03	0.07

[a] Normal weight, <23.8 kg/m^2; overweight, 23.8–28.6 kg/m^2; obese, >28.6 kg/m^2.
[b] SEM, standard error of mean.

these associations did not reach statistical significance. In contrast, women who reported physical inactivity at work had a tendency toward normal weight; the association, however, did not reach statistical significance (Table 2).

Associations of Social Position with Covariates

Women in a low social position had a higher prevalence of smoking (47%) than those in a high social position (25%) ($P = 0.003$). Also, there was a tendency for women in a low social position to be physically inactive at leisure, but the differences were not statistically significant. On the contrary, alcohol consumption was higher among a high social position women (9.5 g/day) than among those in a low social position (6.3 g/day) ($P = 0.03$).

The association of social position with dietary habits was less consistent. There was a tendency for women in a high social position to have a healthier diet than those in a low social position, but these associations did not reach statistical significance.

Women in a low social position were more likely to report an early menarche, an early menopause, and higher parity. The associations, however, did not reach statistical significance.

TABLE 2

Associations of BMI Categories with Lifestyle-Related Factors

Variable	Normal[a] $n = 124$	Overweight $n = 119$	Obese $n = 56$	P
Smoking (% yes)	40%	30%	22%	0.03
Physical inactivity at leisure (%)	17%	17%	26%	0.27
Physical inactivity at work (%)	50%	46%	46%	0.81
Alcohol consumption (g/day) (mean ± SEM)[b]	9.0 ± 0.8	7.3 ± 0.7	6.3 ± 1.4	0.02
Dieting (No. of times/person) (mean ± SEM)	0.18 ± 0.8	0.57 ± 0.1	0.94 ± 0.2	0.0001
Dietary habits				
Total energy intake (kcal/day) (mean ± SEM)	1337.5 ± 38.2	1327.0 ± 35.1	1472.1 ± 79.5	0.11
Total fat intake (g/day) (mean ± SEM)	48.3 ± 1.9	45.8 ± 1.6	52.1 ± 3.6	0.19
Total fiber intake (g/day) (mean ± SEM)	13.5 ± 0.4	14.2 ± 0.4	15.8 ± 1.0	0.02
Carbohydrate intake (g/day) (mean ± SEM)	154.2 ± 4.2	158.3 ± 4.7	176.3 ± 10.2	0.04
Protein intake (g/day) (mean ± SEM)	56.5 ± 1.7	57.9 ± 1.5	64.0 ± 2.9	0.05
Sucrose intake (g/day) (mean ± SEM)	24.3 ± 1.2	25.1 ± 1.2	31.0 ± 3.3	0.03

[a] Normal weight, <23.8 kg/m^2; overweight, 23.8–28.6 kg/m^2; Obese, >28.6 kg/m^2.
[b] SEM, standard error of mean.

Women in a low social position had lower self-esteem ($P = 0.01$), poorer social supports ($P < 0.001$), higher job strain ($P = 0.05$), poorer coping ($P = 0.05$), and poorer quality of life ($P = 0.05$) than women in a high social position.

Associations of Social Position with BMI

Proportions of women who were normal weight, overweight, or obese by social position strata are summarized in Fig. 1. More women who were overweight (39%) or obese (39%) were found in a low social position and fewer were found in a high social position, 26% and 25%, respectively ($P = 0.01$).

Age-adjusted logistic regression showed that the social gradient was steeper for obese than for overweight women. After adjusting for age, the odds of being obese for women in a low social position were 2.74 (95% CI 1.13 to 6.67) compared with women in a high social position. For those in the intermediate social position, the age-adjusted odds ratio (OR) for obesity was 2.34 (95% CI 1.05 to 5.24) (P value for trend = 0.01).

The age-adjusted OR for overweight among women in a low social position was 2.23 (95% CI 1.13 to 4.39) compared with women in a high social position, while the OR for overweight among women in an intermediate social position was 1.19 (95% CI 0.64 to 2.23) (P value for trend = 0.03).

Explanatory Factors for the Low-SES–Obesity Association

We used logistic regression analysis to assess the factors that accounted for the social gradient in obesity. Obese women were compared with women with

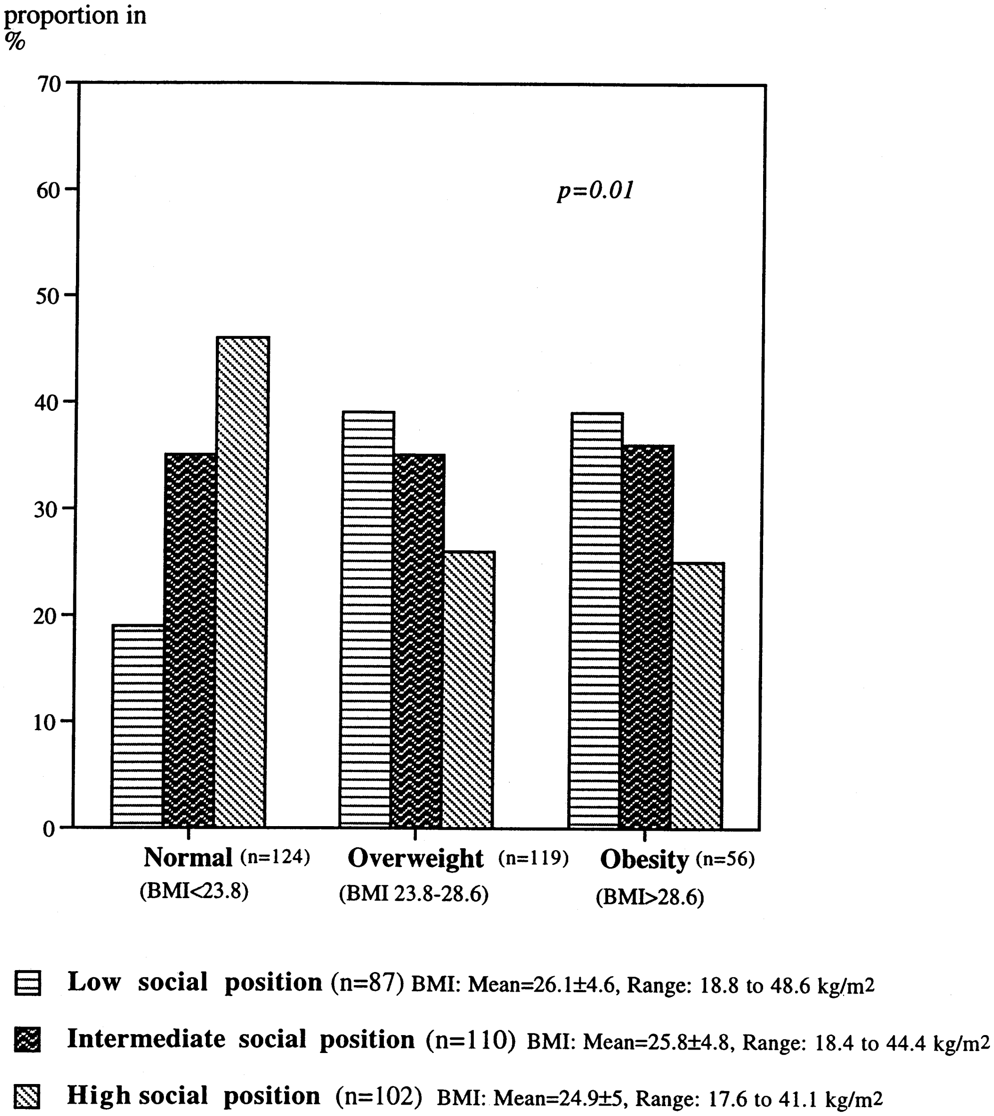

FIG. 1. Proportions of women with normal weight, overweight, and obesity by categories of social position.

normal weight. Factors were grouped into dietary habits (fiber, carbohydrates, sucrose, protein, and total energy), reproductive history (early menarche and high parity), and psychosocial factors (poor quality of life, lack of self-esteem, and job strain). Each factor was taken at a time in the logistic regression model together with social position and age. All factors belonging to the same group were further included in the model simultaneously. For each model, the odds ratio (with explanatory factor) for obesity in relation to low social position was observed and the change in odds ratio (with and without explanatory factor) was calculated. We adjusted for age in each model because age was associated with both social position and obesity and with several explanatory factors.

Among the factors that accounted for the SES–obesity association, reproductive history (early menarche and high parity) had the strongest explanatory power (Fig. 2). The age-adjusted OR for obesity in relation to low social position was 2.74 (95% CI 1.13 to 6.67, P trend = 0.01). It was decreased to 1.98 (95% CI 0.71 to 5.27, P trend = 0.13) when early menarche and high parity were added to the logistic model, accounting for 44% of the social gradient in obesity. Among the reproductive factors, early menarche explained the largest proportion (28%).

Dietary habits was the second strongest factor accounting for the association between low social position and obesity. The age-adjusted OR for obesity in relation to low social position decreased from 2.74 to 2.05 (95% CI 0.78 to 5.34, P trend = 0.09), accounting for 40% of the social gradient in obesity (Fig. 2). Among the dietary habits, total fiber, carbohydrates, and sucrose explained the largest proportion (>35%).

By adding psychosocial factors (quality of life, self-esteem, and job strain) to the logistic regression model together with age and social position, the age-adjusted OR for obesity in relation to low social position decreased to 2.17 (95% CI 0.89 to 5.71, P trend = 0.06), accounting for 33% of the social gradient in obesity. Among the psychosocial factors, poor quality of life explained the largest proportion (34%) (Fig. 2).

When analyzed in the same model, reproductive factors, lifestyle, and psychosocial factors accounted for 53% of the social gradient in obesity and the OR for obesity decreased to 1.75 (95% CI 0.35 to 8.69, P trend = 0.40). Forty-seven percent of the social gradient in obesity remained unexplained.

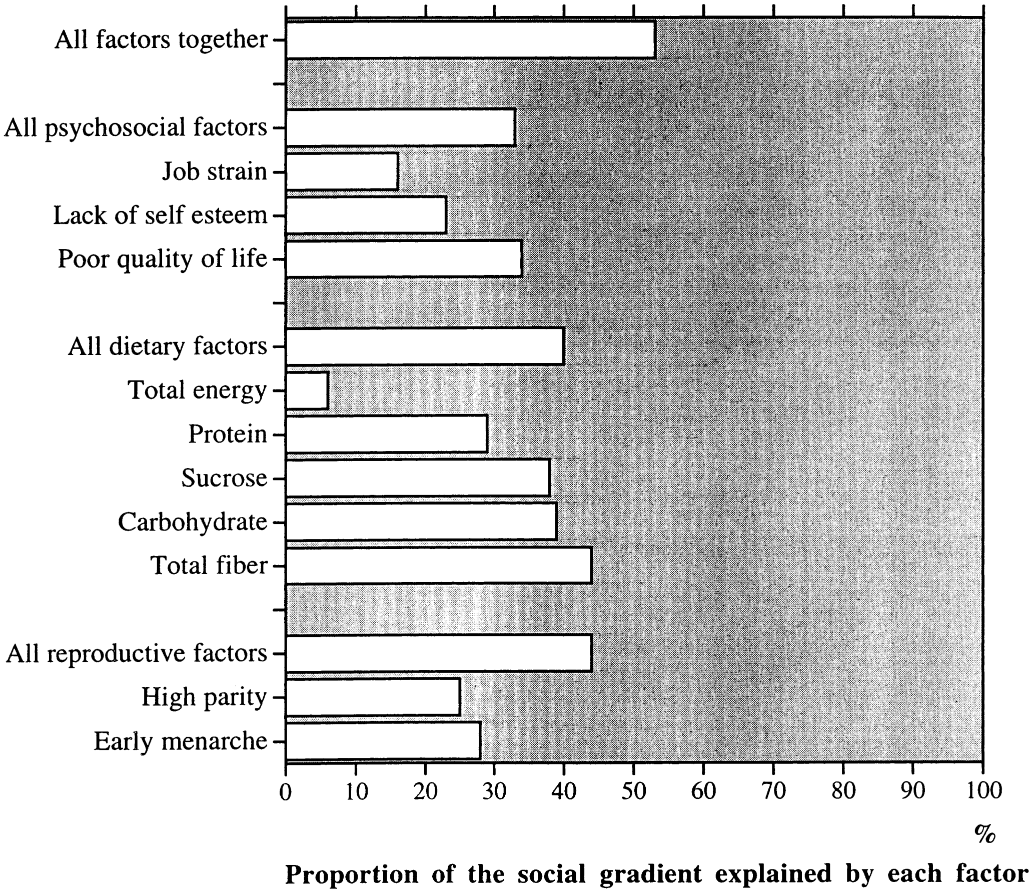

FIG. 2. Factors accounting for the association between socioeconomic status and obesity among Swedish women.

DISCUSSION

Swedish women with a low social position were more likely to be overweight or obese than were women with a high social position. The social gradient was steeper for obesity than for overweight. After adjustment for age, the OR for overweight and obesity in women in a low social position vs a high position was 2.2 (95% CI 1.1 to 4.4) and 2.7 (95% CI 1.1 to 6.7), respectively.

Both low social position and obesity were related to reproductive history (early menarche and high parity), unhealthy dietary habits, and psychosocial stress (poor quality of life, low self-esteem, and job strain). Reproductive history, dietary habits, and psychosocial factors accounted for a large proportion of the association between low social position and obesity. Among these factors, reproductive history revealed the strongest association.

Results in this report and results from other studies [*7–38*] confirm our hypothesis that low SES is associated with an unhealthy lifestyle, unfavorable psychosocial factors, and reproductive history, and this may explain why women with low SES are more likely to be obese.

The findings in this study should be considered in the light of its strengths and weaknesses. The index of social position that was used in this report is a well-validated measure of socioeconomic status and captures the simultaneous effect of education and occupation. Weight and height of the subjects were measured by a well-trained research nurse, which eliminates the risk of systematic or random error which might occur in self-reports.

Although the response rate was high (83%), there is a possibility of nonresponse bias. We did not have extensive data (e.g., BMI, SES) on the nonparticipants to compare them with the participants. We had access only to age and did not find significant differences in mean age between participants and nonparticipants.

The strongest limitation of this study is its cross-sectional survey nature, which does not account for how long-term patterns of lifestyle and psychosocial factors may influence obesity. Firm conclusions about the direction of causality cannot be drawn. It is possible that obesity may influence SES. However, Kuskowska-Wolk and Bergström, in their study of trends in BMI among Swedish women, demonstrated that changes in BMI with increasing age differed substantially between socioeconomic groups. The mean BMI of senior salaried employees and professional women increased much less than that of manual workers [*10*]. The authors suggest that high-SES women are more keen to keep their weight by exercising, eating healthy foods, and dieting, making them more successful in weight maintenance. Also, results from the Minnesota Heart Survey showed that the trends in BMI were significantly associated with educational level among both men and women [*21*]. The mean BMI of women with college education increased much less than that of women with less than high school education.

The causal chain of low SES–obesity in relation to other determinants of obesity may be difficult to confirm in cross-sectional studies. It is possible, however, that low SES precedes obesity by determining psychosocial stress, which later influences dietary habits and therefore leads to obesity. The association between SES and reproductive history may possibly be of two-way direction. SES may precede reproductive history or vice versa.

Our observed social gradient in overweight and obesity is consistent with earlier findings [*7–21*]. In all these studies low SES was associated with obesity. Several of these studies did not examine the factors accounting for the social gradient. In some studies, the authors demonstrated that gender and ethnicity [*7*] and behavioral factors (smoking, exercise patterns, dietary habits, and intentional dieting) account for some of the social gradient in BMI. Controlling for these factors, however, did not explain away the social gradient in BMI levels. Croft et al. also found a significant effect of low social position on BMI after taking age, exercise, smoking, dietary habits, and marital status into account [*19*]. The authors could not account for the residual association. Sobal hypothesized parity, energy balance, and marital status as possible mediating variables of the low-SES–obesity association [*6*]. He assumed energy intake and expenditure to be influenced by SES. This has also been confirmed by other studies [*14,15,17*].

To understand why socioeconomic differences exist in overweight or obesity, the factors in the causal chain between low SES and obesity need to be addressed.

We found that reproductive history accounted for the largest proportion of the social gradient in obesity. The strong association that we found between reproductive factors and BMI is in agreement with earlier research [*17–19,34–36*]. It is suggested to reflect a cumulative impact of pregnancies [*36*]. Child bearing and rearing have been reported to account for some of the increase in BMI among women, which may determine obesity [*34,35*]. It has been suggested that some of the weight gained during pregnancy may be retained [*36*], and that having more children may contribute to an altered lifestyle among women, facilitating weight gain. Kohrs et al. [*35*] demonstrated a significant association between early menarche and high BMI, which is consistent with our results. The association of early child bearing with both low SES and obesity has also been reported in other studies [*20*]. Women with low SES have been documented to have higher parity than women with high SES. This supports our finding of early menarche and high parity as explanatory factors for the association between low SES and obesity.

Although the association of BMI with total energy and total fat intake was not significant, other dietary factors were found to account for a large proportion of the social gradient in obesity in our study. Our results are similar to the results demonstrated by Tavani et al. [*15*] and Lichtman et al. [*56*], who reported that BMI was not positively associated with high caloric intake, particularly among women. The lack of association between total energy and BMI might be due to underreporting of total caloric intake by overweight women, as has been reported in other studies [*56,57*]. We found obesity to be associated with large intake of carbohydrates, protein, and sucrose. It is also possible that obese women underreported their fat intake, thereby underestimating their total caloric intake. Another explanation could be that individuals with overweight attempt to cut down on their weight by consuming less caloric food stuffs [*7*]. Overweight or obese women had tried to lose weight more often than women with normal weight.

The finding that dietary habits were among the factors that accounted for a large part of the social gradient in obesity may suggest that dietary habits is an explanatory variable for the low-SES–obesity association among Swedish women. Individuals in a low social position have *less* healthy dietary habits, which makes them heavier than women in a high social position.

We did not find a significant association between physical activity at leisure and at work and BMI, which is inconsistent with findings from other studies [*32,33*]. This lack of association could be attributed to misreporting of the physical exercise level during leisure or to the activity scale not being sensitive enough to pick up social class variations. It is known, however, that energy balance is a determinant of body weight [*58*], and obesity is a consequence of the chronic imbalance between energy intake and expenditure [*59*].

Although low social position was found to be associated with high prevalence of cigarette smoking and low alcohol consumption, both cigarette smoking and alcohol consumption were found to be inversely related to BMI, which is consistent with other findings [*22,23*]. Some researchers have suggested that the inverse smoking–BMI association may be explained by nicotine in cigarettes, which raises basal metabolism [*60*] and increases gastrointestinal motility, which can result in loss of food calories and therefore lower BMI [*61*]. The inverse association between alcohol and BMI has been explained by the increased metabolism and gastric oxidation of ethanol among women [*30*]. It is also possible that the high alcohol consumption and low caloric intake among women with high social class may explain the inverse alcohol–BMI association. Furthermore, high-SES individuals may compensate with other positive behaviors, such as leisure physical exercise and low-fat diet [*15*].

Psychosocial stress in relation to obesity has been rarely examined. One Swedish study demonstrated that feeling of stress was associated with higher BMI [*11*]. We found that women who lacked self-esteem or had poor quality of life or had high psychological demand, but low control at work, were less likely to exercise and to have healthy dietary habits. Earlier studies have demonstrated that children develop high body fat levels because of low self-esteem at an early age [*37,38*]. Low self-esteem, poor quality of life, and job strain may cause psychological distress which might lead to overeating and lack of physical exercise. We observed higher sucrose and carbohydrate intake among obese women, which might reflect eating patterns as a way of coping with stress. On the other hand, low self-esteem and poor quality of life can be consequences of obesity particularly among women who have tried to reduce their weight, but failed. In our study obese women reported five times more frequent intentional dieting than women who were normal weight.

The lack of association between obesity and low social support found in this report is in agreement with what Wing et al. demonstrated. The authors did not find any significant association between social support and BMI [*31*]. The lack of association between obesity and social support may be due to the fact that obesity develops over time and the effects of social support measured at a certain period may not influence obesity measured at another period.

The findings in this study and in other studies confirm our hypothesis that low SES is associated with psychosocial stress and reproductive history, which in turn might influence dietary habits and exercise habits, thus resulting in obesity. The results suggest that intervention on factors that can be modified, such as unhealthy dietary habits, low self-esteem, job strain, and poor quality of life, may reduce some of the SES differences in obesity.

CONCLUSION

We have demonstrated that obesity is a prevalent problem among low-SES women. We found that low SES is associated with obesity through several factors, including reproductive history, unhealthy dietary habits, and psychosocial stress. Women who have early menarche and many children, who lack self-esteem, who have poor quality of life, or who experience high psychosocial job strain with low control at work may react to the combined strain by overeating and exercising less, in particular if they have low education and a low status job.

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