Social disparities in overweight and obesity among nearly elderly and elderly people in Taiwan

Zhihong Sa, MA
Ulla Larsen, PhD

Authors' affiliation:

Department of Sociology
University of Maryland
College Park, MD 20742-1315

Corresponding author:

Zhihong Sa
Ph. D candidate
Department of Sociology
University of Maryland
College Park, MD 20742-1315
Email: zsa@socy.umd.edu
Phone: (301) 405 9259
Fax: (301) 3146892

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ABSTRACT

This study assessed the association between socioeconomic status (SES) and overweight and obesity among near elderly (aged 53-69) and elderly (age 70+) people, using a longitudinal survey data in Taiwan. Multivariate OLS regression models showed that mainlander status and current income were positively associated with body mass index (BMI) among near elderly and elderly men. In contrast, SES was not related to BMI in elderly women, while education was inversely associated with BMI among near elderly women. The associations between SES and BMI persisted after controlling for health behaviors and social support. Despite the overall modest association between SES and overweight and obesity among the elderly, the shifting pattern in the link between SES and overweight and obesity between near elderly and elderly women indicates an emerging social disparity in overweight and obesity in Taiwan. The findings suggest that patterns of social gradients in obesity are conditioned upon socioeconomic and cultural contexts.

Keywords: obesity, socioeconomic status, socioeconomic development, aging, Taiwan.

Introduction

Obesity has become one of the most prevalent chronic conditions impacting the health of populations worldwide (WHO 2003). Studies that examine the relationship between socio-economic status (SES) and obesity demonstrate a well-established pattern of social disparities in obesity. In developed countries, SES is inversely associated with obesity (Sobal and Stunkard, 1989; Ball and Crawford, 2005). In contrast, the association is positive in most developing countries (Sobal and Stunkard, 1989). However, recent studies indicate that the pattern of social disparities in obesity found in developed countries has started to emerge in developing countries with relatively high levels of development (Monteiro et al. 2004). The burden of obesity appears to shift towards the disadvantaged groups at an earlier stage of socio-economic development (Song 2005). Today, no systematic study has been done to capture the shifting patterns in social disparities in obesity and their underlying mechanisms. The study of these issues is important for understanding social inequalities in health, as well as for the development of public health policies aimed at preventing obesity.

The primary aim of the present study was to examine the association between SES and overweight and obesity among the elderly in Taiwan. Taiwan has gone through dramatic socioeconomic changes over the past 50 years. The analysis of the near elderly (aged 53-69) and the elderly (aged 70+) documented the impact of socioeconomic development on the shifting patterns in social disparities in overweight and obesity in Taiwan. The analysis investigated how lifestyle factors and social support mediate the relationship between SES and overweight and obesity and it clarified the mechanisms underlying the SES-obesity links among a non-Western elderly population.

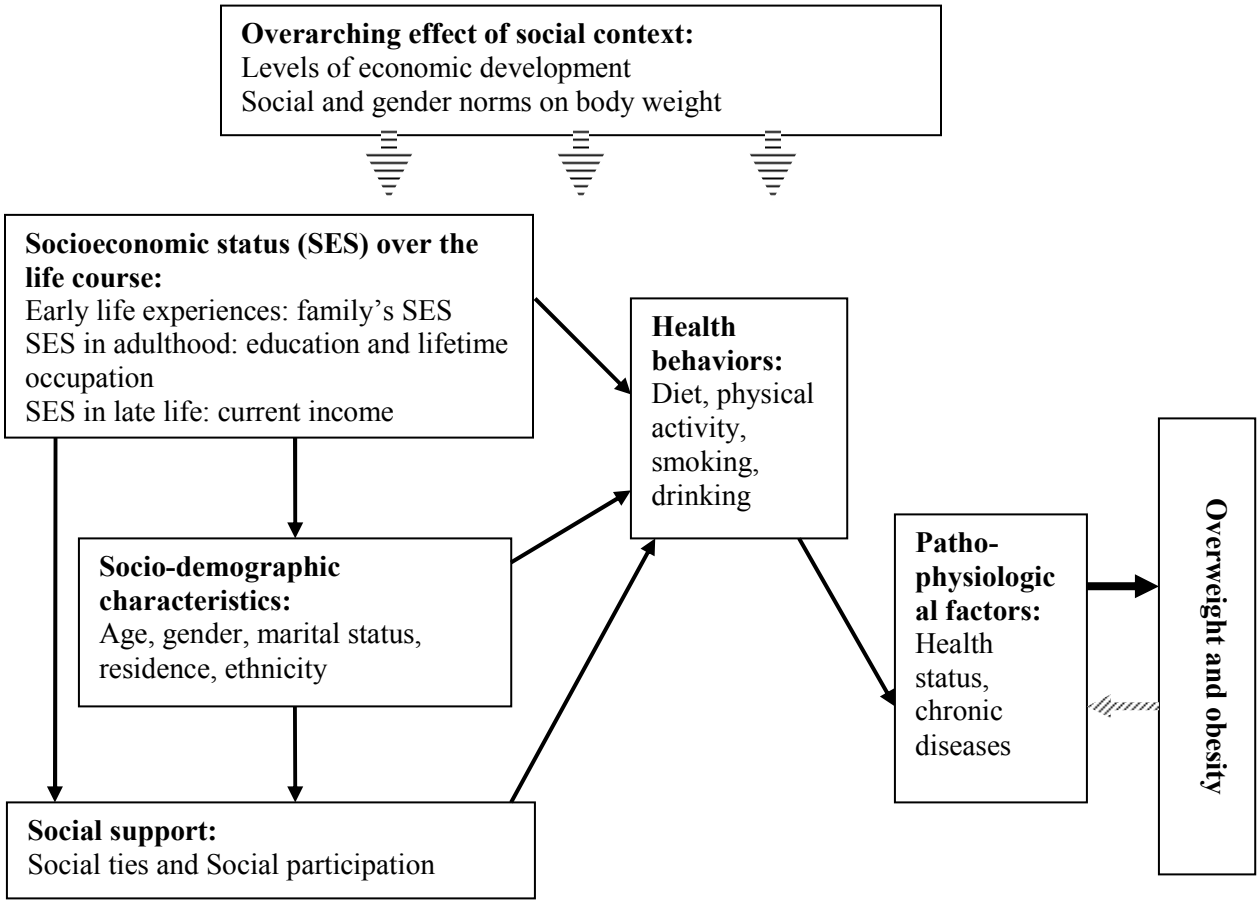
A secondary aim was to examine the cumulative effect of social disadvantage over the life course on the risk of overweight and obesity. The life course effect of social disparities on obesity has been hypothesized and tested among Western populations (Parsons et al. 1999; Lahmann et al. 2000; Power and Parsons 2002; Power et al. 2003; Langenberg et al. 2003; Ball and Mishra 2005). However, similar research is not found for adults in non-Western societies who live through different socioeconomic and cultural contexts than those in Western countries.

Conceptual framework

Level of economic development and social disparities in overweight and obesity

Although the thrust of this study focused on social disparities in overweight and obesity at the individual level, it is essential to frame the question within a broad socioeconomic and cultural contexts to understand how social disparities in health are ingrained in contextual factors. According to the literature, the level of economic development plays an important role in the relationship between SES and obesity. In low-income developing countries with food scarcities, low urbanization and industrialization, people of higher SES are more likely to be obese (Sobal and Stunkard, 1989) as they can obtain adequate food supplies and have less physically demanding jobs (Popkin 1999). As food scarcity and manual labor become less common when socio-economic development has been reached a certain level, the relationship between SES and obesity gets weaker or nonexistent. In developed countries, the relationship between SES and obesity becomes reverse (Sobal and Stunkard 1989; Kaplan et al. 2003; Zablotsky and Mack, 2004; Zhang and Wang, 2004; Regidor et al. 2004; Ball and Crawford, 2005) because people with higher SES tend to have more resources for a healthy lifestyle than people with lower SES (Sobal 1991).

Figure 1. Mechanisms of social disparities in overweight and obesity



Social and gender norms of body weight

Social and gender norms influence the relationship between SES and obesity through symbolic meanings of body weight and body shape. Cultural values favoring fatness have been evoked in some traditional societies, because the plump body shape is a symbol of privilege and wealth that only higher SES groups are able to obtain. By contrast, obesity is rejected and stigmatized in Western societies, where slimness is valued as a cultural ideal with the increasing prevalence of obesity (Sobal 2001). Body weight is considered a major criterion in judging female attractiveness, and obesity is more severely stigmatized among women than men in Western societies (Bordo 1993). Body dissatisfaction and weight concern are stronger among

middle-aged women (McLaren and Kuh, 2004). The Western perception of the ideal thin female body has increasingly been accepted by women in non-Western societies (Xie et al. 2003).

In sum, the above discussion underscored the importance of structural and ideological changes in shaping the patterns of social disparities in obesity across gender. Thus, the present study was based on the theoretical perspective that the individual relationship between SES and obesity is shaped by the historical, socioeconomic, and cultural contexts in which they exist.

Socioeconomic status over the life course and overweight and obesity

Most studies of the link between SES and obesity examine the impact of adult SES and weight. However, this approach falls short in explaining the cumulative effects of social disadvantage on obesity throughout the life span. The life course approach argues that the effects of potential causal factors may be cumulative over time, and the health status at a given age or for a given birth cohort reflects not only current living circumstances, but also prior conditions (Davey Smith and Lynch, 2004). In the case of obesity, a life course perspective hypothesizes that social trajectories starting with poorer SES origins are more likely to be followed by lower SES and unfavorable lifestyle, all of which contribute to obesity in later life (Power and Parsons 2002). This hypothesis has been supported by evidence in developed countries, showing that lower childhood and adulthood SES are both related to obesity in later life (Parsons et al. 1999; Power et al. 2003; Langenberg et al. 2003; Ball and Mishra 2005).

Different measures of SES may influence weight status in different ways. The access hypothesis postulates that lower education and income have negative consequences on weight. Poorly educated people have lower levels of knowledge and behavioral skills needed to control weight. Economic constraints limit choices of diet and leisure time activities (Sobal 1991). The

culture hypothesis argues that people in different educational or occupational groups have different lifestyle and shared beliefs regarding the acceptability of obesity resulting in different levels of body weight (Sobal 1991, 2001). The inverse association between education and obesity in developed countries and among women in developing countries lends support to these hypotheses (Sobal & Stunkard, 1989; Monteiro et al. 2004; Ball & Crawford, 2005). Income is also inversely associated with obesity for women in developed countries, but the effect of occupation is not consistent (Sobal & Stunkard, 1989; Zhang & Wang, 2004).

Mediating role of health behaviors and social support

The above individual framework indicates that lifestyle factors and health behaviors may mediate the relationship between SES and obesity. Studies show that individuals of lower SES participate less in physical activities (Grzywacz & Marks 2001), have higher perceived barriers of healthy eating (Inglis et al. 2005) than their higher status counterparts. Women with higher SES have more concerns about body weight and are more likely to be involved in weight control practices (Jeffery & French, 1996; Wardle & Griffith, 2001). Despite the strong association between SES and health behaviors, SES appears to be an independent predictor of obesity after controlling for physical activity and dietary patterns (Jeffery et al. 1991; Jeffery & French, 1996; Lahmann et al. 2000; Ball et al. 2003; Molarius 2003).

Social support is another modifiable factor that can mediate the relationship between SES and obesity, possibly through its effect on physical activity and healthy dietary (Eyler et al. 1999; Ball and Crawford 2006). Social support from family or friends is found to be positively related to physical activity (Eyler et al. 1999). Further, the facilitating effect of social support on

physical activity is made possible through instrumental or emotional support and information exchange (Isreal and Schurman 1990, cited in Eyler et al. 1999).

Taiwanese context

Taiwan is a newly industrialized society that has undergone rapid demographic and socioeconomic changes after World War II. Fertility and mortality declined rapidly resulting in population aging. The percentage of people aged 65 or older was 8.3 percent in 1999, and is projected to reach 14 percent by 2020 (Chiu 2001). Taiwan has changed from a rural, agricultural society to one that is highly urbanized and industrial. Between 1952 and 2001, the proportion of the labor force in agriculture dropped from 56 to 7.5 percent, while the percentage of urban population increased from 21 to 69 percent (Selya 2004).

Concomitant with industrialization and urbanization, the lifestyle in Taiwan has increasingly shifted towards the Western style that characterizes energy-dense diet and high level of sedentarianism (Lin et al. 2003). For example, Taiwan's average per capita meat intake is the highest in Asia (Smil 2002). The increasing spread of cities and growing population density limits open space for physical activities (Selya 2004), and the recent decade witnessed an increase in the prevalence of overweight and obesity.

Apart from the environmental and lifestyle changes, changes in the social stratification system may put the elderly at risk or protection against being overweight or obese. Education attainment is one of the most important determinants of social stratification in Taiwan. During the period of Japanese colonialism (1895-1945), elementary education was gradually extended to males, but only a highly selective group had access to secondary education (Hermalin et al. 1994). After World War II, the Nationalist government invested heavily in education, leading to

a rapid expansion and a more equitable distribution of education between women and men (Hermalin et al. 1994).

Ethnicity is another important marker of social hierarchy in Taiwan. The majority are Fukienese and Hakka, the native Taiwanese, who are descendants of earlier Chinese immigrants (Fricke et al. 1994). The third major ethnic group is known as Mainlanders, who mostly comprise Nationalist officials, military personnel, and entrepreneurs who withdrew to Taiwan in the late 1940s after the fall of the Nationalist army in the civil war (Tsai & Chiu 1991). Mainlanders had better education and brought a sizable amount of industrial capital, and they filled the high-ranking positions associated with wealth, privileges and political power (Hermalin et al. 1994). Mainlanders and their offspring continue to have higher social positions than the Taiwanese (Tsai 1992). Differences between the Hakka and the Fukienese are modest, although the former have been better-educated than the latter (Tsai 1992).

Taiwan's long-term economic expansion has been achieved with a remarkable degree of income equity (Hermalin et al. 1994). Between the 1950s and 1990s, the per capita income has increased more than tenfold, and the distribution of income has become more equitable. The older population has not equally enjoyed the benefit of economic success as a result of their lower educational attainments (Chan, Ofstedal and Hermalin, 2002). In Taiwan, support from children is a major source of income for many older parents. Despite it, many older people experienced income fluctuations. Old people in disadvantaged groups, particularly older women, are more likely to suffer from economic instability (Chan et al. 2002).

Hypotheses

Older people's life experiences in Taiwan encompass pre-industrial and industrial societies and lifetime exposure to the risk of overweight and obesity is different from old adults'

in Western societies and developing countries. As a result of the different life trajectories between the near elderly and elderly in Taiwan, the relationship between SES and overweight and obesity are expected to be different for these two cohorts.

The traditional Chinese cultural believes of "happy mind and fat body" and "becoming fat and good fortune" persist among the elderly (Li et al. 2004), and obesity is not a strong stigma among older people in Taiwan. However, due to Taiwan's long exposure to western influences, the emphasis on slimness may affect older women's weight perception and weight control practices, particularly the near elderly women. Therefore, we expect a gender difference in the SES and obesity relationship between older men and women.

Hypotheses 1: Cohort and gender differences in SES-obesity relationship

a. Mainlander status and SES in later life are expected to be related to overweight and obesity among men, while other indicators of SES are not.
b. None of the SES measures are expected to be related to overweight and obesity among elderly women.
c. Education is expected to be inversely related to overweight and obesity among nearly elderly women, while other indicators of SES are not.

Hypotheses 2: Mediating role of health behaviors and social support in SES-obesity relationship

a. Physical activity and smoking are expected to mediate the association between SES and overweight and obesity among men, while dieting and drinking are not.
b. Physical exercise and dieting are expected to mediate the association between SES and overweight and obesity for women, while smoking and drinking are not.
c. Social support is likely to mediate the SES-obesity association for women but not for men.

Data and methods

The study used data from the longitudinal Survey of Health and Living Status of the Near Elderly and Elderly in Taiwan. The survey began in 1989 with a national sample (including the institutionalized population) of 4,049 elderly persons aged 60 years and older. In 1993, 3155 were re-interviewed. In 1996, 2,669 survivors of the elderly sample were reinterviewed; the study was also extended to include a national sample of 2,462 near elderly persons aged 50-66 years. The two cohorts were re-interviewed in 1999 with 2,310 elderly aged 70 years and over and 2,130 near elderly aged 53-69 years (Taiwan Bureau of Health Promotion 2006).

Given our interest in the cumulative effect of SES on overweight and obesity in late life, we drew data from 1989, 1996 and 1999 waves for the elderly cohort, and 1996 and 1999 waves for the near elderly cohort. Self-reported weight and height were collected in the 1999 wave of the survey. The analysis was based on samples of 2,014 near elderly and 1,855 elderly people who survived to 1999. Missing data on weight and height were excluded (n = 51 for near elderly and n = 91 for elderly). We also excluded respondents who reported being underweight (body mass index (BMI) <18.5 kg/m^2) from the near elderly (n = 65) and elderly samples (n = 211). Additional analysis indicated that underweight people were more likely to have lower SES than those with normal weight.

Measures of socioeconomic status

Socioeconomic status was assessed by multiple indicators in respondents' lifespan, i.e. childhood, adulthood, and current SES. We used father's occupational prestige index (55-76) as a measure of childhood SES. This index was created based on Tsai and Chiu's (1991) socioeconomic index (SEI), derived from the prestige, education, and income associated with Taiwanese occupations. Adulthood SES was measured using education and mainlander status.

Education was based on years of schooling and classified three categories: no education or illiterate, one to six years of education or literate as primary education, seven or more years of education as secondary education. Mainlander status was coded as a dichotomous variable, Mainlanders/other. Income in 1999 was considered a measure of current SES, and was coded as high, middle, and low approximately corresponding to tertile distribution of the original income variable. Lifetime occupational status was not used because it was highly correlated with mainlander status for elderly men. In addition,, the occupation variable is problematic for women, because more than one third of women has never worked outside the home.

Health behaviors

Since weight status is more related to current physical activity and dietary patterns than previous one, we used questions from the 1999 survey wave. The survey asked respondents frequency, duration, and intensity of physical exercises they participated in each week. Following the guidelines for physical exercise for adults developed by the American College of Sports Medicine (1998), we measured regular physical exercise as three or more time per week for at least 30 minutes each time at a level that causes one to break a sweat dichotomously.

Respondents, who reported reducing the intake of high-calorie, high-fat, and high cholesterol food for health reasons were considered making intentional efforts to change their diet. A dichotomous variable measuring having/not having a restrictive diet at the survey time was created.

Alcohol consumption and smoking were considered because alcohol consumption is usually associated with weight gain and smoking can cause weight loss. Alcohol consumption and smoking were coded for men and women differently because relatively few women drink and smoke. For men, alcohol consumption and smoking were measured by a three-category

variable over the period 1996 to 1999: current user, former user, or never. These two variables were coded as dichotomous measures reflecting ever used or not over the period for women.

Measures of social support

Two variables were constructed to capture the effect of social support on overweight and obesity. The number of social ties with non-relatives was constructed as a count of the number of close friends and neighbors whom the respondent saw, spoke, or contacted by telephone at least once a week in 1999. Social participation was a dichotomous measure of whether the respondent reported current membership or participation in any of the seven activities: neighborhood associations, religious associations, professional or civic groups, social service groups, political associations, village or lineage associations, and elderly clubs.

Covariates

Age, residence, marital status, and health status were controlled in the regression models. Age in 1999 was treated as a linear term based on preliminary analysis. To capture the effect of urbanization, residence was measured by a dichotomous variable reflecting lifetime residence in an urban area or having moved from a rural to an urban area versus always residing in a rural area. Marital status was coded as a dichotomous variable: married (married or single in 1996 and marred in 1999) versus unmarried (unmarried or divorced/separated/widowed between 1996 and 1999). Summary indices on self-reported health status and chronic diseases were created by counting the number of waves with "poor" or "not so good" health status and any chronic diseases over the period 1996 to 1999.

Measures of overweight and obesity

A linear term of BMI was used as the indicator of overweight and obesity. BMI was calculated as weight in kg divided by height in m^2. The use of BMI as a linear variable was based

on earlier findings of a linear association between BMI and health outcome in this elderly population (Sa and Larsen, 2006). The majority of respondents provided self-reported weight and height, while those who didn't provide estimates of weight and height were measured. BMI indicators by type of measurement were created reflecting measured, self-reported, measured and self-reported, or unknown source of BMI. The BMI indicators were used in all models.

Analytical strategies

In line with the primary interest in cohort and gender differences in the relationship between SES and overweight and obesity, we conducted the analysis for near elderly and elderly, and for men and women separately. First, mean and percent distributions of BMI and explanatory variables were presented. The cohort differences were measured using the *T*-test for continuous variables and the Pearson χ^2 test for categorical variables. Next, Pearson's correlations were presented for SES indicators by cohort and gender. Finally, OLS linear regression models were conducted. In multivariate regression analysis, nested models were used to examine the mediating effects of health behaviors and social support on the relationship between SES and BMI. The first set of adjusted models showed the relative importance of the indicators of SES for the prediction of BMI. The full nested models indicated the effect of SES after controlling for all other variables. Missing data on all explanatory variables were retained in the analysis. Missing values were imputed using the median for continuous variables and missing cases were flagged and controlled in all models. The analyses were conducted using SAS version 9.0 (SAS Institute, Inc. 2002)

Results

The descriptive statistics showed some common characteristics for men and women (Tables 1 & 2). A majority of men and women lived in rural areas in most of their lifetime and

had low SES of family origin. Near elderly men and women had significantly higher BMI and were more likely to be overweight and obese than their elderly counterparts. However, the data indicated cohort and gender differences in terms of socio-demographic characteristics and health behaviors (Tables 1 & 2). For example, men were predominantly married at the survey time. A majority of near elderly women were married, while most of elderly women didn't have a spouse. The data also highlighted that elderly men and women were significantly more likely to be mainlanders than near elderly men and women. However, the percentage of mainlanders among men was much higher than among women. In addition, among both men and women, the nearly elderly cohort had significantly better education than the elderly cohort. Yet, men were more advantaged in educational attainment than women. With regard to health behaviors, about one third of men participated in regular exercises. The corresponding figures were 20 percent and 26 percent for elderly and near elderly women. While most men had a history of smoking or alcohol drinking, near elderly men were significantly more likely to be currently drinkers and smokers than elderly men. In contrast, very few women reported having ever smoked, and less than 20 percent of women reported having had alcohol. Moreover, men had relatively high level of social participation and social networks with friends and neighbors. Although near elderly women participated significantly more in social activities and had more social interactions with friends and neighbors, their levels of social participation and social ties were clearly lower than that of men.

Correlations were estimated between indicators of SES by gender and cohort. All indicators of SES were correlated at the $p<0.001$ level of significance for men and women (Tables 3 & 4), except for the association between income in 1999 and mainlander status for near elderly women (Table 4). In general, the associations between SES indicators were not so high as

to suggest that they are completely dependent constructs. We used all of the above SES indicators in the multivariate analysis.

Univariate OLS regression models (Table 5) showed that education, current income, and mainlander status were each significantly positive associated with BMI among elderly men. Surprisingly, regular exercise, dieting, and number of social ties with non-relatives also had a significant positive association with BMI. In model 2 (Table 5), mainlander status remained significant after controlling for demographic characteristics and health status. In the full model, the positive effect of mainlander status persisted after controlling for health behaviors and social support. In contrast, near elderly men who had high current income were significantly more likely to be overweight or obese in the full model (Table 6). High parental SES appeared to be a significant predictor of overweight and obesity in the full model (Table 6).

High income, regular exercise, dieting, and chronic diseases were positively associated with BMI among elderly women in the univariate analysis (Table 7). However, no SES indicator was associated with BMI, while the positive association between dieting and chronic diseases and BMI remained in multivariate models. In contrast, near elderly women who had secondary and above education and who participated actively in social activities were significantly less likely to have higher BMI (Table 8). Similarly, there was a positive association between dieting and chronic diseases and BMI among near elderly women.

It should be noted that r-square values of model fit were less than 0.09 for all models suggesting that the models had limited explanatory power. In addition, SES indicators only contributed modestly to the explanatory power except for the adjusted models for elderly men.

Conclusion and discussion

The findings suggested several patterns in response to the hypotheses.

The overall association between SES and overweight and obesity among the older people in Taiwan was not as strong as similar associations found in other parts of the world. The results suggested a transitional pattern of social disparities in overweight and obesity. Among men, overweight and obesity focused on higher SES groups, reflecting a typical pattern of developing countries. However, overweight and obesity shifted towards the less-educated among women. Thus, our first hypothesis is generally supported. One possible explanation for the modest association between SES and overweight and obesity is that social distribution is relative equal in Taiwan compared to other societies. The shifting patterns in social disparities in overweight and obesity among women suggest that the pattern of social gradients in obesity is conditioned upon social changes and women's weight may be more sensitive to these contextual factors.

However, the second hypothesis on the mediating role of health behaviors and social support is not supported. Health behaviors and social support did not change the magnitude of the association between SES and overweight and obesity among this elderly population. Additional analysis suggested that men and women of higher SES adopted more healthy lifestyles than those in lower SES groups. However, multivariate analysis showed a positive association between regular exercise and BMI among men, and a strong positive association between dieting and BMI among women. Thus, the findings indicated a reverse causality in these associations. It is very likely that overweight and obese people adjust their behaviors because they have more health problem than people of normal weight. The findings have strong policy implications. Public health programs aimed at preventing obesity should raise awareness among all population about the importance of maintaining a healthy weight through regular physical exercises and a healthy diet.

Social support was not significantly related to body weight among men and elderly women. In contrast, there was a negative association between social participation and BMI among near elderly women. However, we cannot determine the casual order because the baseline BMI is not known. Social support can be an important modifiable factor for weight control, and further analyses of social support and weight based on longitudinal data are warranted.

Finally, the life course effect of overweight and obesity found in Western countries was not confirmed among the elderly population in Taiwan. The lack of variations in early childhood SES is an important factor for the observed pattern. The findings in this study suggest that the effect of life course SES on overweight and obesity is context-specific.

The study has some limitations. First, the results may be biased because of selection (i.e. mortality is distributed following specific characteristics). Overweight and obese people may have died of obesity-related chronic diseases at younger ages compared to normal weight people. Second, the analysis was based on self-reported weight data which may bias the results because of reporting biases. For example, self-reported weight data may be biased due to social desirability. Women in general and older women in particular are more likely to under-report their weight (Stunkard and Albaum, 1981; Roberts 1995). Third, baseline BMI was not controlled in the analysis, but it is unlikely that the results would be substantially different after controlling for baseline BMI . Overweight and obesity are rarely developed in late life when most people experience a weight loss. Finally, using cross-sectional BMI data does not allow us to determine the causal order in the observed association between SES and overweight and obesity because overweight and obesity can also affect SES.

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Table 1. Mean and percent distributions of body mass index (BMI) and explanatory variables for near elderly (aged 53-69) and elderly men (aged 70+) in Taiwan (1996-1999)[1]

Variable	Elderly (N=1037)	Near elderly (N=1041)	p-value[2]
	Mean (SD) or % (n)	Mean (SD) or % (n)	
Demographic characteristics			
Age in 1999 (mean)	75.7 (5.00)	61.0 (4.90)	<0.001
Marital status in 1996-99			
Married at both waves or unmarried to married[3]	71.0 (736)	87.9 (915)	<0.001
Married to unmarried or unmarried at both waves	29.0 (301)	12.1 (126)	
Ethnicity			
Mainlander	34.1 (354)	11.7 (122)	<0.001
Other	65.4 (678)	88.3 (919)	
Lifetime residence			
Urban or move from rural to urban	44.6 (462)	43.2 (450)	0.54
Rural	55.3 (573)	56.8 (591)	
SES indicators			
Parental socioeconomic index (55-76) (mean)	58.3 (5.06)	58.3 (5.30)	0.96
Education			
No education	19.0 (197)	9.1 (95)	<0.001
Primary	50.1 (519)	55.2 (575)	0.02
Secondary or above	31.0 (321)	35.6 (371)	0.02
Income in 1999[4]			
Lowest tertile	24.6 (255)	30.6 (319)	
Middle tertile	39.6 (411)	40.3 (419)	
Highest tertile	35.8 (371)	29.1 (303)	
Health behaviors in 1999			
Regular exercise[5]			
No	64.7 (671)	67.6 (704)	0.16
Yes	35.3 (366)	32.4 (337)	
Dieting for health reasons			
No	87.4 (906)	87.6 (912)	0.87
Yes	12.6 (131)	12.4 (129)	
Smoking			
Current	33.9 (351)	49.1 (511)	<0.001
Previous	39.0 (404)	21.9 (228)	<0.001
Never	27.2 (282)	29.0 (302)	0.36
Drinking			
Current	32.2 (334)	49.0 (510)	<0.001
Previous	34.6 (359)	19.3 (201)	<0.001
Never	33.2 (344)	31.7 (330)	0.47
Social support in 1999			
Participation in social activities[6]			
No	43.5 (451)	43.8 (456)	0.89
Yes	56.5 (586)	56.2 (585)	
Number of social ties with nonrelatives (mean)[7]	6.0 (9.55)	7.3 (10.7)	0.003

Table 1. ***Cont'd***

Variable	Elderly (N=1037)	Near elderly (N=1041)	p-value
	Mean (SD) or % (n)	Mean (SD) or % (n)	
Self-reported health status 1996-1999			
Number of waves with "poor" or "not so good" health (mean)	0.5 (0.71)	0.4 (0.64)	<0.001
Number of weves with chronic diseases (mean)[8]	1.1 (0.84)	0.8 (0.83)	<0.001
Body mass index in 1999			
BMI (kg/m^2) (mean)	23.2 (2.75)	23.9 (2.88)	<0.001
Overweight status			
Normal ($18.5 \leq$ BMI <25)	75.5 (783)	67.9 (707)	<0.001
Overweight (BMI $\geq$ 25)	24.5 (254)	32.1 (334)	
BMI by type of measurement			
Measured	5.7 (59)	4.7 (49)	0.31
Self-reported	70.4 (730)	77.5 (807)	<0.001
Measured and self-reported	19.1 (198)	13.0 (135)	<0.001
Don't know	4.8 (50)	4.8 (50)	0.98

[1] All missing cases were kept and flaged. Missing values for continuous variables were imputed using medians.

[2] Differences between near elderly and elderly were estimated using the T test for continous variables and Pearson χ^2 test for categorical variables.

[3] There are a small number of respondents who reported being unmarried in 1996 and married in 1999.

[4] Cohort-specific income categories. No cross-cohort comparison was made.

[5] Defined as three or more time per week for at least 30 minutes each time at a level that causes one to break a sweat.

[6] Defined as respondents' reported membership or participation in any of the seven activities: neighborhood associations, religious associations, professional or civic groups, social service groups, political associations, village or lineage associations.

[7] Measured as the number of close friends and neighbors whom the respondent sees, speaks, or contact by telephone at least once a week.

[8] Including high blood pressure, diabetes, heart disease, and arthritis.

Table 2. Mean and percent distributions of body mass index (BMI) and explanatory variables for near elderly (aged 53-69) and elderly women (aged 70+) in Taiwan (1996-1999)[1]

Variable	Elderly (N=818)	Near elderly (N=973)	p-value[2]
	Mean (SD) or % (n)	Mean (SD) or % (n)	
Demographic characteristics			
Age in 1999 (mean)	76.3 (5.14)	60.7 (4.71)	<0.001
Marital status in 1996-99			
Married at both waves or unmarried to married[3]	38.4 (314)	75.5 (735)	<0.001
Married to unmarried or unmarried at both waves	61.6 (504)	24.5 (238)	
Ethnicity			
Mainlander	10.2 (83)	2.8 (27)	<0.001
Other	89.4 (731)	97.2 (946)	
Lifetime residence			
Urban or move from rural to urban	40.2 (329)	42.2 (411)	0.39
Rural	59.7 (488)	57.6 (560)	
SES indicators			
Parental socioeconomic index (55-76) (mean)	58.0 (4.64)	58.2 (5.09)	0.40
Education			
No education	61.3 (501)	41.5 (404)	<0.001
Primary	30.9 (253)	45.3 (441)	<0.001
Secondary or above	7.8 (64)	13.2 (128)	<0.001
Income in 1999[4]			
Lowest tertile	22.4 (183)	32.7 (318)	
Middle tertile	47.6 (389)	25.7 (250)	
Highest tertile	30.1 (246)	41.6 (405)	
Health behaviors in 1999			
Regular exercise[5]			
No	79.5 (650)	74.0 (720)	0.007
Yes	20.5 (168)	26.0 (253)	
Dieting for health reasons			
No	85.5 (699)	83.6 (813)	0.27
Yes	14.6 (119)	16.4 (160)	
Smoking			
Ever	7.5 (61)	4.7 (46)	0.02
Never	92.5 (757)	95.3 (927)	
Drinking			
Ever	15.8 (129)	16.0 (156)	0.88
Never	84.2 (689)	84.0 (817)	
Social support in 1999			
Participation in social activities[6]			
No	62.2 (509)	55.9 (544)	0.007
Yes	37.8 (309)	44.1 (429)	
Number of social ties with nonrelatives (mean)[7]	4.9 (7.00)	6.1 (8.80)	0.003

Table 2. ***Cont'd***

Variable	Elderly (N=818)	Near elderly (N=973)	p-value
	Mean (SD) or % (n)	Mean (SD) or % (n)	
Self-reported health status 1996-1999			
Number of waves with "poor" or "not so good" health (mean)	0.9 (0.78)	0.5 (0.71)	<0.001
Number of weves with chronic diseases (mean)[8]	1.4 (0.74)	1.1 (0.83)	<0.001
Body mass index in 1999			
BMI (kg/m^2) (mean)	23.8 (3.38)	24.4 (3.33)	<0.001
Overweight status			
Normal ($18.5 \leq$ BMI <25)	70.3 (575)	63.4 (617)	0.002
Overweight (BMI ≥ 25)	29.7 (243)	36.6 (356)	
BMI by type of measurement			
Measured	11.7 (96)	8.2 (80)	0.01
Self-reported	55.3 (452)	62.0 (603)	0.004
Measured and self-reported	28.4 (232)	25.7 (250)	0.20
Don't know	4.7 (38)	4.1 (40)	0.58

[1] All missing cases were kept and flaged. Missing values for continuous variables were imputed using medians.

[2] Differences between near elderly and elderly were estimated using the T test for continous variables and Pearson χ^2 test for categorical variables.

[3] There are a small number of respondents who reported being unmarried in 1996 and married in 1999.

[4] Cohort-specific income categories. No cross-cohort comparison was made.

[5] Defined as three or more time per week for at least 30 minutes each time at a level that causes one to break a sweat.

[6] Defined as respondents' reported membership or participation in any of the seven activities: neighborhood associations, religious associations, professional or civic groups, social service groups, political associations, village or lineage associations.

[7] Measured as the number of close friends and neighbors whom the respondent sees, speaks, or contact by telephone at least once a week.

[8] Including high blood pressure, diabetes, heart disease, and arthritis.

Table 3. Pearson's correlations between socioeconomic indicators for near elderly and elderly men[1]

	Parental SEI	Mainlander	Education	Income
Parental SEI				
Near elderly	1.00			
Elderly	1.00			
Mainlander				
Near elderly	0.20	1.00		
Elderly	0.20	1.00		
Education				
Near elderly	0.32	0.21	1.00	
Elderly	0.33	0.34	1.00	
Income in 1999				
Near elderly	0.13	0.12	0.33	1.00
Elderly	0.24	0.40	0.45	1.00

[1] All coefficients are significant at $p<0.001$.

Table 4. Pearson's correlations between socioeconomic indicators for near elderly and elderly women[1]

	Parental SEI	Mainlander	Education	Income
Parental SEI				
Near elderly	1.00			
Elderly	1.00			
Mainlander				
Near elderly	0.21	1.00		
Elderly	0.27	1.00		
Education				
Near elderly	0.38	0.19	1.00	
Elderly	0.44	0.29	1.00	
Income in 1999				
Near elderly	0.16	0.09	0.30	1.00
Elderly	0.15	0.18	0.29	1.00

[1] All coefficients are significant at $p<0.001$ except for the association between income in 1999 and Mainlander for near elderly women ($p<0.01$).

Table 5. Unadjusted and adjusted OLS regression models using demographic characteristics, socio-economic indicators, health behaviors and social support to predict body mass index (BMI) for elderly men (aged 70+) in Taiwan, 1969-99 (N=1037)

	Unadjusted	Adjusted models		
		Model 1	Model 2	Model 3
	b	*b*	*b*	*b*
SES indicators				
Parental socioeconomic index	0.02	-0.001	-0.001	-0.0002
Education (ref = no education)				
Primary	0.28	0.11	-0.07	-0.13
Secondary or above	**0.62***	0.05	-0.23	-0.36
Income in 1999 (ref = lowest tertile)				
Middle tertile	0.42	0.21	-0.01	-0.05
Highest tertile	**0.89*****	**0.52***	0.25	0.19
Health behaviors in 1999				
Regular exercise				
Yes (ref = no)	**0.69*****			**0.41***
Dieting for health reasons				
Yes (ref = no)	0.68**			0.25
Smoking (ref = never)				
Current	-0.39			-0.29
Previous	0.30			0.29
Drinking (ref = never)				
Current	0.22			0.09
Previous	0.14			0.10
Social support in 1999				
Participation in social activities				
Yes (ref = no)	0.28			0.1
Number of social ties with nonrelatives	0.02*			0.02
Demographic characteristics				
Age in 1999 (years)	-0.08***		-0.06**	-0.06**
Marital status in 1996-99 (ref = unmarried)				
Married at both waves or unmarried to married	0.48*		0.24	0.21
Ethnicity				
Mainlander (ref = other)	**0.95*****	**0.80*****	**0.70*****	**0.70*****
Lifetime residence				
Urban or move from rural to urban (ref = rural)	0.38*		0.03	0.04
Self-reported health status 1996-99				
Number of waves with "poor" or "not so good" health	-0.22		**-0.39****	**-0.31***
Number of weves with chronic diseases	**0.57*****		**0.62*****	**0.57*****
BMI by type of measurement (ref = self-reported)				
Measured		0.19	0.31	0.40
Measured and self-reported		-0.17	-0.10	-0.08
Don't know		-0.54	-0.39	-0.29
Adjusted R^2		0.03	0.07	0.08
R^2		0.04	0.09	0.11

Table 6. Unadjusted and adjusted OLS regression models using demographic characteristics, socio-economic indicators, health behaviors and social support to predict body mass index (BMI) for near elderly men (aged 53-69) in Taiwan, 1969-99 (N=1041)

	Unadjusted	Adjusted models		
		Model 1	Model 2	Model 3
	b	*b*	*b*	*b*
SES indicators				
Parental socioeconomic index	-0.02	-0.03	-0.03	**-0.04***
Education (ref = no education)				
Primary	0.55	0.49	0.31	0.29
Secondary or above	0.53	0.28	0.06	-0.03
Income in 1999 (ref = lowest tertile)				
Middle tertile	0.17	0.17	0.08	0.10
Highest tertile	**0.72****	**0.81****	**0.64***	**0.64***
Health behaviors in 1999				
Regular exercise				
Yes (ref = no)	**0.49***			**0.44***
Dieting for health reasons				
Yes (ref = no)	0.88**			0.50
Smoking (ref = never)				
Current	-0.09			0.0003
Previous	0.22			0.32
Drinking (ref = never)				
Current	0.16			0.13
Previous	0.03			-0.15
Social support in 1999				
Participation in social activities				
Yes (ref = no)	0.14			0.13
Number of social ties with nonrelatives	0.004			0.006
Demographic characteristics				
Age in 1999 (years)	-0.04*		-0.05*	-0.06**
Marital status in 1996-99 (ref = unmarried)				
Married at both waves or unmarried to married	-0.13		-0.41	-0.43
Ethnicity				
Mainlander (ref = other)	0.24	0.32	0.41	0.43
Lifetime residence				
Urban or move from rural to urban (ref = rural)	0.31		0.25	0.29
Self-reported health status 1996-99				
Number of waves with "poor" or "not so good" health	0.005		-0.15	-0.07
Number of weves with chronic diseases	**0.49*****		**0.57*****	**0.49*****
BMI by type of measurement (ref = self-reported)				
Measured		0.25	0.27	0.21
Measured and self-reported		-0.21	-0.23	-0.25
Don't know		-0.21	-0.23	-0.23
Adjusted R^2		0.01	0.04	0.04
R^2		0.02	0.05	0.07

Table 7. Unadjusted and adjusted OLS regression models using demographic characteristics, socio-economic indicators, health behaviors and social support to predict body mass index (BMI) for elderly women (aged 70+) in Taiwan, 1969-99 (N=818)

	Unadjusted	Adjusted models		
		Model 1	Model 2	Model 3
	b	*b*	*b*	*b*
SES indicators				
Parental socioeconomic index	0.03	0.02	0.01	0.01
Education (ref = no education)				
Primary	0.26	0.15	0.02	0.06
Secondary or above	0.60	0.21	0.08	0.21
Income in 1999 (ref = lowest tertile)				
Middle tertile	0.38	0.37	0.16	0.20
Highest tertile	**0.70***	0.61	0.38	0.33
Health behaviors in 1999				
Regular exercise				
Yes (ref = no)	0.62*			0.41
Dieting for health reasons				
No (ref)	**1.10****			**0.82***
Smoking				
Ever (ref = never)	-0.77			-0.50
Drinking				
Ever (ref = never)	0.17			0.25
Social support in 1999				
Participation in social activities				
Yes (ref = no)	-0.19			-0.39
Number of social ties with nonrelatives	-0.004			-0.01
Demographic characteristics				
Age in 1999 (years)	-0.05*		-0.04	-0.03
Marital status in 1996-99 (ref = unmarried)				
Married at both waves or unmarried to married	0.31		0.05	0.05
Ethnicity				
Mainlander (ref = other)	0.35	0.10	0.04	0.03
Lifetime residence				
Urban or move from rural to urban (ref = rural)	0.35		0.14	0.03
Self-reported health status 1996-99				
Number of waves with "poor" or "not so good" health	-0.10		-0.22	-0.22
Number of weves with chronic diseases	**0.78*****		**0.82*****	**0.67*****
BMI by type of measurement (ref = self-reported)				
Measured		0.17	0.29	0.27
Measured and self-reported		0.41	0.44	0.41
Don't know		0.03	0.22	0.18
Adjusted R^2		-0.004	0.02	0.03
R^2		0.01	0.05	0.06

Table 8. Unadjusted and adjusted OLS regression models using demographic characteristics, socioeconomic indicators, health behaviors and social support to predict body mass index (BMI) for near elderly women (aged 53-69) in Taiwan, 1969-99 (N=973)

	Unadjusted	Adjusted models		
		Model 1	Model 2	Model 3
	b	*b*	*b*	*b*
SES indicators				
Parental socioeconomic index	-0.03	-0.01	-0.01	-0.01
Education (ref = no education)				
Primary	0.27	0.26	0.20	0.16
Secondary or above	**-0.87***	**-0.86***	**-0.94***	**-0.90***
Income in 1999 (ref = lowest tertile)				
Middle tertile	0.03	0.03	-0.02	0.01
Highest tertile	0.17	0.34	0.23	0.26
Health behaviors in 1999				
Regular exercise				
Yes (ref = no)	-0.21			-0.06
Dieting for health reasons				
Yes (ref = no)	**1.19*****			**0.93****
Smoking				
Ever (ref = never)	-0.73			-0.81
Drinking				
Ever (ref = never)	0.30			0.37
Social support in 1999				
Participation in social activities				
Yes (ref = no)	**-0.67****			**-0.67****
Number of social ties with nonrelatives	0.01			0.005
Demographic characteristics				
Age in 1999 (years)	-0.01		-0.02	-0.01
Marital status in 1996-99 (ref = unmarried)				
Married at both waves or unmarried to married	0.35		0.30	0.25
Ethnicity				
Mainlander (ref = other)	-0.88	-0.36	-0.18	0.06
Lifetime residence				
Urban or move from rural to urban (ref = rural)	0.13		0.34	0.25
Self-reported health status 1996-99				
Number of waves with "poor" or "not so good" health	0.15		0.02	-0.09
Number of weves with chronic diseases	**0.60*****		**0.63*****	**0.51*****
BMI by type of measurement (ref = self-reported)				
Measured		0.81*	0.75	0.73
Measured and self-reported		0.27	0.28	0.28
Don't know		-0.64	-0.46	-0.59
Adjusted R^2		0.01	0.04	0.05
R^2		0.02	0.05	0.08