ABSTRACT

Title of Document: SOCIAL DETERMINANTS OF OVERWEIGHT AND OBESITY AMONG ELDERLY MEN AND WOMEN IN TAIWAN

Zhihong Sa, Ph.D., 2009

Directed By: Professor Joan R. Kahn
Department of Sociology

Although an obesity epidemic has spread to people of all age groups, empirical knowledge about elderly obesity remains largely scant, particularly in non-Western societies. This dissertation addresses that gap by examining the social determinants of overweight and obesity and weight gain among men and women, using 1999 and 2003 waves of the longitudinal Survey of Health and Living Status of the Near Elderly and Elderly in Taiwan. Existing literature shows that the effect of socioeconomic status (SES) on body weight shifts from positive to negative as the level of development of a society progresses from low to high, and social gradients in obesity appear first among women. A gender-specific pattern of social disparities in overweight and obesity is expected to have emerged in Taiwan.

The analysis captures a gendered pattern in the transition of the SES-obesity relationship in Taiwan. Similar to less-developed countries, men and women with more material resources (i.e. income and wealth) have an elevated risk of overweight and

obesity, indicating the importance of material resources in getting access to food through most of the lifetime of this elderly population. However, household wealth is inversely associated with short-term weight gain among women, suggesting that wealth may become a protective factor against overweight and obesity.

The education effect has shifted to the pattern of Western societies, particularly among women. While education has strong negative impacts on cumulative body weight among women, it is inversely associated with short-term weight gain for both men and women. The protective effect of education emerges earlier among women than among men, probably as a result of educated women adopting the Western ideal of thinness. Also, the negative effect of childhood SES on body weight among women is transmitted through education. Hence, social disparities in overweight and obesity among older women is mainly produced by differential weight gains in adulthood for individuals of different SES.

Finally, the relationship between social participation and excess body weight is explored. Men and women with active social participation have a reduced risk for greater weight gain, suggesting that social participation may have some buffering effects on unhealthy weight outcomes of the disadvantaged groups, especially among women.

SOCIAL DETERMINANTS OF OVERWEIGHT AND OBESITY AMONG ELDERLY MEN AND WOMEN IN TAIWAN

By

Zhihong Sa

Dissertation submitted to the Faculty of the Graduate School of the University of Maryland, College Park, in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
2009

Advisory Committee:
Professor Joan R. Kahn, Chair
Professor Sonalde Desai
Professor Sandra L. Hofferth
Professor Ulla M. Larsen
Professor Leonard I. Pearlin

Acknowledgements

Many people helped me complete this dissertation and reach this point in my education. I would like to express my deep gratitude to Dr. Joan Kahn, my academic adviser, for providing invaluable guidance and support over the past two years. Her professional expertise, time, patience, and encouragement were indispensable for the completion of the dissertation. I am very grateful to other members of the dissertation committee as well. Dr. Leonard Pearlin's passion and insights for the study of aging have been a constant inspiration for me to pursue this dissertation project and the research area of aging and health. The thoughtful comments and suggestions provided by Dr. Sonalde Desai and Dr. Sandy Hofferth have greatly improved this dissertation. I also want to thank Dr. Rebeca Wong, a former committee member who has moved to Texas, for her insightful advice on my dissertation study.

A very special thanks goes to Dr. Ulla Larsen, a mentor, committee member, as well as a friend for her unwavering support over the past four years. I have benefitted tremendously from working closely with her. Her hard working spirit, intellectual curiosity, dedication to the students, and integrity as a person make her the role model that I would like to follow in my professional career. Ulla was there for me even when she was seriously ill. Without her selfless support, I could not have made it through. For that I will always be grateful.

I am truly thankful to colleagues and friends for their support throughout the duration of my graduate studies. I am particularly grateful to my fellow graduate students and colleagues - Ching-yi Shieh, Kiersten Johnson, Lijuan Wu, Veena Kulkarni, Sangeeta Parashar and Yeats Ye - for their professional support, friendship, and their sense of humor. Thank you, also, to Grace Ji, Ivy Chaine, Cecilia Tsang for emotional and spiritual support.

Appreciation also goes to the elderly in Taiwan who took the time and energy to answer the survey questions. Without their responses, the study of an important yet largely hidden issue would not be possible.

Finally, I would like to thank my parents, Sa Benwang and Yan Xiufen, for their love and support, and faith in me, and for allowing me the freedom to choose my own path, all of which have made this endeavor possible.

Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1: Introduction

Overweight and obesity have become global health problems. The prevalence of overweight and obesity has increased among all age groups, including the elderly. Excess body weight for the elderly is associated with mortality, functional impairments and a series of chronic diseases (Launer, Harris, Rumpel et al. 1994; Zamboni, Mazzali, Zoico et al. 2005; Adams, Schatzkin, Harris et al. 2006). A growing body of literature shows that abdominal obesity is more closely related to health risks among the elderly than overall obesity, probably as a result of changes in body shape and body fat distribution associated with aging (Seidell and Visscher 2000; Chen, Bermudez and Tucker 2002; Zamboni et al. 2005; Sa and Larsen 2006).

Existing literature shows that the association between socioeconomic status (SES) and overweight or obesity shifts from positive to negative as a society moves from low levels of development to high levels of development, and the pattern of social disparities in excess body weight is more consistent among women than among men (Sobal and Stunkard 1989; Monteiro, Moura, Conde et al. 2004; McLaren 2007). While both body weight and SES develop over the life course, most of these studies focus on the link between adult SES and excess body weight. In Western countries, both childhood and adulthood SES have independent effects on excess body weight in mid- or late life (Lahmann, Lissner, Gullberg et al. 2000; Lawlor, Ebrahim and Davey Smith 2002; Langenberg, Hardy, Kuh et al. 2003; Power, Graham, Due et al. 2005). However, little is known about the relationship between life-course SES and excess body weight in non-Western societies. Moreover, despite the growing interest in the role of social relationships on health, nobody has examined the linkage between social participation and excess body weight in late life. If increases in overweight and obesity are accelerated among people with low SES or low levels of social participation, it is likely to compound the already widening health disparities for obesity-related diseases. An investigation of social determinants of excess body weight in later life is an important endeavor. To my knowledge, this is the first study of such issues in Asian societies.

In the context of a newly industrialized Taiwanese society, the dissertation aims to understand the effects of life-course SES and social participation on cumulative weight status and short-term weight gain in elderly men and women. I hypothesize that there is an emerging pattern of social disparities in excess body weight among the elderly in Taiwan and the pattern is gender-specific. Specifically, I address the following questions:

1. What is the impact of life-course SES on the risk of overall and central obesity and weight gain among the elderly? What are possible pathways by which exposure to SES dis/advantages at different life stages contribute to social gradients in weight status and weight gain in later life? Are there gender differences in these relationships?
2. Is there any association between social participation and overall and central obesity? How does social participation influence the risk of weight gain? Are there gender differences in these relationships?

3. What is the relationship between life-course SES, social participation and health behaviors? To what extent do health behaviors explain social differentials in overall and central obesity and weight gain? Are there gender differences in these relationships?

The present study contributes to the existing body of literature on social inequalities in health in general and informs social policies and public health interventions aimed at reducing the prevalence of overweight and obesity and social inequalities in health in Taiwan in particular.

First, Taiwan and other transitional countries alike have experienced an epidemic in obesity, but there is a dearth of studies on excess body weight, particularly among the elderly. Taiwan has undergone one of the most dramatic socioeconomic transformations in the world over the past 40 years. Concomitantly, the Taiwanese society has experienced a rapid nutrition transition and shifted to higher-fat diets and sedentary lifestyles, which contribute to the increasing problem of overweight and obesity. Based on the definition of the World Health Organization (WHO), the prevalence of overweight and obesity (BMI $\geq$ 25 kg/m^2) was about 25 percent for both men and women during 1993-96, and the prevalence increased to more than 33 percent among men by 2000-2001. Despite their relatively healthier lifestyles and tendencies to lose weight, elderly men and women (aged $\geq$ 65 years) have similar or much higher risks of overweight and obesity compared to younger adults (Chu 2005). Further, central obesity is a severe health problem among the elderly, particularly for women (Yeh, Chang, Yeh et al. 2005). More than 60 percent of elderly women and 33 percent of elderly men were abdominally obese by Asian standard (waist circumference ≥ 80 cm for women and ≥ 90 cm for men). Central obesity has more serious health consequences among Taiwanese older adults than overall obesity (Huang, Lee, Lee et al. 2005; Sa and Larsen 2006). Overweight and obesity has induced heavy burdens for the health system of Taiwan. Thus, the present study has important implications for the prevention of overweight and obesity and for the development of obesity-related health policies.

Second, Link and Phelan (1995) argued that since social gradients in health are produced by differential exposure to social and economic disadvantages, social factors such as SES and social connections are the "fundamental causes of disease". The theory of fundamental causes of disease predicts that social inequalities in health are likely to emerge under health transitions. Resources are transportable from one situation to another, as health-related situations change, and those who command the most resources are in a better position to take advantage of new knowledge about health risks and protective factors, resulting in the reproduction of social gradients in health (Phelan, Link, Diez-Roux 2004). Existing studies demonstrate that the relationship between SES and body weight shifts from positive to negative as a nation's level of development progresses from low to high and stages of health transition change, resulting in the reproduction of social gradients in body weight. As a result of rapid socioeconomic and health transitions in Taiwan, social disparities in excess body weight may be produced within a short period of time. Therefore, an investigation of the impact of social changes on social disparities in weight status and weight gain among the elderly in Taiwan provides a good test case of the theory of fundamental causes of disease.

Third, although some of the shaping conditions for an individual's life chances are embedded in family of origin, the theory of fundamental causes of disease focuses on social conditions in adulthood. The life course perspective predicts that the health inequalities prevailing in mid- and later-life stem from the early life course origins and reflect cumulative social disadvantages over the life span (O'Rand 1996; Alwin and Wray 2005). This hypothesis has been supported by studies in Western countries which show that social disparities in excess body weight are produced by differential weight gains early in life and maintained into adulthood. But this may not be the case for the elderly in Taiwan who lived through different socioeconomic and health conditions. An examination of life course stages and the temporal pathways through which they contribute to social disparities in excess body weight in a non-Western society can fill a gap in the literature. The identification of specific life stages associated with a higher risk of obesity is also helpful for the development of effective policies and programs for obesity prevention.

Lastly, social participation, as one type of social relationships, is potentially important for maintaining a healthy weight among the elderly. However, empirical data are almost non-existent. Extant literature on the links between social relationships and body weight mainly focuses on the effect of social networks, especially ties between family members and friends, on body weight. These studies indicate that ties between family members and friends yield both protective and harmful effects on excess body weight or weight-related health behaviors (Seeman and Anderson 1983; Sobal 1984; Sallis, Hovell and Hofstetter 1992; Eyler, Brownson, Donatelle et al. 1999; Christakis and Fowler 2007). However, a recent study demonstrate that state-level social capital, a measure tapping into informal and formal social participation elements of social relationships, has protective effects for obesity and sedentarism (Kim, Subramanian and Gortmaker 2006). This suggests that social participation, as a reflection of community environment, may have stronger effects on body weight than ties between family members and friends. Social participation promotes physical activities among elderly women in Taiwan, particularly for the lower SES groups. Thus, community social support may have some buffering effects on unhealthy body weight among disadvantaged groups of which elderly Taiwanese women comprise a disproportionately large part. An assessment of the links between social participation and excess body weight among the elderly has both theoretical and policy implications for social inequalities in health.

The 1999 and 2003 waves of the longitudinal Survey of Health and Living Status of the Near Elderly and Elderly (53 years or older in 1999) in Taiwan provide a unique opportunity to examine the emerging patterns of social disparities in excess body weight under conditions of rapid social transitions. In line with this central thrust, the analyses include two major components, focusing on cumulative weight status and short-term weight gain respectively. This study starts with a cross-sectional analysis of the social determinants of overweight and obesity among the elderly aged 57 years or older based on data from the 2003 follow-up survey of the 1999-2003 panel data.

Recognizing the more severe health consequences of central obesity among the elderly than overall obesity, I include both body mass index (BMI) and waist circumference as outcome variables for this part of the analyses. Another advantage of including waist circumference is that waist circumference data are measured whereas BMI data are self-reported. Based on the 1999-2003 panel data, the second set of analyses examines social predictors of weight gain over the four year period among the elderly aged 53 years or older in 1999. In both of these analyses, we aim to identify temporal pathways by which exposure to SES disadvantages at different stages of the life course contributes to disparities in excess body weight in late life. While the influence of genetic predispositions cannot be counted in the cross-sectional analysis of weight status, it is controlled in the perspective study of weight gain. Further, as a driving force behind cumulative body weight, the analysis of weight gain can shed light on social processes leading to disparities in overweight and obesity. Given the stark gender differences in SES-obesity links found in past research, gender is considered a moderating factor in the relationship between social factors and body weight. All analyses are conducted separately for men and women.

The remainder of the dissertation is organized as follows. Chapter 2 provides background information for this study. I first discuss how socioeconomic changes over the past forty years in Taiwan have led to nutritional and health transitions. Then I talk about systems of social and gender stratifications and changes in social organizations and cultural norms about body image that may have differential influences on elderly

Taiwanese men's and women's exposure to the risk for or protection against overweight and obesity.

Chapter 3 discusses the theoretical background of the study and develops a series of research hypotheses. I begin with the theory of fundamental causes of disease, the life course perspective in social inequalities in health, and cultural perspectives on body image. Then, I review literature about the influence of SES over the life course and social participation on excess body weight. On that basis, a number of research hypotheses are formulated.

Chapter 4 describes the data, analytic samples, dependent variables and covariates as well as statistical methods used in the empirical analysis.

Chapter 5 presents results on social determinants of overweight and obesity among men and women. First, I describe the prevalence of overall and central obesity among the elderly and sample characteristics. Then, bivariate associations between social factors and overall and central obesity, and between social factors and health behaviors/status are assessed. Lastly, the net effects of SES and social participation on overall and central obesity are examined in a multivariate analysis.

Chapter 6 discusses results about social predictors of weight gain for men and women. First, the distribution of weight change between 1999 and 2003 is presented. Next, bivariate associations between social factors and weight gain and between social factors and patterns of physical activity are examined. Finally, I assess the effects of SES and social participation on the risk of weight gain and the onset of overweight/obesity using baseline data as well as change data between baseline and follow-up surveys.

Chapter 7 summarizes the findings and draws conclusions about social disparities in overweight and obesity among the elderly in Taiwan. The implications of the findings about social inequalities in health and policies for the prevention of overweight and obesity are discussed.

Chapter 2: Taiwanese Context

In this chapter, I first describe the socioeconomic changes that Taiwan has gone through in the second half of the 20th century. Then I discuss how these contextual influences lead to nutrition and epidemiological transitions. Finally, I talk about how changes in systems of social stratification, social organization and cultural values about body image render older adults differential exposure to risk or protection against overweight and obesity.

2.1 Rapid socio-demographic changes and economic growth

Taiwan is a newly industrialized society that has undergone one of the most rapid demographic and socioeconomic transitions after World War II. Between 1949 and 2008, total fertility dropped by nearly five births per woman, whereas life expectancy increased by about 28 years (Population Reference Bureau 2009). As a result, the percentage of people who are aged 65 or older has quadrupled from 2.5 to 10 percent between 1952 and 2008, and is projected to rise to 14 percent by 2020 (Li 1994; Population Reference Bureau 2009). Taiwan has been transformed from a poor, agricultural society to one that is affluent and highly industrialized. The average annual growth rate of the economy was 9.8 percent between the 1960s and mid-1970s, 7.8 percent between mid-1970s and 1999, and around 3.6 percent thereafter. The GNP per capita grew more than tenfold from US$152 in 1961 to US$15,271 in 2005 (Lee 2008). The significant rise in income raised the standard of living and enhanced the purchasing power of people.

Economic expansion has come side by side with rapid urbanization and structural changes. Between 1952 and 2001, the percentage of the labor force engaged in agriculture decreased from 56 to 8 percent, while the percentage of the labor force in industrial and service sectors increased from 29 percent and 27 percent to 36 percent and 57 percent, respectively. The percentage of population living in cities increased from 21 to 69 percent (Selya 2004). Since the 1980s, the Taiwanese government has shifted its investment from heavy industries toward more high-tech industries (Hermalin, Liu and Freedman 1994). By the late 1990s, Taiwan had successfully transformed from a labor-intensive economy to a knowledge-based one (Selya 2004). The post-WWII period also witnessed dramatic social changes including educational expansion, increases in women's labor force participation and expansion of mass media (Hermalin et al. 1994).

2.2 Nutrition and Epidemiological Transition

Elsewhere in the world, socioeconomic transitions have adversely affected lifestyles, particularly dietary and physical activity patterns, contributing to the increasing problems of overweight and obesity and other nutrition-related non-communicable diseases. Developing countries have been experiencing a more rapid shift in stages of the nutrition transition than what has occurred in Western countries (Popkin, Paeratakul, Zhai et al. 1995; Paeratakul, Popkin, Ge et al. 1998; Popkin 1999; Bell, Ge and Popkin 2001, 2002). Taiwan is no exception. With the dramatic economic growth and structural changes since the 1970s, the Taiwanese have increasingly converged to the Western lifestyle that is characterized by high-fat diet and high levels of sedentarianism (Huang and Bouis 2001; Selya 2004).

One early fruit of economic development in Taiwan is the increase of agricultural production and food availability (Hermalin et al. 1994). Like in other developing countries, lower food prices coupled with rising income have contributed to the increase in the consumption of oil, animal fat and a decrease in cereal intake. Between the 1960s and 1990s, per capita rice consumption declined by one-half, meat consumption quadrupled and fish consumption doubled (Huang and Bouis 2001). The shift to high energy-dense diets became especially apparent after the 1980s. In 1980, the proportion of energy consumed from animal food was 23 percent. By the late 1990s, Taiwan's average per capita meat intake was the highest in Asia (Smil 2002). Although carbohydrate was still the main source of energy, the overall percentage consumed from added fats and oils increased to 31 percent in 1980 and 34 percent in 1993-1996 and remained stable thereafter (Zeng 1986; Pan, Lee, Chuang et al. 2008; Statistical Yearbook of the Republic of China 2007). The proportion of fat consumed in the 1990s was much higher than other Asian countries with comparable per capita income such as South Korea over the same period (Kim, Moon and Popkin 2000).

Structural changes such as urbanization, expansion of service sectors, declining household size and rise in women's labor force participation that are less compatible with home food production increase the consumption of processed foods and fast food outside the home (Wu 2006). Service sectors are more concentrated in urban areas. Fast-paced urban lifestyles place a premium on processed foods (Huang and Bouis

2001). Urban markets also create the demand for the establishment of large super-market chains and Western fast food chains. For example, McDonald's opened its first restaurant in Taiwan in 1984 and the number of restaurants had grown to 350 by 2002 (Pingali 2004; Wu 2006). Moreover, the rising female labor force participation increased the value of women's time and reduced their time available for food preparation, contributing to the growing demand for processed food and eating away from home (Wu 2006).

While traditional Chinese diets give way to Western diets, the dietary shifts appear to be moderate among older adults in Taiwan. The dietary patterns of the elderly are in general healthier than that of younger adults. They consumed more fiber and had the recommended level of fat intake (Wu, Chang, Wei et al. 2005). The reasons for older adults' healthy diets are not clear. It is plausible that older adults' eating habits are not as much influenced by economic and structural changes as children and younger adults.

Like in other developing countries, there has been great decline in work-related physical activities in Taiwan as people shifted away from high-energy expenditure activities such as farming, fishing, mining and forestry towards the light-energy expenditure labor such as work in service sectors (Popkin and Gordon-Larsen 2004; Monda, Gordon-Larsen, Stevens et al. 2007). The recent transformation of the Taiwanese economy to being based on capital- and information-intensive industries created more sedentary activities such as sitting in front of a computer terminal. Further, increased mechanization leads to the reduction of activity levels within each occupation

(Popkin and Gordon-Larsen 2004). For instance, there was a rapid increase in the use of farm machinery after 1960 in Taiwan. This also made possible for surplus laborers to move to light-energy expenditure non-farm jobs. However, older adults who lack the skill set required by newly created high-tech jobs are more likely to continue to work in traditional sectors (Hermalin et al. 1994). Thus, their levels of work-related physical activities may be less affected by structural changes than younger adults.

Lifestyle changes, especially improved modes of transportation, may be conducive to reduced energy expenditure. In China, adults who purchased motor scooters or cars to travel to work have a higher risk of becoming overweight, compared to those that made no change in their mode of transportation (Bell et al. 2002). In Taiwan, ownership of a motorcycle increased rapidly from about 3 percent of households in 1964 to 45 percent in 1976 (Hermalin et al. 1994). By 2007, almost all households owned a motorcycle. Ownership of cars was limited in the 1970s, but the percentage of households owing a car increased to 25 percent in 1989 and 58 percent in 2007 (Hermalin et al. 1994; Statistical Yearbook of the Republic of China 2007). Moreover, the widespread use of refrigerators and washing machines have reduced the level of physical activity in everyday life (Selya 2004). The popularity of TVs after the 1970s and personal computers since the 1990s may have led to even greater inactivity in leisure time.

A majority of Taiwanese adults remain sedentary during their leisure time. There are only 30 percent of adults engaged in regular physical activity, among which 14 percent reached the daily recommended level of exercise (i.e. three or more times per week for at least 30 minutes per session with moderate intensity) (Ku, Fox, McKenna et al. 2006). While the prevalence of leisure-time physical activity is the lowest for adults aged 20 to 44, the percentage of physically active people increased with advancing age (Ku et al. 2006; Ku, Fox and Chen 2009). Although women are increasingly engaged in physical activities, they are less active than men due to social and cultural barriers and time constraints (Yu, Liaw and Barnd 2004). Those who are better-educated, who have paid jobs or higher income are more likely to be active than those who are poorly educated, unemployed, or in lower income groups (Ku et al. 2006).

As a result of socioeconomic and lifestyle changes, Taiwan has been experiencing a significant increase in the prevalence of overweight and obesity and obesity-related morbidity and mortality. National data on adult body weight are not available until the mid-1990s. But data on children and adolescents show that the prevalence of overweight/obesity increased from 3 percent to 12 percent between 1970 and 1988 (cited in Chu 2005). By 2001, about 27 percent of boys and 17 percent of girls were overweight and obese (Chen, Fox, Haase et al. 2006). Among adults aged 20 years or older, based on the standard criteria of the WHO, the prevalence of overweight and obesity (BMI $\geq$ 25 kg/m^2) was about 25 percent for both men and women between 1993 and 1996; the prevalence increased to more than 33 percent for men but decreased to 21 percent for women by 2000-2001 (Chu 2005). According to the Taiwanese standard[1], the prevalence of overweight (BMI ≥ 24 kg/m^2) and obesity (BMI ≥ 27 kg/m^2) increased gradually among men: 23 percent and 11 percent in 1993-1996, 29 percent and 16 percent in 2000-2001, and 31 percent and 19 percent in 2005. In contrast, the corresponding figures were fairly stable among women: 20 percent and 14 percent in 1993-1996, 19 percent and 11 percent in 2000-2001, and 21 percent and 13 percent in 2005 (Chu 2005; Huang 2008).

Although the elderly in Taiwan are less influenced by the common risk factors of overweight and obesity than younger adults as noted earlier (e.g. Western diets, lack of leisure-time physical activity, reduced energy expenditure from work), the level of overall obesity is similar or higher among the elderly than among young and middle-aged adults, especially among women. According to the WHO criteria[2], while about a quarter of men aged 65 years or older were overweight or obese (BMI ≥ 25 kg/m^2) between 1993-1996 and 2000-2001, the prevalence of overweight and obesity among elderly women was 43 percent in 1993-1996 and 35 percent in 2000-2001 (Chu 2005; Huang 2008). Further, abdominal obesity is a severe problem, particularly among elderly women. Using the sex-specific Asian cutoffs for central obesity (waist circumference ≥ 80 cm for women and ≥ 90 cm for men), 60 percent of elderly women

---

[1] Lower BMI and waist circumference cutoffs are found to be associated with higher risk of mortality and morbidity among Asian populations compared to Caucasians (WHO/IASO/IOTF 2000). The WHO standard measures of overall and central obesity may result in underestimates of obesity-related health risks among Asian populations. Thus, some Asian countries apply country-specific BMI cutoffs in clinical screening. Studies suggest that BMI values of 24 and 27 kg/m^2 are appropriate cutoffs for overweight and obesity among Taiwanese adults (Huang 2008).

[2] Our earlier study (Sa and Larsen 2006) suggests that the WHO definition for overweight/obesity (BMI ≥ 25 kg/m^2) is appropriate for the identification of health risks among the elderly in Taiwan. Thus, data on levels of overweight and obesity among the elderly by the Taiwanese standard is not presented.

and 33 percent of elderly men were abdominally obese (Yeh et al. 2005). While the gender difference may be attributed to biological factors, it may also be due to poorer nutritional knowledge and lack of awareness of health risks associated with excess body weight among elderly women (Lin and Lee 2005).

Overweight and obesity have become serious health problems in Taiwan. Overweight and obesity are related to cardiovascular diseases risk factors, metabolic syndrome and poor quality of life among young and middle-aged adults as well as the elderly (Tsai, Yang, Lin et al. 2004; Huang et al. 2005; Sa and Larsen 2006; Fu, Wen, Yeh et al. 2008). Among the elderly Taiwanese, central obesity is more closely associated with health risks than overall obesity (Huang et al. 2005; Sa and Larsen 2006). Four (i.e. cancer, heart disease, diabetes and hypertension) out of the top ten leading causes of death are from obesity-related diseases (Statistical Yearbook of the Republic of China 2007). Between 2000 and 2002, the medical costs induced by metabolic syndrome diseases accounted for about 3 percent of the national healthcare expenditure (Fu et al. 2008). The proportion of medical costs devoted to the prevention of obesity and obesity-related diseases is projected to increase.

2.3 Systems of social and gender stratification

The rapid social and economic transitions in Taiwan have not only affected dietary and physical activity patterns directly, but they have also influenced weight-related behaviors, values and lifestyles indirectly through their impacts on the social stratification system. Older Taiwanese adults have been exposed to the common social and environmental influences for weight gain. But their life experiences encompassing pre-industrial and industrial societies may render the lifetime exposure to risk and protective factors against overweight and obesity across social groups different from that of younger adults. Older Taiwanese men and women have lived through distinctive life trajectories, which may shape their differential exposure to the risk of excess body weight.

It is argued that the traditional system of sex stratification has played a key role in mediating change in social stratification across gender in Taiwan in the period following World War II (Greenhalgh 1985). I first provide some background information on the traditional gender system in Chinese society which features familial institutions and intergenerational contracts (Greenhalgh 1985). In traditional China, the descent line and the family were two distinct yet interrelated familial institutions. The descent line was a trans-generational unit of males concerned with inheritance and succession, and the family was a contemporaneous unit of males and females concerns with tasks of livelihood. While men's membership in the descent line was ascribed, women's had to be achieved by producing and raising a son. Women were short-term members of their fathers' family before marriage and they belonged to their husbands' family after marriage. In either case, there was a strict sexual division of labor in which men were responsible for productive work outside the home and women were in charge of reproductive activities within the household. While both sons and daughters were obligated to make contributions to the family economy, sons were supposed to provide old-age support to parents. Since parents perceived their future well-being as dependent on their sons, they invested as much as they could in their sons' upbringing, providing educational and economic opportunities. As daughters would marry out and contribute less to the family, parents invested less on their education than on sons. The traditional gender system persisted and perpetuated gender inequalities in access to socioeconomic resources – education, occupation, income and property in post-war Taiwan.

The overall level of educational attainment is low among the elderly in Taiwan, especially among elderly women. Primary education was gradually extended during the period of Japanese colonialism (1895-1945). While access to primary education was available to boys and girls, boys benefited more from the expanded educational opportunities than girls. The Japanese restricted the secondary educational opportunities to a highly selected group of people, limiting gender differences in secondary education in the first half of the 20th century (Hermalin et al. 1994). After World War II, well aware of the role of education in development, the Nationalist government gave high priority to education, providing opportunities for boys and girls alike. They greatly expanded the school system left by the colonial government, multiplying the number of schools at all levels. In 1953 the government made six years of primary education free and compulsory, and in 1968 secondary education became mandatory (Greenhalgh 1985; Hermalin et al. 1994). The expansion of education has led to a dramatic increase in school attendance at every level and more equitable distribution of education across gender. Since the 1950s, female enrollment rose faster than that of males at each schooling level, and by the early 1970s the gender gap in education had greatly narrowed (Hermalin et al. 1994). Despite the modest sex discrimination in the educational system, parents continued to favor sons over daughters in level of educational investment as a family strategy, perpetuating gender inequality in educational attainments in the post-war period (Greenhalgh 1985).

In traditional Chinese society, there were four distinct classes of occupations. At the top were the scholars who comprised teachers and government officials. As the economic backbone of an agrarian society, farmers came next. Artisans constituted the third class, while the merchants were at the bottom of the ladder (Grichting 1971). As a consequence of social transformation, the social hierarchy in Taiwan in the post-war era has increasingly been based on education and skills. While professional people continue to enjoy the highest ranks, the position of the group of business executives has rapidly moved up (Tsai and Chiu 1991). Manual laborers are at the bottom of the social ladder.

Traditionally, Taiwanese women did housework or worked at home-based businesses (Greenhalgh 1985). Economic development since the 1950s brought an explosion of job opportunities for women, followed by a massive influx of women into the labor force. Male labor force participation remained stable at more than 70 percent and declined slightly after the late 1990s. In contrast, female labor force participation increased from 20 to 34 percent between 1956 and 1966; it increased further to 40 percent in the 1970s and remained around 45 percent since then (Greenhalgh 1985; Statistical Yearbook of the Republic of China 2007).

Despite the rapid increase in female labor force participation, women face limited access to high-status jobs due to the pro-male environment and gender inequality in education (Greenhalgh 1985). In the early 1980s, manufacturing and services absorbed 91 percent of the female labor force outside agriculture, whereas only about 9 percent of women were in professional and managerial positions. Job opportunities for men were more broadly distributed across the industrial spectrum (Greenhalgh 1985). By 1995, while a majority of clerical and service jobs were filled by women, women's share of professional and managerial positions were 43 percent and 15 percent, respectively (Brinton 2001). Thus, women still remain in the lower half of the social ladder.

Unlike other developing societies, Taiwan has achieved long-term economic growth with a relatively high degree of equity (Hermalin et al. 1994). While income increases improved the standard of living across all social strata, disadvantaged groups benefited more because of the greater equalization of income between the 1950s and the 1970s resulting from a successful land reform. However, income inequality has increased over the past two decades with the decline of the rate of economic growth (Lee 2008). In addition, the benefits of economic growth have not been equally shared by men and women. Despite women's improved earnings, over most of the period between the 1950s and 1980s, the earnings of women worsened relative to those of men (Greenhalgh 1985). Between 1978 and 1992, the gender earnings ratio remained at 65 percent, probably because of the increased wage discrimination against women (Zveglich, Rodgers and Rodgers III 1997). The gender wage gap is wider among middle-aged and older adults than that among young adults (Brinton 2001). Women are not only disadvantaged in earnings but also in inheritance. Although legal provisions give daughters a share in their fathers' property at division, this right is routinely signed away at marriage. Thus, women remain excluded from access to their ancestral property and are largely propertyless. As members of the descent line, men have rights to inherited property and thus greater cumulative assets (Greenhalgh 1985). The increasing income inequality may have a stratifying effect on overweight and obesity. But the stratifying effect may be stronger among elderly men than among elderly women as a result of the persistent gender inequality in earnings and cumulative wealth.

2.4 Social participation among the elderly

In the past two decades, structural and political changes have led to the concomitant reduction in the role of family and increasing importance of social participation in Taiwan. It is intriguing to examine the impact of social participation on older adults' health. Historically, social participation was very restricted. In order to maintain their power, the Japanese colonial government and the Kuomintang state implemented tight control over Taiwanese society and eradicated most voluntary associations (Chen 2001). The lifting of the state of emergency (martial law) in 1987 has contributed to the expansion of civic organizations. Between 1988 and 1996, the number of non-profit organizations has increased by three times. By 1998, about 23 percent of Taiwanese joined voluntary associations. Social participation among the elderly has increased from 13 percent in 1989 to 22 percent in 2003, but their overall participation is still relatively low (Taiwan Bureau of Health Promotion). Moreover, participation is socially patterned for the elderly (Hsu 2007). Due to traditional gender role expectations, elderly women are not encouraged to participate in social activities except with religious groups. Elderly men, particularly those with paid jobs and in high SES groups, have more chances to engage in social activities. In general, social participation decreases with advancing age probably as a result of deteriorating health.

The scant literature suggests that social participation may play an important role in promoting physical activities among the elderly, especially among women in Taiwan (Yu et al. 2004; Ku et al. 2006). Middle-aged and elderly women who belong to community organizations participate actively in group physical activities such as Tai Chi, folk dancing, jogging and walking. Community engagement is particularly important for participation in physical activities among low SES elderly women who do not have enough financial resources to join fitness clubs which charge relatively high annual fees (Yu et al. 2006). Older people are also found to be more physically active than younger adults in several other East Asia countries (cited in Ku et al. 2006). This may be attributed to the popularity of culture-specific physical activities such as Tai Chi among the elderly who usually practice these activities in groups. Thus, the facilitating role of social participation in physical activities may originate in the collectivistic traditions of East Asia (Ku et al. 2006).

2.5 Social norms about body image

While these structural factors may have important influences on body weight, the impact of changing social norms about body image cannot be ignored. In traditional Chinese culture, a modest degree of plumpness was preferred over thinness. This cultural value about body weight is reflected in idioms such as “happy mind and fat body" and "becoming fat and good fortune" (Lee 1999). With the diffusion of the Western ideal of thinness through mass media and commercial advertisements over the past decades, the traditional beliefs of beauty have given way to the Western ideal and a slim body has increasingly become a symbol of sexual attractiveness and success in Taiwan (Shih and Kubo 2002). While body dissatisfaction and a desire to pursue a slim body have become widespread among young people, body dissatisfaction is more common among women than men (Shih and Kubo 2002; Wong, Bennink, Wang et al. 2000). Anxiety about the aging body is also accentuated for older Chinese women, among whom dieting is perceived to be a means of maintaining sexual attractiveness and youthful aging (Lee 1999). Thus, changes in cultural values about body image may place older men and women at differential exposure to the risk of overweight and obesity in Taiwan.

2.6 Summary

To conclude, the dramatic socioeconomic transformations that have occurred in Taiwan have changed Taiwanese lifestyles and contributed to the increasing problem of overweight and obesity. While the elderly appear to be less affected by the common risk factors of overweight and obesity, the prevalence of overweight and obesity among the elderly is similar or higher than that among young and middle-aged adults, particularly among women. Socioeconomic development has created new opportunities in access to socioeconomic resources for all people and catalyzed the emergence of social organizations. However, the benefits of development have not been equally distributed among younger and older generations or among men and women. The disadvantaged position of the elderly, particularly women, may render them to be at higher health risks. Therefore, an investigation of social determinants of excess body weight among the elderly is important for a better understanding of the impact of socioeconomic changes on the production of social inequalities in health in a transitional society like Taiwan.

Chapter 3: Literature Review and Research Hypotheses

From chapter 2, it is clear that Taiwan has experienced rapid socioeconomic, nutrition and health transitions in the past 40 years. The theory of fundamental causes of disease, life-course perspective on social inequality in health, and cultural perspectives on body size offer conceptual and analytic tools to assess social gradients in body weight and their determinants for the elderly in Taiwan. In this chapter, I first review the theoretical perspectives pertinent to the analysis of social disparities in body weight. Then I formulate a conceptual framework, which addresses how social, behavioral and biological factors affect an older adult's risk for overweight and obesity. Finally, the relationships between SES, social participation and excess body weight are assessed and research hypotheses are generated in the context of Taiwan. Overweight and obesity are considered health conditions rather than risk factors for other health outcomes throughout this analysis.

3.1 The theory of fundamental causes of disease

Link and Phelan (1995)'s theory of fundamental causes of disease, following others in this line of investigation (Lieberson 1985; House, Kessler, Herzog et al. 1990; House, Lepkowski, Kinney et al. 1994) offers a sociological approach to the study of social inequalities in health. They argued that social factors are the fundamental causes of disease because they reflect relative status in the system of social stratification and social relationships. When there is a way to minimize or avoid risk for disease, individuals' ability to benefit from it is shaped by resources such as knowledge, money, power, prestige, and beneficial social connections (Link and Phelan 1995). These social and economic resources directly shape individual health behaviors by influencing whether people know about, have access to, can afford, and are supported in their efforts to engage in health-enhancing behaviors (Phelan et al. 2004). For example, in developed countries, people with higher SES are more likely to have healthy lifestyles in terms of diet, physical activity, smoking and alcohol consumption than people of lower SES (Kim, Symons and Popkin 2004). In addition, resources shape access to broad contexts such as neighborhoods and social networks that vary dramatically in associated profiles of risk and protective factors. For instance, individuals with higher income are more likely to live in neighborhoods with safe environment, better access to exercise facilities and healthy foods which are conducive to healthy lifestyles and healthy body weight (Glass and McAtee 2006; Mujahid, Diez Roux, Shen et al. 2008). Being embedded in social networks with high-status peers are more likely to engage an individual in health-enhancing behaviors (Phelan et al. 2004). As a consequence of these processes, people who command more resources are able to gain a health advantage to a greater extent than people who have less access to resources. Thus, social gradients in health are produced by differential exposure to social and economic disadvantages.

It is clear from the above discussion that for social causes to get "under the skin", they must influence and interact with proximal risk factors and intervening factors that are closer to disease in the causal pathway. While the theory of fundamental causes of disease acknowledges the importance of proximate mechanisms in health interventions, it mainly focuses on the causal relationship between social factors and health. Link and Phelan (1995) stressed that the association between social factors and health is maintained by proximate mechanisms, but the health effects of social causes cannot be eliminated by addressing the mechanisms that happen to link the two at a given time. Conceptually, due to the flexible and multi-purpose nature of social and economic resources, they are highly adaptable to changes in health-related conditions and are widely used to protect health. The wide-ranging utility of these varied resources allows for the association between social factors and disease or risk factors to persist despite changes in the environment (Phelan et al. 2004). Further, because proximate mechanisms are constrained by hierarchical social structures, social conditions rather than individual risk factors are the fundamental causes of disease. Empirically, the health effects of social factors should be reduced to proximal risk factors if we have a well-specified model. But in reality, no matter what mechanisms are considered, there are always residual effects left. Therefore, the role of social conditions in health is central and irreducible.

The theory of fundamental causes of disease predicts that social inequalities in health are likely to emerge under conditions of dramatic shifts in the profile of diseases, risks, knowledge of risks, and treatments. To this end, Link and Phelan (1995) argued that resources are transportable from one situation to another, as health-related situations change, and those who command the most resources are in a better position to take advantage of new knowledge about health risks and protective factors. Thus, social differentials in risk factors and disease shift over time, with the shifts always benefitting higher SES groups, resulting in the dynamic reproduction of social gradients in health (Phelan et al. 2004). In developed countries, one of the most notable changes is a shift in the social patterning of lifestyle behavioral factors and related diseases. High-fat diets and freedom from physical labor used to be the privilege of higher SES groups, but when knowledge about the health benefits of a low-fat diet and physical activity emerged, groups with higher SES adopted these healthy behaviors more quickly than did groups with lower SES (Popkin, Siega-Riz and Haines 1996; Phelan et al. 2004). Concomitant with these changes, there is an inverse association between SES and obesity (Sobal and Stunkard 1989). The positive associations between lifestyle risk factors, obesity and SES found earlier in developed countries can be seen in developing countries at an early stage of health transition (Sobal and Stunkard 1989; Kim et al. 2004; McLaren 2007). For transitional countries where changes in socioeconomic and health conditions are well underway, social gradients in risk factors and obesity start to emerge (Popkin, Paeratakul, Zhai et al. 1995; Monteiro et al. 2004).

The theory of fundamental causes of disease (Link and Phelan 1995) shifts the focus from individual risk factors to social factors, and provides a structural approach to conceptualize social gradients in body weight. So far, the few studies following this line of investigation focus on developed countries, although the theory of fundamental causes of disease may be more relevant for societies undergoing dramatic socioeconomic changes. An investigation of the impact of social changes on social disparities in excess body weight in Taiwan provides a good test case for the theory of fundamental causes of disease.

3.2 Life-course perspective on social inequalities in health

Although the theory of fundamental causes of disease primarily concerns adult social status and health outcomes, both chronic diseases and SES develop over the life course. Obesity in early life is closely related to body weight in adulthood, and children born into deprived circumstances often follow a trajectory that leads to SES disadvantages later in life. The life-course perspective provides useful conceptual tools to examine the social pathways leading to gradients in health. I briefly introduce the key concepts and principles of the life-course perspective that are pertinent to the analysis of social disparities in body weight. A detailed review of the literature on the effects of SES at different stages of the life course on overweight and obesity will follow later.

The life course refers to the social trajectories of education, work, and family that are followed by individuals over the life span (Elder 1998). Life course perspective, like the theory of fundamental causes of disease, also emphasizes the impact of social change on social distributions of diseases. Individuals' life trajectories are shaped by historical changes in social structure and culture, and they in turn influence behaviors and development of diseases (Elder 1998). Therefore, social inequalities in health are a product of intertwined social and biological processes involving the interplay between individual life trajectories and social environment that is embedded in a multi-layered social and cultural context (Kuh, Power, Blane et al. 2004; Alwin and Wray 2005).

The basic question for the life course perspective is the relative contribution of SES at different stages of the life course to health inequalities in adulthood. Thus, the main purpose of the life course researchers is to assess the contribution of early life and later life SES jointly in the identification of risk and protective processes across the life course (Kuh and Ben-Shlomo 2004). To this end, the life course perspective hypothesizes that the distinctive health trajectories of people of different SES stems from the social conditions that long precede the decades in which these trajectories take shape (O'Rand 1996; Alwin and Wray 2005). Childhood SES may affect adult health and disease risk through several pathways (Kuh et al. 2004). First, parental SES influences one's access to educational and other learning experiences which serve as the main gateway to later occupational and economic status. Adult SES in turn affects disease risk by determining exposure to causal factors later in life. Thus, childhood adversity may set the individual on a life trajectory that includes a cumulative risk of exposure over the life span. Second, the childhood SES affects exposures to risk factors during gestation, infancy, childhood, and adolescence, which are part of long-term biological processes and are related to various aspects of development. In this case, childhood adversity may have critical effects on later health. Third, the childhood SES shapes the development of behaviors that endure and have long-term effects on disease risk.

There is growing evidence that exposure to social disadvantages in childhood and early adulthood (i.e. educational attainment) has adverse health consequences later in life. But there is no single answer to the question of whether early- or later-life conditions (i.e. occupation, income and wealth) are more important determinants of adult health at a particular time point. This is because SES at different stages of the life course affects particular health conditions in particular ways (Davey Smith and Lynch

2004). For example, adult obesity appear to be particularly responsive to SES conditions in adolescence while others appear to be influenced by social-patterned exposure acting across life (e.g. coronary heart disease) or in adulthood (e.g. breast cancer) (Parson, Power, Logan et al. 1999; Davey Smith and Lynch 2004). Further, the relative importance of early- or later-life conditions can change over time and place (Davey Smith and Lynch 2004; Alwin and Wray 2005). I will elaborate this point later based on the case of obesity.

Despite the focus on the relative importance of early- or later-life conditions, recent research posits that SES have impacts on health at multiple points across the life span, and adverse health outcomes at mid- or late life reflect the cumulative social disadvantage over the life span (Alwin and Wray 2005). This cumulative disadvantage hypothesis is extremely relevant for studies of the elderly which show that social inequalities in health persist across the life span. Thus, it is important to examine the extent of cumulative damage or protection to health as the duration of exposures to social dis/advantage increase (Kuh and Ben-Shlomo 2004).

Recent studies also emphasize the effects of protective social resources on health. Protective resources such as social relationships that are unevenly distributed by social status accumulate over the life course and are hypothesized to increase the likelihood of positive health behaviors and potentially buffer or moderate the impact of adverse conditions. Thus, protective resources may offer the opportunity to break out of current life-course trajectories (Hatch 2005). For example, social support is found to temper the effects of adverse circumstances on health through its link to the utility of social networks and participation in community activities (Lin and Peek 1999).

Overall, the effects of social conditions on health at older ages, according to the life course perspective, originate from social circumstances at early ages and cumulative dis/advantages over the life course. The life course perspective can shed light on pathways through which exposure to social dis/advantages at different stages of the life course are translated into adverse body weight outcomes at old age.

3.3 Cultural perspective on body size/shape

The theory of fundamental causes of disease and the life-course perspective mainly approach social inequalities in health from a structural perspective, whereas it is helpful to take into account cultural values for the study of social differentials in body weight. A useful framework is the sociology of Bourdieu and his cultural perspective of class (1984). Of particular relevance is Bourdieu's concept of "habitus," which refers to the embodiment of social structures in individuals. According to the concept of habitus, the body (inclusive of appearance, style, and behavior) is a social metaphor for a person's status. Thus, class of status is not just about money but rather comprises a constellation of attributes that Bourdieu calls "capital," which may be economic, cultural, or social in nature. These forms of capital can take on symbolic value when they are recognized as legitimate. For example, a certain body shape/size may have prestige that is not necessarily in keeping with its economic dimensions. From this perspective, body size/shape becomes a marker of social distinction. A taste for social distinction develops over time as a function of one's SES and changes in macro social conditions. In societies with food scarcities, a large body size may symbolize higher social status. A thinner body may be socially valued to a greater extent for people in higher SES in societies where foods are ubiquitous. Therefore, the cultural perspective emphasizes that system of social hierarchy can function as a symbolic system in which distinctions of taste become the basis for social judgment and differentiations of body weight.

In contemporary Western societies, there is a clear social stratification of body size across gender (Bordo 1993). Traditional gender roles provide socially defined expectations such that women are judged more by their physical appearance than are men. As a result of the strong social pressure on thinness among women, obesity is more severely stigmatized in women than in men both socially and economically, and dissatisfaction and concerns about large body size is more prevalent among women than among men. Since thinness is more likely to be valued by women higher on the socioeconomic spectrum, weight control practices are socially patterned. Socio-economically advantaged women are more likely to aspire to, and invest effort in attaining a particular bodily appearance. Consequently, the influence of socioeconomic condition on body size is clearly gendered: there is an average larger body size and a higher prevalence of obesity among socially disadvantaged than among socially advantaged women, but the pattern is not consistent among men (McLaren 2007).

3.4 Conceptual framework

In light of the above discussion, a thorough understanding of social disparities in body weight relies on the integration of the theory of fundamental causes of disease, the life-course perspective on social inequalities in health and cultural perspective on body size/shape. I develop a conceptual framework shaped around the fundamental causes of disease over the life course. This framework considers life-course SES and social participation as fundamental causes of gradients in excess body weight and allows for gender differences in social gradients in excess body weight. The framework applies to the analysis of overweight/obesity as well as weight gain, two related aspects of excess body weight.

To examine social gradients of body weight, we need to understand the complex mechanisms through which social effects are transmitted into physical health outcomes. While body weight is determined by the balance between energy intake and energy expenditure, this balance is a product of biological, behavioral, social and contextual influences (Sobal 1991). The model starts by embedding the links between social factors and body weight in broad social, economic and cultural contexts (Figure 1). Contextual influences on body weight, especially the level of socioeconomic development and cultural norms about body image, determine the overall environments within which social gradients of body weight are produced. The model then moves downstream to explain the impact of social stratification and social relationships on body weight. The model posits that life-course SES and social participation affect the risk of excess body weight through health behaviors. Although diet and activity patterns are the immediate behavioral influences on body weight, patterns of health behaviors are shaped by social conditions such as SES and social connectedness through the utilization of resources (Sobal 1991; Link and Phelan 1995). Leisure-time physical activity and diet are more sensitive to the level of development than other behavioral factors such as smoking and alcohol drinking (Kim et al. 2004). Physical activity is a modifiable factor that is found to be directly linked to weight status and weight change (Sobal and Stunkard 1989; Williamson, Madans, Anda et al. 1993; Sternfeld, Wang, Quesenberry et al. 2004). The effect of diet on body weight is inconsistent in existing literature. Further, dietary data is unavailable in this analysis. I therefore consider the links between social factors and physical activity as the major behavioral mechanism leading to social gradients in excess body weight. The model recognizes that the effects of social, behavioral and biological factors on excess body weight are intertwined. The biological dimension is captured by self-rated health status and chronic conditions. Demographic characteristics such as age, ethnicity, marital status, place of residence, and employment status are considered as control variables.

[Figure 1 about here]

Below is a literature review of the relationship between SES, social participation and excess body weight. I first lay out contextual factors underlying the links between SES and body weight. Then, I review literature on the relationship between life-course SES, social participation and excess body weight, along with behavioral pathways leading to social gradients in excess body weight. Lastly, the mediating effect of health behaviors in the relationships between social factors and excess body weight is discussed. Gender differences in these relationships are assessed and hypotheses are developed throughout the analyses.

3.5 Social determinants of excess body weight for the elderly in Taiwan

3.5.1 Contextual influences on SES-obesity links

Extant studies have shown a gradual reversal of the social gradient in body weight as the level of development of a country progresses from low to high (McLaren 2007). While the prevalence of obesity is higher among high SES groups in most developing countries, the prevalence of obesity and weight gain is higher among lower SES people in developed countries (Sobal and Stunkard 1989; Ball and Crawford 2005; McLaren 2007). In middle- and high-income developing countries, the SES-obesity relationship has started to shift toward the pattern of developed countries, and the convergence occurred earlier among women than among men (Monteiro, Conde and Popkin 2001; Monteiro et al. 2004; Yoon, Oh and Part 2006; Sabanayagam, Shankar, Wong et al. 2007). Structural and cultural perspectives provide two interrelated explanations for the shifting patterns in SES-obesity relationship across different social contexts.

From a structural perspective, the society's level of development has substantial impacts on individuals' energy intake and expenditure (Sobal 2001). In developing countries with food scarcities and lower levels of industrialization and urbanization, obesity is more prevalent among people of higher SES who can afford more adequate food supplies and who have less physically demanding jobs (Sobal and Stunkard 1989).

Obesity is higher among high SES groups even in countries with rapid economic growth, probably because the level of health knowledge and education is not high enough to support a shift to healthy lifestyles (Popkin et al. 1995; Kim et al. 2004). By contrast, in developed countries, the shift to tertiary production, technological advancement and over-supply of foods has pushed people into more sedentary lifestyles and high energy-dense diets. However, with a relatively higher level of education, SES and obesity become inversely related because people of higher SES have increasingly adopted healthy lifestyles (Sobal 1991; Popkin et al. 1996). In transitional countries where food scarcity and manual labor are less common as economic development has reached a certain level, the SES-obesity relationship becomes weaker than before and then shifts toward a pattern of developed societies (Monteiro et al. 2001; Monteiro et al. 2004).

While the structural approach links socioeconomic changes to the SES-obesity relationship, cultural perspectives emphasize the influence of symbolic values on body size preference (Sobal 1991). Cultural values favoring fatness have been evoked in traditional societies, where plump body shape is a symbol of status, wealth and health that only higher SES groups are able to obtain (Sobal 1995). For example, plumpness was valued as insurance against illness in Western societies more than a century ago. At the turn of the 20th century, social norms changed from valuing fatness to desiring and seeking thinness, particularly for women (Sobal 2001). The traditional values favoring large body size prevail in some developing countries where large-scale structural changes lag behind. The reason that social gradients in body weight emerge earlier among women than among men is probably because that contrary forces are at work in the transitional stage: weight-based discrimination on the one hand, particularly salient for women, and a larger body size on the other as a sign of power and dominance for men (McLaren 2007).

In Western societies, social ideals have increasingly emphasized the value of slimness for women since the 1960s. The discrepancy between actual versus desired body size has led to women's "normative discontent" with body weight and has promoted them to maintain an ideal body size (Rodin, Silberstein and Striegel-Moore 1984). Some researchers argued that older women are protected by a cohort effect of having growing up during a time when cultural pressures for thinness were not as strong as they are today (Pliner, Chaiken and Flett 1990; Tiggemann and Stevens 1999). However, recent studies showed that body dissatisfaction and weight concerns prevail among older women, especially among the middle-aged group (McLaren and Kuh 2004). This is probably due to the "double standard of aging" whereby physical aging is judged more harshly in older women than in older men. Since women are more likely to conform to norms about ideal body size than men, the socially patterned body weight is clearly gendered in Western societies (Sobal and Stunkard 1989; McLaren 2007). With the trend of globalization, the Western ideal of female thinness has increasingly been accepted by women in Asian societies (Shih and Kubo 2002; Luo, Parish, Laumann 2005). The changing gender norms about body size/shape may find greater expression in the emerging inverse relationship between SES and obesity among young and middle-aged women in developing countries (Monteiro et al. 2004).

The above discussion suggests that the SES-obesity relationship starts to shift from a positive to a negative direction, in response to changes in levels of socioeconomic development and cultural values about body size. But what is it about SES that affects an individual's exposure to the risks or protective factors against excess body weight? Being born into or having a particular social status cannot itself cause obesity, but characteristics and values of social groups related to knowledge, material resources or lifestyle choices may ultimately affect energy balance.

3.5.2 Life-course socioeconomic status (SES) and body weight

SES over the life course refers to one's inherited and achieved position in a social hierarchy that is endowed with material, social, symbolic, and ideological resources (Palloni 2006). Life-course SES is often measured by parents' education or occupation, one's own education, income, wealth, or occupational prestige. Although the multiple dimensions of SES are highly correlated, they are conceptually different from each other. As indicated earlier, body weight is not only related to knowledge and material resources, but also affected by cultural values and gender norms. Thus, different dimensions of SES may influence the risk of excess body weight through different mechanisms, and the mechanisms may be gender-specific. The elderly in Taiwan have lived through a period of dramatic socioeconomic changes, which are deemed to have impacts on SES-obesity relationships. Given these complexities, the SES-obesity relationship is discussed separately for various aspects of SES, incorporating variation by level of development, gender and age.

Education

Education is the most common measure of SES in adulthood in health studies. Because educational attainment is usually completed early in life and remains stable throughout adult life, it is one of the most appropriate measures of SES for the elderly. Education influences health through its effects on knowledge and beliefs regarding healthy lifestyles, as well as on the degree of mastery and control over one's health (Mirowsky and Ross 2003). In Western countries, the knowledge, cognitive and behavioral skills, and normative socialization acquired through education appear to be important in maintaining a healthy and socially desired body size (Sobal 1991; Wardle, Waller and Jarvis 2002). For example, people with higher education may have more knowledge about nutrition, healthy weight control practices and physical activity that might influence weight, and they might be more likely to integrate healthy behaviors into a coherent lifestyle. Education also socializes people into the dominant social norms about body weight, and provides them with motivations to conform to cultural weight expectations (Sobal 2001; Wardle and Griffith 2001).

Due to the overall low level of education and the social norms in favor of plumpness in traditional societies, education is not always a protective factor for healthy lifestyles (Kim et al. 2004). In fact, education is a risk factor for overweight and obesity in developing countries (Sobal and Stunkard 1989; Popkin et al. 1995; Monteiro et al. 2004; McLaren 2007). However, as development progresses, informed choices about healthy lifestyles tend to play a more important role in individuals' body weight (Monteiro et al. 2001). This is probably because better-educated people are more likely to be aware of the health issues their society associates with obesity (Kushi et al. 1988). In societies where obesity is more severely stigmatized for women than for men, weight dissatisfaction and weight control efforts are most prevalent among women from higher social classes (McLaren and Kuh 2004). As a result of these forces, education has strong protective effects against obesity and weight gain among women, and to a lesser extent among men in developed countries (Sobal and Stunkard 1989; Ball et al., 2002; Wardle et al., 2002; Zhang and Wang, 2004; Ball and Crawford 2005; Baltrus, Everson-Rose, Lynch et al. 2007; McLaren 2007). In newly industrialized and transitional countries, education is protective against overweight and obesity for women but not for men (Monteiro et al. 2001; Monteiro et al. 2004; Yoon et al. 2006; Sabanayagam et al. 2007).

The evidence based on young and middle-aged adults demonstrates a shifting pattern in education-obesity links across the development spectrum, and the inverse association emerges earlier among women than among men. The few studies in Western countries show that education is also protective against obesity among older women, but the effect of education is inconsistent for older men (Lahmann et al. 2000; Kaplan, Huguet, Newsom et al. 2003; Regidor, Gutierrez-Fisac, Banegas et al. 2004; Zablotsky and Mack 2004). The observed gender differences suggest that older women are also affected by social norms about body size (Allaz et al. 1998). Education is found to be unrelated to body weight among the elderly in a study of two Asian societies, but the analysis is not stratified by sex (Jenkins, Johnson and Ofstedal 2007).

The above discussion suggests that education increasingly becomes a stratifying factor for body weight as a country moves from low to medium or high levels of development. Based on the literature, I expect the following relationships between educational achievement and excess body weight among the elderly in Taiwan.

Hypothesis 1a Taiwan, as a newly industrialized society, has been going through rapid socioeconomic, nutrition and health transitions. Under the influence of widespread health knowledge and changing norms about body size, better-educated people, particularly women, are more likely to adopt healthy lifestyles for health concerns and appearance goals. Thus, education is likely to be a protective factor against overweight and obesity for older women, but the protective effect of education is modest or non-existent among older men.

Hypothesis 1b In a context of increasing prevalence of overweight and obesity, better-educated people are in a better position to know the health risks associated with excess body weight and more likely to adhere to healthy behaviors to prevent weight gain over time. Therefore, education is hypothesized to have a negative influence on weight gain for both men and women.

Material resources (income and wealth)

Income and wealth are common measures of SES in health research as they reflect an individual's ability to access health-related material resources. Material resources provide the means for individuals to seek the ideal body size of a society

(Sobal 1991). In developing countries, higher income or wealth increases one's ability to get adequate food and a higher chance of being overweight and obese (Paeratakul et al. 1998; Sobal and Stunkard 1989; Popkin et al. 1995; Monteiro et al. 2004; McLaren 2007). Patterns of high energy expenditure among the poor and the symbolic meaning of a large body size also contribute to the positive association between income/wealth and obesity (Monteiro et al. 2004). As a society reaches a certain level of economic development, weight loss resources rather than food supply are more closely related to body weight. In developed countries, high-income people, particularly women, have more flexibility in choice of diet and are more likely to engage in leisure-time physical activity (Jeffery and French 1996; Grzywacz and Marks 2001; Power 2005). Despite this, empirical studies show that income is not consistently related to body weight or weight gain in developed countries, probably because of the overall trend of weight gain among people of all income groups in an environment of relatively low food price (Ball and Crawford 2005; McLaren 2007). Similarly, in transitional countries, the positive impact of income on obesity deteriorates with the decline of food price (Monteiro et al. 2004). However, cultural values stigmatizing plumpness for women while favoring or neutralizing a larger body size for men coexist. As a result, income or wealth is positively associated with body weight among men but the relationship is inconsistent among women in transitional societies (Monteiro et al. 2001; Monteiro et al. 2004; Yoon et al. 2006; McLaren 2007; Sabanayagam et al. 2007).

Income is generally not considered an independent risk factor for overweight and obesity among the elderly, probably because of the complexity involved in using it.

Since retirement is often associated with a decline in income, using current income as an indicator of SES ignores the cumulative effects of a lifetime deprivation or privilege on chronic health risks among older adults (Robert and House 1996). To address this discrepancy, indicators of household wealth such as home ownership and assets may better reflect older adults' exposure to excess body weight. However, empirical data on wealth-obesity links are very limited. The only study examining the link between material resources and weight among the elderly in Taiwan shows that assets are inversely associated with body weight whereas income and body weight are not related (Jenkins et al. 2007). Based on these discussions, I develop the following hypotheses.

> *Hypothesis 2a* In Taiwan, older men are the bread winners of the family and older women mind the house. Although a decline in income accompanying retirement occurs among both men and women, older women experience a greater decline in income than older men due to the loss of spouse. On this background, income is hypothesized to be positively associated with body weight among men but not related to body weight among women, following the pattern of transitional societies.
>
> *Hypothesis 2b* Since wealth/assets reflect cumulative resources, I expect a strong positive association between assets and excess body weight among men but the association may be modestly positive or non-existent among women.
>
> *Hypothesis 2c* In Taiwan, like in other developed countries, diet and leisure-time physical activity are limited weight loss resources. Older adults, especially

women, who have higher income/wealth have greater access to the means of weight control resources than their lower income/wealth counterparts. However, due to the general decline of income after retirement, income is not likely to be related to weight gain among men and women.

Hypothesis 2d An inverse association between wealth/assets, particularly cumulative wealth/assets, and weight gain is more likely to emerge among women. It is not likely to exist among men as a result of gendered norms about body image.

Occupation

Occupation is correlated with educational attainment and income, but it represents obesity risks distinct from those associated with education or income, namely, level of work-related physical activity and social prestige (Sobal 1991). Low-status jobs usually involve more physical activities than do high-status jobs, and physically demanding jobs are protective against obesity in developing countries (Bell, Ge and Popkin 2001; Paeratakul et al. 1998). As societies shift from being based on primary to secondary to tertiary production with increasing levels of industrialization, the amount of work-related physical labor decreases markedly. Consequently, work-related physical activities converge to low or moderate levels in all social classes in transitional and developed societies (Sobal 1991). However, the effect of occupation on body weight is gender-specific. Lower occupational jobs for men are more physically demanding, which reduces the risk of obesity. But men with low-status occupations are more likely to have unhealthy lifestyles, which offset the protective effects of work-related physical activities (Wardle et al. 2002). Therefore, in developed countries, occupation is not associated with body weight among men. However, women with low-status jobs are more likely to be overweight or obese. While low level of work-related physical activities increases the risk of overweight and obesity for women of all walks of life, low-status female jobs are usually associated with lack of autonomy, which make it difficult for one to adopt a healthy lifestyle (Ball, Mishra and Crawford 2002; Wardle et al. 2002; McLaren 2007).

Occupation, as an indicator of social status, may be a marker of shared beliefs about body size/shape (Sobal 1991). Individuals high in the occupational hierarchy may internalize the symbolic value of a thin body and a healthy lifestyle and at the same time face exposure to a workplace environment that promotes these values (McLaren and Kuh 2004; McLaren 2007). Evidence shows that people, especially women, who are in high status jobs are more concerned about body shape and engage in more efforts to lose weight (Jeffery and French 1996; Wardle and Griffith 2001). This provides further explanations for the strong inverse relationship between occupational status and body weight among women in developed countries. However, existing studies demonstrate a consistent inverse association between occupational status and weight gain for both men and women in developed countries (Ball and Crawford 2005).

While occupation has strong impacts on day-to-day life/activities that may affect weight gain and obesity among young and middle-aged adults, this may not be the case among the elderly. Many older adults are retired, and many older women have never been in the paid labor force, or have worked intermittently. Current occupation is not a good predictor of body weight among the elderly. Instead, lifetime or primary occupation may better reflect the overall level of physical activities and social prestige associated with a particular occupation (Grundy and Holt 2001). The few studies of older adults in Western countries indicate that the inverse association between occupational status and obesity or weight gain persists among older women, but the pattern is inconsistent for older men (Lahmann et al. 2000; Regidor et al. 2004).

Hypothesis 3a Older adults in Taiwan have lived through a period of transition from a traditional to a newly industrialized society. The association between lifetime occupation and body weight is expected to be shifting from the pattern of developing countries (positive) to that of the developed countries (null for men and negative for women). Thus, there is likely to be a modestly positive or non-relationship between lifetime occupation and body weight among men, but a non- or modestly negative relationship among women.

Hypothesis 3b Since a majority of this elderly cohort (aged 53 years or older) in Taiwan has retired, lifetime occupation is supposed to have modest or no influence on weight gain among both men and women.

SES of family origin

Apart from these conventional indicators of SES, recent literature in Western countries increasingly demonstrates the important influence of an individual's family background on his/her obesity risk. Being born into a particular SES group cannot cause obesity, but life trajectories starting with poorer SES origins are more likely to be followed by unfavorable social, behavioral, or biological factors, all of which contribute to obesity in later life (Parson et al. 1999; Power and Parsons 2002). One important mechanism through which childhood circumstances affect the risk of adult obesity may be through its long-term effects on lifestyles and health behaviors. High SES parents may be more likely to socialize children to acquire a belief about healthy lifestyles that enable them to be more responsive to changing risk factors for disease over the life course. SES of family origin can also instill in children cultural values about body weight itself (Sobal and Stunkard 1989). For example, individuals who grow up in low SES families are more likely to engage in detrimental health-related behaviors, such as poor nutrition and low levels of physical activity in both childhood (Lynch, Kaplan and Salonen 1997; Wardle and Steptoe 2003) and adulthood (van de Mheen, Stronks, Looman et al. 1998). Due to the behavioral tracking from childhood to adulthood, weight accumulates gradually throughout the life course which may lead to the social gradient in body weight by childhood SES (Hardy, Wadsworth and Kuh 2000). Further, individuals born into low SES families are less likely to achieve high SES than those with high SES of origin. The inability to move out of the lower SES conditions continues to limit opportunities for changing lifestyle behaviors (Kuh et al. 2004).

While social and behavioral mechanisms influence the accumulation of obesity risk over time, biological pathways emphasize the critical effect of childhood SES on adult obesity. Studies in Western countries show that individuals with lower SES origins are more likely to have low birth weight and poorer growth in childhood, which increases the risk of central obesity in adulthood (Parsons et al. 1999; Gillman 2004). There is ample evidence identifying positive links between heavy birthweight and obesity in either childhood or adulthood, and between child obesity and adult obesity (Parsons et al. 1999; Ferraro, Thorpe and Wilkinson 2003; Gillman 2004). The prenatal conditions, particularly nutrients and insulin exposure, can have long-term effects on body weight regulation (Gillman 2004). But prenatal conditions are significantly affected by environmental factors including family SES and lifestyle behaviors. Thus, exposure to socioeconomic dis/advantages in early life has critical effect on body weight in later life.

Empirical studies[1] demonstrate an inverse association between childhood SES and body weight and weight gain in Western countries, particularly among women (Parsons et al. 1999). The pattern persists among middle-aged adults and elderly women (Power et al. 2005; Blane, Hart, Davey Smith et al. 1996; Brunner, Shipley, Blane et al. 1999; Lahmann et al. 2000; Lawlor et al. 2002; Langenberg et al. 2003; James, Fowler-Brown, Raghunathan et al. 2006; Baltrus, Everson-Rose, Lynch et al. 2007; Giskes, van Lenthe, Turrell et al. 2008). Moreover, a majority of these studies show an enduring effect of childhood SES on obesity and weight gain in mid- or late life, especially for women, even after controlling for adulthood SES. Adult SES also has independent influences on body weight in most studies and the effect of adult SES appears to be more important than childhood SES in some cases (Power et al. 2005). The independent

---

[1] More recent studies on young adults are not included.

effects of childhood and adulthood SES suggest that social gradients in body weight are established early in life and maintained into adulthood in Western societies.

The more consistent influence of childhood SES on body weight later in life among women than among men suggests that gendered norms about body image are at work. In Western societies, the circumstances and values of life in the SES into which one is born may transmit pressures for thinness to adolescent girls during their socialization (Sobal and Stunkard 1989). For example, the desire to be thin among girls increases with social class, whereas it differs little by social class for boys (Dornbusch, Carlsmith, Duncan et al. 1984). Girls from families with higher SES are also encouraged to diet more than girls of lower SES of origin (Drewnowski, Kurth and Krahn 1994). The attitudes and behaviors toward body size being formed in childhood have continuing influences in adulthood (Kuh et al. 2004). Thus, exposure to low SES in childhood has a stronger latency effect on body weight in adulthood among women than among men.

While the inverse association between childhood SES and body weight appears to be consistent in many Western countries, the relationship does not exist among either elderly men or women in Spain (Regidor, Gutierrez-Fisac, Banegas et al. 2004). In this study, only adult SES is inversely related to body weight among women, but none of the SES indicators are associated with weight among men. Childhood circumstances affect obesity risks later in life as a result of certain lifestyles acquired in early life related to food intake and physical activity (Power and Matthews 1997). However, food intake and body weight are conditioned upon food availability. The elderly cohort in

Spain (born between 1920 and 1940) grew up in a period of major rationing of basic food products due to economic stagnation (Regidor et al. 2004). The nutrition and subsequent health transitions including favorable behavioral shifts should have occurred later in Spain than in other Western countries. Body weight in later life may be more influenced by differential weight gain by adult SES than childhood SES in Spain. Thus, the discrepancies in findings may be attributed to different socioeconomic contexts the study populations have lived through.

Hypothesis 4a This elderly Taiwanese cohort (born between 1905 and 1946) had lived through a transition from traditional to industrial society and experienced a shift towards healthier lifestyles in recent decades. According to the predictions of socio-behavioral pathways over the life course, older adults in Taiwan with high childhood and adulthood SES are more likely to be responsive to risk factors for overweight and obesity and less likely to gain excess weight than their counterparts with low SES in childhood and adulthood. The elderly have achieved upward social mobility, but elderly men had more chances to move up than elderly women as a result of gender inequalities in Taiwan. Thus, older men's childhood SES is not likely to influence cumulative body weight when their own SES is taken into account, whereas both childhood and adulthood SES are expected to be related to body weight for older women.

Hypothesis 4b For the same reasons, older men's childhood SES is not expected to be related to weight gain after controlling for own SES. In contrast, both childhood and adulthood SES are likely to be related to weight gain for women.

3.5.3 Social participation and body weight

The theory of fundamental causes of disease (Link and Phelan 200) considers social relationships as important resources and argues that social relationships operate in a similar manner as SES to influence health outcomes. But the theory does not explain the possible mechanisms through which social relationships affect health. Social relationships, according to House et al. (1988), refer to social networks established through marriage or contacts with extended family and friends as well as more broad social ties developed through social participation such as church membership or other formal and informal group affiliations. Social relationships generate social capital by providing informational and instrumental help, creating obligations and expectations, and establishing norms and effective sanctions (Berkman and Glass 2000). In turn, social capital may enhance health through various mechanisms. Social support – whether in the form of instrumental help, emotional sustenance, or provision of information – is only one of the social processes involved in the social relationship-health linkage. Social regulation, norms or trust embodied in social participation may influence human thought, feeling and behavior in ways that promote health. Therefore, social networks and social participation affect health by facilitating health promoting behaviors such as diet and physical activity through socialization; by diffusing health-related knowledge or innovative ideas; by accessing financial and medical resources; or by fostering positive cognitive orientations such as a sense of control over life or self-efficacy that promote health (House et al. 1988; Berkman and Glass 2000).

There are a few studies examining the association between social networks, social participation and body weight. Evidence has been found that social networks can yield both protective and harmful effects on body weight or weight-related health behaviors. On the positive side, support from family and friends has been shown to predict greater preventive health behaviors or risk reduction efforts such as leisure-time physical activities (Sallis et al.1992; Eyler et al. 1999) and reducing dietary fat (Bovbjerg et al. 1995). Social networks, however, also carry the potential for encouraging unhealthy behaviors. Spouse pairs, for example, show concordance for drinking and level of physical activities (Venters 1984). Heavier drinking is found to be associated with greater network involvement among men (Seeman and Anderson 1983). Several studies show that married couples, adult siblings, or even friends gain weight together (Sobal 1984; Christakis and Fowler 2007). Although ties among siblings are relevant to the biologic traits, clearly, the synchronic fatness for couples and friends suggest that some behavioral traits of obesity and norms on bodily appearance are spread through strong social ties. In this case, unhealthy behaviors and fatness become part of the shared lifestyles and values within the network of family members or friends.

Social participation may be more important for maintaining a healthy weight, but empirical data on the link between social participation and body weight are non-existent. Existing studies demonstrate strong positive associations between social participation and physical activity (Lindstrom et al. 2003; Greiner et al. 2004; Poortinga

2006). Community participation shows positive effects for dietary change among the elderly (Silverman et al. 2002). Despite the ample evidence showing an association between physical exercise and body weight, the direct link between social participation and weight cannot be established based on the assumption that physical exercise leads to lower body weight. A few recent studies (Holtgrave and Crosby 2006; Kim et al. 2006) indicate that informal socializing and formal group participation, as important elements of a measure of state-level social capital, have protective effects for individual obesity and leisure-time physical inactivity. Kim et al. (2006) speculated that the state-level social capital may operate to a great extent through local mechanisms. Therefore, social participation, as a reflection of a wide variety of factors concerning community organizations, may have stronger effects on body weight than do individual-based social networks.

The effects of social participation may not operate uniformly for men and women. Norms of ideal body weight are known to vary between men and women, such that men may be more resistant to contextual influences of social organization or social activities (Kim et al. 2006). Women face a higher social penalty for being overweight/obese compared to men, and may be more responsive to the social regulation and control embodied in activities contributing to bodily appearance and body weight.

Hypothesis 5a Based on the literature, social participation is expected to have protective effects against overweight and obesity and the effects may be stronger for women than for men. In the background of recent development of civil society in Taiwan, current participation may not reflect past participation. Current participation may not be a good predictor of cumulative body weight. Thus, current participation is expected to have a modestly negative or non-relationship with body weight among women, and no relationship for men.

Hypothesis 5b Social participation, particularly persistent participation, is likely to be protective against subsequent weight gain among both men and women, but the protective effects may be stronger among women than among men.

3.5.4 Social factors, health behaviors and body weight

Previous analyses suggest that SES and social participation affect the risk of overweight and obesity through various intermediate risk factors especially leisure-time physical activity and diet. A strong social patterning of health behaviors is well established such that people who have higher SES over the life course and who are more social engaged are more likely to be involved in weight-related healthy behaviors. In other words, weight-related health behaviors are important mediating factors standing in the causal pathways through which social factors influence body weight.

Despite the strong association between life-course SES and intervening health behaviors, existing studies show that only a small proportion of the SES-obesity association is explained by health behavioral factors (Jeffery, French, Forster et al. 1991; Ball, Mishra and Crawford 2003; Molarius 2003). Childhood and adulthood SES continue to be independent predictors of excess body weight and weight gain among adults including the elderly after controlling for health behaviors (Jeffery et al. 1991; Jeffery and French 1996; Wamala et al. 1997; Paeratakul et al. 1998; Brunner et al. 1999; Lahmann et al. 2000; Bell et al. 2001; Lawlor et al. 2002; Ball et al. 2003; Kaplan et al. 2003; Molarius 2003; Zablotsky and Mark, 2004; James et al. 2006; Yoon et al. 2006). The residual effects of social factors indicate the persistent social gradients in body weight. These results may be attributed to cross-sectional and incomplete measures of risk factors, and reporting errors on both measures of social and risk factors. As mentioned earlier, research on the relationship between social participation, health behaviors and body weight does not exist.

Hypothesis 6a Physical activity is socially patterned by SES at different stages of the life course and levels of social participation among men and women.

Hypothesis 6b Life-course SES and social participation tap into a wide spectrum of socioeconomic resources, cultural values and health behaviors that are related to body weight. Thus, physical activity measured at a particular time point only explains a small portion of the association between SES, social participation and overweight or obesity. Physical activity, particularly cumulative measures of activity, have a stronger mediating effect on the relationship between SES, social participation and weight gain among both men and women.

Chapter 4: Data and Methods

In this chapter, I first introduce the data used for this study. Then I discuss the characteristics of the analytic samples and describe the definitions and measures of the variables in the analysis. Lastly, I present the methods used in the statistical analysis.

4.1 Data

The present study draws data from the Survey of Health and Living Status of the Near Elderly and Elderly in Taiwan (HLSES), a nationally representative longitudinal survey conducted in 1989, 1993, 1996, 1999 and 2003. As a joint project between the Bureau of Health Promotion in Taiwan and the University of Michigan, the main purpose of the survey is to assess the impacts of rapid social and economic changes on older adults' well-being in Taiwan. The survey includes a wide range of retrospective and current information on demographic, social, economic and health-related characteristics of older adults. Relatively comparable information on demographic characteristics, economic status, social support/network, heath behaviors and health conditions were collected for each subsequent wave of the survey. Thus, the survey provides an ideal data source for the examination of the relationship between social and behavioral factors and body weight or weight change from a life course perspective.

The HLSES began in 1989 with a national sample of 4,049 elderly respondents aged 60 years or older including the institutionalized population, among whom 3,135 were re-interviewed in 1993. In 1996, the study was extended to include a national sample of 2,462 near elderly adults aged 50 to 66 years. The near elderly and elderly cohorts were interviewed again in 1999 and 2003 with 4,440 and 3,778 respondents followed up, respectively. To ensure a high response rate, the survey tracked down the respondents who moved domestically at their new addresses. The response rate for all waves of the survey, except for 1996 wave, is above 90 percent (visit http://www.bhp.doh.gov.tw/BHPnet/Portal/Them.aspx?No=200712270002 for a detailed description of the survey data).

The initial sample was selected following a multi-stage probability procedure. In the first stage, a random sample of non-aboriginal townships was drawn among all administrative units of Taiwan. Thirty mountainous areas with largely aboriginal populations (consisting of 2% of the total population) were excluded from the sampling frame. Within each selected township, blocks (*lins*) were randomly selected. In the third stage, two eligible respondents were selected randomly from each selected block. Both township and blocks were selected with probabilities proportional to size of the population in the sampling unit. Only one respondent was selected from a given household (Taiwan Provincial Institute of Family Planning 1989). The selection of the 1996 near elderly sample followed the same procedure. A majority of the respondents were drawn from the same townships as those for the 1989 elderly sample.

4.2 Analytic Samples

This study is mainly based on data from the 1999 and 2003 survey waves, while some SES measures (i.e. education and lifetime occupation) are derived from the initial survey (1989 for the elderly and 1996 for the near elderly). The decision of using 1999 and 2003 waves is data driven. Although body weight and height were asked in four surveys, the non-response rate for these two variables is high in previous waves (e.g. body mass index is missing among 46% of respondents in the 1989 survey). Only the most recent two survey waves provide adequate data for the current analyses (3.4% and 6.7% of respondents did not report weight and height in the 1999 and 2003 surveys, respectively). This study starts with a cross-sectional examination of the social determinants of overweight and obesity among the elderly aged 57 years or older based on data from the 2003 follow-up survey of the 1999-2003 panel data. After excluding missing cases on explanatory and outcome variables, the total number of observations is 3,156[1] for the analysis on overall obesity (n = 1,672 for men and n = 1,484 for women). Due to small discrepancies in missing cases for outcome variables, the sample size for the analysis on central obesity is 3,277 (n = 1,696 for men and n = 1,581 for women).

The second set of analyses utilize the 1999-2003 panel data to investigate social predictors of weight change among the elderly aged 53 years or older in 1999. The sample used in these analyses comprise 3,103 respondents (n = 1,632 for men and n = 1,471 for women). This sample represents respondents who were interviewed in both 1999 and 2003 and who provided valid data for all variables included in the analyses. Table 4.1 shows that among 4,440 respondents who were interviewed in 1999, 3,537 (80% of the 1999 sample) were alive and re-interviewed in 2003. Among these survivors, 3,103 (70% of the 1999 sample) provided complete data on baseline

---

[1] The sample size for the 2003 cross-sectional analysis is slightly larger than that for the 1999-2003 panel study as a result of discrepancies in missing cases for outcome variables and covariates between these two samples.

characteristics in 1999 and weight change between 1999 and 2003. Attrition from the 1999 survey is due to death (54.4%), loss to follow-up (13.2%), non-response on weight change variables (21.5%) between 1999 and 2003 and missing values on baseline characteristics (10.9%) in 1999.

Additional analyses indicate that survivors (including respondents who provided invalid data on covariates) are very different from those who dropped out from the 2003 survey with regard to demographic, social and behavioral characteristics. Table 4.2 demonstrates that survivors are significantly more likely to be younger, urban residents, educated, to have the highest income and higher levels of wealth, and to participate in social and leisure-time physical activities relative to those who dropped out from the 2003 survey. This suggests that the study samples are somewhat biased. Thus, the effect of SES, social participation and physical activity on body weight and weight change could be underestimated. The sample bias is more attributed to mortality and non-response on body weight than to loss to follow-up. Respondents who failed to provide weight data in either surveys share similar characteristics to those who died between 1999 and 2003. In contrast, those who were lost in the follow-up survey have more favorable demographic, social and behavioral characteristics than the other two groups. The limitation of this study due to sample bias will be further addressed in results and conclusion chapters.

4.3 Dependent Variables

The first set of dependent variables measures overall obesity. The 2003 survey wave asked open-ended questions about weight (in kg) and height (in cm). A majority of respondent provided self-reported weight and height. Weight and/or height were measured (5.6% of the sample) by the interviewer in case they were not provided by respondents. Body mass index (BMI) is calculated as weight (in kg) divided by the square of height (in cm). First, I use the WHO standard cutoffs for body weight (WHO 1998) to identify respondents who are 1) underweight (BMI < 18.5 kg/m^2); 2) normal weight (BMI 18.5-25 kg/m^2); and 3) overweight/obese (BMI $\geq$ 25 kg/m^2). The WHO defines a BMI of 25-29.9 kg/m^2 as overweight and 30 kg/m^2 or more as obesity. Recent studies show that lower BMI cutoffs are associated with higher risk of mortality and morbidity among Asians compared to Caucasians (WHO/IASO/IOTF 2000). Based on these studies, the WHO (2004) recommended lower BMI cutoffs (23-27.4 kg/m^2 for overweight and $\geq$ 27.5 kg/m^2 for obesity) for Asian populations. However, our earlier study (Sa and Larsen 2006) identified 25 kg/m^2 as an appropriate BMI cutoff associated with an elevated risk for metabolic syndrome among old men and women in Taiwan. Therefore, in the second step of the analysis on BMI, the overweight/obesity category was split into overweight (25-27.4 kg/m^2) and obesity ($\geq$ 27.5 kg/m^2).

Underweight is not a focus of this study, but it is important to separate underweight and normal weight groups. Additional analyses (results not shown) indicate that older adults who are underweight in our sample are more likely to be in low SES groups, to have poor health behaviors and health conditions relative to the normal weight group. A combination of underweight and normal weight groups may underestimate the association between SES, health behaviors and overweight/obesity. Because of the established U-shaped relationship between body weight and poor health outcomes, underweight and normal weight groups need to be considered separately.

The second set of dependent variables measures central obesity as indicated by waist circumference (in cm) measured in 2003. Recent studies increasingly show that abdominal obesity is a better predictor of health risks among the elderly than overall obesity (Chen et al 2002; Zamboni et al. 2005; Sa and Larsen 2006). The WHO (1998) provided guidelines for waist circumference cutoffs associated with different levels of health risk, but these cutoffs are not appropriate for Asians who generally have a smaller body size than Caucasians. The WHO (2000) recommended waist circumference cutoffs associated health risks for Asian populations are waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm. Based on the WHO recommended Asian standard, the first measure of central obesity is coded as a dichotomous variable assigning 1 to respondents who are abdominally obese (waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm) and 0 otherwise. Further, the sex-specific values at the 85th percentile of waist circumference ($\geq$ 98 cm for men and $\geq$ 96 cm for women) are used as cutoffs for high-risk central obesity. Thus, the second measure of central obesity is coded sex-specifically as 1) normal waist circumference (< 90 cm for men and < 80 for women), 2) medium-risk waist circumference (90-97 cm for men and 80-95 cm for women), and 3) high-risk waist circumference ($\geq$ 98 cm for men and $\geq$ 96 cm for women).

The third set of dependent variables measures weight change. Body weight change is a complex issue for the elderly as both change of weight and height are involved in the process of aging. For ease of interpretation and comparison with extant research, the first measure of weight change is simply defined as weight change (in kg) rather than BMI change between 1999 and 2003. Weight change (in kg) is calculated by subtracting respondent's self-reported weight in 2003 from that in 1999. Older adults are more likely to lose weight than gain weight. Using a linear form of weight change may not provide an accurate assessment of social differentiations in weight gain. I created a categorical measure of weight change to examine the magnitude of relative weight gain. Percentage weight change is calculated as weight change divided by 1999 weight and is further coded as four mutually exclusive categories 1) weight loss ($\geq$ 5% or >3.5 kg decrease); 2) weight stability (a change between -4.9% and 4.9% or -3.5 kg to 2.5 kg); 3) moderate weight gain (5-9.3% or 2.5-4.9 kg increase); and 4) large weight gain ($\geq$ 9.4% or $\geq$ 5 kg increase). In order to capture the onset of overweight/obesity, I create a third measure of weight gain which is defined as having a normal weight (BMI 18.5-25 kg/m^2) in 1999 and becoming overweight/obese (BMI $\geq$ 25 kg/m^2) by 2003. This measure is coded as a three-category variable: 0 = maintain a normal weight; 1 = from normal weight to overweight/obese; 2 = from normal weight to underweight. Weight stability and maintaining a normal weight are used as reference categories in multivariate analyses.

In line with the analytic strategies, which are described later in this chapter, all explanatory variables (except for childhood SES and economic conditions, education and lifetime occupations) are coded consistently based on 1999 and 2003 data, respectively. Variables from the 2003 data are used in the 2003 cross-sectional analysis, while the 1999 measures are used to predict weight change between 1999 and 2003.

4.4 Independent Variables

Socioeconomic status at different stages of life course

Socioeconomic status, the primary explanatory variable, is measured by six indicators of SES at different stages of the life course, namely, childhood SES and economic condition, education, lifetime occupation, income and wealth.

Childhood SES is defined by father's main occupation that was obtained retrospectively from the initial survey (1989 for elderly sample and 1996 for near elderly sample). Father's occupation is relatively homogenous for this elderly cohort, thus it is grouped into two categories: high-status (professionals, management, routine non-manual work) or low-status occupations (skilled and unskilled manual work). The economic aspect of early life conditions is measured by family economic resources. In 2003, respondents were asked if they grew up in "an affluent, well-to-do, average, below average, or poor family"? I created a dichotomous measure reflecting whether a respondent grew up in a well-to-do family (=1) by combining answers for "affluent" and "well-to-do" or his/her childhood family economic condition was average or poor (=0) by collapsing the categories of "average", "below average", and "poor".

Education is considered a measure of SES in early adulthood. Educational attainment is based on years of schooling and is classified into three categories: no education or illiterate, one to six years of education or literate (primary), and seven or more years of education (secondary or higher).

Lifetime occupation is a measure of adulthood SES and reflects the respondent's primary occupation; it also reflects levels of work-related physical activities. Lifetime occupational status is grouped into seven categories based on answers to questions asked in the 1989 (elderly sample) and 1996 (near elderly sample) waves: agricultural (omitted category), unskilled manual labor, service and semi-skilled labor, skilled labor, managerial, professional, home makers and self-employed or unemployed. If the respondent was not employed at the time of the baseline survey, their most recent occupation is recorded. The cases for the categories unemployed and self-employed in the male sub-sample are too small to generate meaningful estimates. They are dropped from the analyses.

Income is used as an indicator of SES in late life. Information on the respondent's and his/her spouse' joint yearly income was collected in each survey wave. Exact amount of income is available for those who reported income. For the remainder, income was reported in a broader range. I combine these two variables into one with broader income range, and collapse it into rough tertiles. Those in the first tertile earned less than 120,000 NT (New Taiwanese Dollars) annually in 1999 and 2003. The second and third tertiles are those reporting 120,000 to 300,000 NT and those reporting 300,000 NT and higher. I use the same cutoffs for male and female sub-samples for easy comparison.

Finally, number of assets owned by the respondent and his/her spouse in 1999 or 2003 is used to capture household wealth or cumulative socioeconomic dis/advantages over the life span. Assets include ownership of 1) primary home, 2) other house, land or factory, 3) farm, fishery or ranch, 4) savings, 5) stocks or shares, 6) own company or business, and 7) other valuable assets. I create a summary index counting the number of types of assets owned and then code it into four categories reflecting zero, one, two, and three or more types of assets.

Age-adjusted Pearson's correlation coefficients between indicators of SES at different stages of the life course for men and women are presented in Table 4.3. As expected, most of these indicators are correlated at $p<0.05$ level of significance. Surprisingly, father's occupation is not correlated with childhood family economic conditions for women or with own assets for men and women. Further, own lifetime occupation is not correlated with assets for men. The findings may reflect measurement errors. Despite strong correlations between some variables (own education and lifetime occupation have the highest correlations – 0.53 for men and 0.49 for women), the associations are not sufficiently high to suggest that they are fully dependent constructs. Hence, multivariate procedures will consider several SES indicators simultaneously.

Social participation

Social participation is measured by numbers of social activities a respondent participated. In 1999 and 2003 waves, respondents reported current membership or participation in any of these eight activities: 1) neighborhood associations, 2) religious associations, 3) professional or civic groups, 4) political associations, 5) social service groups, 6) village or lineage associations, 7) elderly clubs and 8) elderly learning centers. A summary index counting the number of social activities participated is created and then collapsed into three categories: none, one, and two or more activities.

Health behaviors

Leisure-time physical activities, smoking and alcohol consumption are included as measures of health behaviors. Respondents were asked about the number of times they participated in any kind of leisure-time physical activities each week as well as the duration and intensity of exercising each time in 1999 and 2003 waves. These three questions are used to create a three-category measure reflecting levels of physical activity: 1) sedentary, 2) moderate (2 to 5 times each week or less than 30 minutes each session), and 3) vigorous (6 or more times each week for at least 30 minutes each time at a level that causes one to break into sweat). The current definition is developed following the American College of Sports Medicine's (1998) guidelines for physical exercise for adults.

Smoking and alcohol consumption in 1999 and 2003 are included because smoking can cause weight loss while quitting smoking and heavy alcohol consumption are usually associated with weight gain. Smoking is measured by a three-category variable: never smoked, current smoker and past smoker. Alcohol consumption is coded as a dichotomous variable with alcohol consumption more than once a week assigned the value of 1 and none or less than once a week assigned the value of 0. Preliminary analysis suggests that only a small proportion of women smoked or drank alcohol. Smoking and alcohol consumption are not significantly associated with body weight (except for alcohol consumption for central obesity) or weight change among women. Smoking and alcohol consumption are dropped from multivariate analyses for the female sub-sample.

Health characteristics

Body weight can be attributed to a complex interrelationship of social, behavioral and biological factors. In line with this conceptual model, health status and chronic conditions are considered secondary explanatory variables. Self-rated health status in 1999 and 2003 is measured dichotomously as self-perceived good health (=1) by combining answers for “good, very good, and excellent health” or otherwise (=0) by combining “fair and poor health” categories. In addition, a series of physician-diagnosed life-threatening and debilitating chronic conditions reported in 1999 and 2003 are included. Heart hypertension, diabetes, heart disease, stroke, cancer and arthritis are coded as dichotomous variables with the presence of each of these conditions taking the value of 1 and 0 otherwise. Composite measures of functional limitations and depression

are created by counting the number of self-reported functional difficulties[2] and

[2] Six items are included in the functional limitation index: standing 15 minutes, bending/kneeling, reaching with both arms, lifting or carrying weights of 20 lb, walking 200 to 300 meters and climbing 2 to 3 stairs.

depressive symptoms. Respondents (4.2% of the panel data) whose answers were given by a proxy did not provide information on depressive symptoms. I impute missing cases for depression index using sex-specific sample means.

Trend predictors

The above variables will be used in both cross-sectional and longitudinal analyses. Given our interest in the effect of cumulative social experience and behavioral change on weight change, a set of trend predictors (i.e. change variables) is created for the analysis of weight change based on information from 1999 and 2003 survey waves.

Changes in income and wealth/assets are measured by three-category variables reflecting respondents 1) who are in the lowest income or wealth (no assets) groups at both waves, 2) who have moderate or unstable income or wealth (one asset), and 3) who maintain a high income or level of wealth (two or more assets) over the period. Missing cases for income variable are retained and are coded as a separate category.

Change in social participation is assessed using a five-category variable: persistently low, persistently moderate (one kind of activity at both waves), persistently high (two or more at both waves), started to participate, and stopped participating over the period.

Change in leisure-time physical activity is defined and categorized as 1) remaining sedentary, 2) remaining of a moderate, or 3) a vigorous level of activity at both waves, 4) becoming active, and 5) becoming inactive over the period.

Change in smoking is coded as 1) persistent none smoker, 2) smoker or started to smoke, and 3) quit smoking over the period. Alcohol consumption is measured as 1) persistently none or low use of alcohol, 2) consuming alcohol more than once a week at both waves, 3) starting and 4) stopping to drink frequently over the period.

4.5 Control Variables

Variables included in the multivariate models control for age, ethnicity, marital status, residence and employment status, which might have confounding effects on body weight or weight change. Age is grouped into five categories to account for non-linear relationship with body weight and weight change. Ethnicity is a predisposing factor as well as a marker of social position among the elderly in Taiwan. While Mainlanders generally have higher SES, differences between the Hakka and the Fukienese are modest (Tsai 1992). Given our interest in social inequalities in health, ethnicity is coded as a dichotomous variable, Mainlanders or other. To take into account the effect of urbanization, residence is measured by a dichotomous variable reflecting living in an urban area or not. Marital status is dichotomized into currently married or not. Since a majority of old adults in the sample have already retired, lifetime occupation may not be able to capture all the effects of work-related physical activities on body weight/weight change. Thus, a dichotomous measure of employment status is included in the analysis.

The above variables are controlled in both cross-sectional and longitudinal analyses. In the longitudinal analysis, BMI in 1999 is included as a continuous variable with a quadratic term to account for any non-linear associations with weight change. Moreover, I define a set of categorical variables to control for changes in marital status and employment status between 1999 and 2003 that may confound with weight change. Marital status is coded as remain or become married, unmarried, and become widowed/divorced/separated over the period. Employment status is measured as employed, unemployed, and retired throughout the period.

Self-reported weight and height data are accurate and reliable among young and middle-aged adults (Stunkard and Albaum 1981). However, self-reported weight and height data are more likely to be misreported among the elderly who often experience a decrease of height (Kuczmarski, Kuczmarski and Najjar 2001). To examine the extent to which the results are biased due to reporting errors, flags of BMI by type of measurement (measured, self-reported, measured and self-reported) are controlled in cross-sectional analyses on BMI.

4.6 Analytic Strategies

All analyses are stratified by sex. This decision is based on the exploratory models that reveal statistically significant interactions between gender and key SES measures. In all analyses, the data are weighted to adjust for differential responses rates and variation in probabilities of selection into the sample. The analyses are performed using Statistical Analysis System (SAS) version 9.1 (SAS Institute Inc. 2002) and STATA version 9 (StataCorp 2006). I begin by presenting descriptive statistics and unadjusted bivariate associations between each set of independent variables (social, behavioral and biological factors) and weight status and weight change. I next use a series of multiple regression models to estimate the association between these independent variables and weight outcomes after controlling for confounding demographic characteristics. Below I explain model specifications for cross-sectional and panel analyses, respectively.

As the first step of the cross-sectional analyses of 2003 weight status, multinomial logistic regression models are conducted to estimate the relative risk of overall obesity. The two outcome measures are 1) three-category BMI (underweight, normal weight, and overweight/obesity), and 2) four-category BMI (underweight, normal weight, overweight, and obesity) with normal weight as the reference category. To understand the relative impact of each set of independent variables (social, behavioral and biological factors) on the risk of overweight/obesity and the interactions of independent variables as they are related to outcome variable, I use a stepwise approach for the analysis of the first BMI outcome. The base model (model 1) includes indicators of SES, social participation and control variables, then health behaviors (model 2), and health status (model 3) variables are added subsequently. The equations of the nested models are as the following:

(1) $\log (P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + \Sigma B_kX_k + r_i$

(2) $\log (P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D$

$+ \Sigma B_kX_k + r_i$

(3) $\log(P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T +$

$B_{10}D$

$+ B_{11\text{-}19}H + \Sigma B_kX_k + r_i$

where: P_{ij} = probability of falling into BMI category j for individual i (j = 2 to 3)

P_{i1} = probability of falling into BMI category 1 for individual i

C = childhood SES

F = childhood family economic conditions

E = education

O = lifetime occupation

I = yearly income

W = number of assets

S = social participation

P = physical activity

T = smoking (men only)

D = alcohol consumption (men only)

H = heath conditions (9 variables)

X_k = control variables

The full model is also estimated for the four-category BMI outcome. Below is the equation:

(4) $\log(P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T +$

$B_{10}D$

$+ B_{11\text{-}19}H + \Sigma B_k X_k + r_i$

where: P_{ij} = probability of falling into BMI category j for individual i (j = 2 to 4)

P_{i1} = probability of falling into BMI category 1 for individual i

Next, I estimate the risk of central obesity using binomial logistic regression models. The outcome variable is a dichotomous measure reflecting being abdominally obese or not. The reference category is having a normal waist circumference. To make comparison with the results for overall obesity, I use the same modeling approach and model specifications as the analysis for overall obesity. The equations of the nested models take the following forms:

(5) $\log (P_i/1\text{-}P_i) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + \Sigma B_k X_k + r_i$

(6) $\log (P_i/1\text{-}P_i) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D$

$+ \Sigma B_k X_k + r_i$

(7) $\log (P_i/1\text{-}P_i) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D$

$+ B_{11\text{-}19}H + \Sigma B_k X_k + r_i$

where: P_i = probability of being centrally obese for individual i

X_k = control variables (indicator for BMI measurement is not included)

Last, multinomial logistic models are estimated for having a medium-risk or high-risk waist circumference with normal waist as the reference group. The equation of the model is as below:

$$(8)\ \log(P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D$$

$$+ B_{11\text{-}19}H + \Sigma B_kX_k + r_i$$

where: P_{ij} = probability of falling into waist category j for individual i (j = 2 to 3)

P_{i1} = probability of falling into waist category 1 for individual i

X_k = control variables (indicator for BMI measurement is not included)

For the analysis using the 1999-2003 panel data, various forms of regression analyses are performed to predict different outcomes for weight change. First, ordinary linear regression (OLS) and multinomial logistic regression models are conducted to estimate the risk of weight change in terms of baseline social, behavioral and health status variables, controlling for demographic characteristics. In these analyses, all covariates take their values in 1999 in order to establish a causal relationship between explanatory and outcome variables. As the first step, OLS regression is applied to predict the risk of overall weight gain with weight gain (in kg) as a continuous variable. Preliminary analysis indicates that, more respondents lose weight than gain weight between the 1999 and 2003 interviews. Similar to women who gain substantial weight, women who lose substantial weight are more likely to be in the socially disadvantaged group. The inclusion of weight losers may push the regression line toward the mean such that the effects of social factors on weight gain are attenuated among women (Appendix Table 4.4). Since the focus of this analysis is on weight gain, weight losers are dropped from the OLS regression models.[3] The sample is restricted to respondents who have zero or positive weight gain. The model equation takes the form:

(1) $Y_i = \alpha + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D + B_{11\text{-}19}H$

$+ \Sigma B_k X_k + e_i$

where: Y_{i2} = weight gain in kg for individual i between baseline and follow-up surveys

X_k = control variables (baseline BMI and its quadratic term are included)

Then, multinomial logistic regressions are estimated to predict the magnitude of relative weight change. The outcome variable has four categories: weight loss, stable weight (reference category), moderate weight gain and large weight gain. Below is the model equation:

(2) $\log(P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D$

$+ B_{11\text{-}19}H + \Sigma B_k X_k + r_i$

where: P_{ij} = probability of falling into weight change category j for individual i (j = 2 to 4)

P_{i1} = probability of falling into weight change category 1 for individual i

X_k = control variables (baseline BMI and its quadratic term are included)

Next, I use logistic regression models to estimate the relative risk of becoming overweight/obese by 2003 among those who have a normal weight in 1999. The outcome variable has three categories: maintain a normal weight (reference category),

[3] 793 and 697 cases are dropped from male and female sub-samples, respectively, due to weight loss.

become overweight/obese, and become underweight over the period. Respondents who become underweight are dropped due to small sample size. The model equation looks like:

$$(3)\ \log (P_i/1\text{-}P_i) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D + B_{11\text{-}19}H + \Sigma B_kX_k + r_i$$

where: P_i = probability of becoming overweight/obese for individual i over the period

X_k = control variables (baseline BMI and its quadratic term are included)

Finally, multinomial logistic regression models are estimated to examine the effect of cumulative social experiences and behavioral change on weight change. In this analysis, I replace the 1999 baseline data with cumulative measures of SES, social participation, health behaviors and weighted-related demographic characteristics based on data from 1999 and 2003 surveys. Thus, the causal order in the relationship between these trend predictors and weight change cannot be elucidated from the following model:

$$(4)\ \log (P_{ij}/P_{i1}) = B_0 + B_1C + B_2F + B_3E + B_4O + B_5I + B_6W + B_7S + B_8P + B_9T + B_{10}D + B_{11\text{-}19}H + \Sigma B_kX_k + r_i$$

where: P_{ij} = probability of falling into weight change category j for individual i (j = 2 to 4)

P_{i1} = probability of falling into weight change category 1 for individual i

I = trend in income

W = trend in level of wealth/assets

S = trend in social participation

P = trend in physical activity

T = trend in smoking (men only)

D = trend in alcohol consumption (men only)

X_k = control variables (trend in marital and employment status are used; baseline BMI and its quadratic term are included)

After dropping the small amount of missing cases for covariates (approximately 3% of the baseline sample), there are still a few variables used in the analyses that contain missing values. These missing data range from less than 3 percent (income in 2003) to almost 9 percent (childhood family economic situations). These missing cases are retained to maximize the sample size. I impute missing values for continuous variable depression using the sample mean. Missing cases for categorical variables are coded as additional categories to the original variables. All missing cases are flagged in regression models.

I conduct multinomial logistic regression models to examine the bias of the study due to attrition from mortality, loss to follow-up and non-response on weight/height. In this analysis, respondents who died between 1999 and 2003, who were lost to follow-up and who did not provide weight/height data in either 1999 or 2003 surveys are coded as additional categories to the original four-category weight change outcome. Multivariate regression analyses generate virtually the same results as those from the simple cross-tabulation (Table 4.2). Because the focus of this study is on social disparities in body weight, regression results regarding factors related to mortality, loss to follow-up and non-response are dropped from the present analyses.

Chapter 5: Which Social Factors Are Related to Overweight and Obesity Among Elderly Men and Women?

In this chapter, I present empirical results on social determinants of overweight and obesity based on the 2003 data. I first describe the prevalence of overall and central obesity among this elderly population and the characteristics of men and women under study. Next, bivariate associations between social and behavioral factors and overall or central obesity as well as the association between social factors and health behaviors/status are assessed. Finally, results from univariate and multivariate logit regression models to estimate the risk of overall and central obesity by social, behavioral and biological factors are presented, followed by a summary of this chapter.

5.1 Prevalence of overall and central obesity

The prevalence of overall and central obesity is relatively high among older men and women in Taiwan. As shown in Table 5.1, about one-third of men and 37.8 percent of women are overweight or obese (BMI $\geq$ 25 kg/m^2) among which 3.7 percent of men and 8.1 percent of women are obese (BMI $\geq$ 30 kg/m^2), based on the WHO definition for overall obesity. The prevalence of obesity (BMI $\geq$ 27.5 kg/m^2) increases to 12.0 percent and 18.7 percent for men and women, respectively when the Asian definition is used. Women are significantly more likely to be obese than men by either the WHO or Asian standard. While central obesity is prevalent among 43.0 percent of men, the prevalence is as high as 69.4 percent among women, according to sex-specific definitions for Asian populations (waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm for women). 15.9 percent of men and 14.6 percent of women are at high risk for central obesity, using the sex-specific 85th percentile as cutoff points (an equivalent of 96 cm for women and 98 cm for men). Although older men and women tend to lose weight (Figure 5.1), women are more likely to become abdominally obese as they become older (Figure 5.2).

[Table 5.1 about here]

[Figures 5.1 & 5.2 about here]

5.2 Sample characteristics

Univariate analyses[1]

A majority of men and women in the sample are Taiwanese, married and living in urban areas (Table 5.2). About two-thirds of men and women are 65 years or older. Most people have retired – only less than one-third of men and about 12 percent of women are currently employed.

[Table 5.2 about here]

Social, behavioral and health characteristics of the study population are presented in Table 5.3. Older adults in Taiwan have predominantly a low SES of family origin. About one-fifth of men (22.7%) and women (20.3%) reported that their fathers were in high-status occupations. Less than ten percent of men (8.9%) and women (8.7%) reported that they grew up in well-to-do families. However, older adults' own

[1] Data are based on BMI sub-samples. There are small discrepancies in sample sizes for BMI and waist circumference sub-samples. Sample characteristics derived from the BMI sample are virtually the same as those from the waist circumference sub-sample.

SES is characterized by significant gender differences such that women are more socially disadvantaged than men. About 52.7 percent and 36.8 percent of men have primary and secondary or higher education, respectively, and the rest (10.5%) have no education. As mentioned earlier, primary education started to expand at the beginning of the 20th century in Taiwan; by the 1960s, primary education became universal and secondary education had expanded substantially. Despite this, more than 45 percent of women in the study sample have never been to school, and only surprisingly small proportions (12.1%) have secondary or higher education. The low educational attainment of women has been translated into their disadvantaged positions in the labor market. While men work outside the home, about a quarter (22.6%) of women do housework all their life and 7.3 percent reported being self-employed or unemployed. Among those who have ever been employed, men are more likely to be in skilled-labor (9.2% vs. 4.4%), managerial (20.3% vs. 6.5%), and professional (16.0% vs. 6.4%) jobs than women. The tertile distribution of household income looks starkly different for men and women when the sample is stratified by gender. Using the same cutoffs, 21.2 percent of men fall into the lowest income tertile compared to 35.6 percent of women. In the flip side, 40.1 percent of men are in the highest income tertile compared to 25.3 percent of women. The lower income of women may result from their loss of spouse and spousal financial support. Not surprisingly, women are also disadvantaged in terms of cumulative wealth. While 63.0 percent of women reported having no or one asset, over a half of men reported having medium (2 items) or high (3 or more items) levels of assets. Moreover, women are not as socially engaged as are men. Less than 38 percent of women participate in social activities among which 12.9 percent have a high level of participation (2 or more activities), compared to 49.2 percent participation and 19.8 percent high-level participation among men.

[Table 5.3 about here]

In terms of health behaviors, around two-thirds of older adults reported currently participating in moderate or vigorous physical activity in their leisure time, and the rest are sedentary (Table 5.3). Smoking and alcohol consumption are highly correlated with gender. More than one-third of men are current or past smokers, respectively and 22.8 percent reported currently consuming alcohol more than once a week. Only 3 percent of women either smoked or consume alcohol frequently.

More than 42 percent of men rated their health as good or excellent compared to 31.4 percent of women (Table 5.3). Among the assessed weight-related chronic conditions, hypertension is the most prevalent (35.2% for men and 40.3% for women), followed by arthritis (16.9% for men and 32.1% for women), heart disease (16.1% for men and 24.6% for women), diabetes (15.3% for men and 19.2% for women), stroke (6.2% for men and 5.7% for women) and cancer (3.0% for men and 3.7% for women). Consistent with the overall trend in Taiwan, the prevalence of obesity-related chronic conditions is relatively high among older adults, and the prevalence is higher among women than among men.

Bivariate analyses

Overweight/obesity (BMI $\geq$ 25 kg/m^2) is related to a number of social, behavioral and biological factors in expected ways. As shown in Table 5.3, the distribution of overweight/obesity varies by indicators of SES for both men and women but in different ways. The prevalence of overweight/obesity is higher among men who grew up in well-to-do families, who are in unskilled or semi-skilled/service jobs over the lifetime, and whose household income fall into the 2nd and 3rd tertiles compared to those whose childhood family economic condition were average or poor, who do agricultural work, and who have low income. Women who are in skilled and managerial jobs and who take care of housework are more likely to be overweight/obese than those who do agricultural work. Overweight/obesity is higher among women who owned modest assets (one item) compared to those who have no assets. However, women who have secondary or more education or who are in professional jobs are less likely to be overweight/obese than those who have no education or who do agricultural work. Contrary to our expectation, high level of social participation is positively related to overweight/obesity among men.

The prevalence of overweight/obesity does not vary much by levels of leisure-time physical activities for men and women (Table 5.3). As expected, men who smoked previously are slightly more likely to be overweight/obese than are never-smokers. Several health conditions also show expected associations with overweight/obesity. The prevalence of overweight/obesity is higher for older adults who have hypertension, diabetes and arthritis, for women who have functional limitations and for men who have heart disease.

The association between social, behavioral and health characteristics and central obesity (waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm for women) are presented in Table 5.4. Indicators of SES are associated with central obesity in similar ways to overall obesity for both men and women. Results of the Peason's χ^2 test show a significant positive association between childhood family economic conditions, lifetime occupation, income and central obesity among men. For example, the prevalence of central obesity is 52.5 percent among men who grew up in well-to-do families compared to 42.1 percent of men whose childhood family economic conditions were average or poor. Central obesity is prevalent among 50.2 percent men who are in semi-skilled/service jobs compared to 40.5 percent of agricultural workers. Men who have higher income and who own assets are more likely to be abdominally obese relative to those who have low income and who have no assets ($p = 0.07$). In contrast, women with high SES of family origin, secondary or higher education, semi-skilled and professional jobs, and high household income have a significantly smaller waist size. However, owning a modest level of assets (one item) increases a woman's risk of central obesity slightly ($p = 0.07$).

[Table 5.4 about here]

Physical activity is inversely associated with central obesity among women. Central obesity is prevalent among 65.3 percent of women who exercise vigorously compared to 73.0 percent of sedentary women. Central obesity, like overall obesity, is positively associated with hypertension, diabetes and arthritis among older adults and with past smoking among men. Women who rated their health as good or excellent are significantly less likely to be abdominally obese than those who reported having fair or poor health. In addition, central obesity is higher among those with heart disease, stroke and functional limitations, but lower among men who have depressive symptoms.

5.3 Association between social factors and health behaviors/status[2]

As an attempt to elucidate the pathways through which social factors affect body weight, the association between life-course SES, social participation and weight-related health behaviors and self-rated health status is assessed using logistic regression. In this analysis, physical activity and smoking are recoded as dichotomous variables. Those who reported doing any exercise and having ever-smoked (men only) are assigned the value 1 and 0 otherwise. Because of the extremely low prevalence among women, smoking and drinking are only included in the men's models. Age is adjusted in all models.

[Table 5.5 about here]

As expected, Table 5.5 shows that after controlling for age, childhood SES, adult SES and social participation are significantly associated with physical activity and self-related health for both men and women. However, the association between the former and smoking or drinking is relatively weak among men. There is a graded, positive association between education, lifetime occupation, yearly income and physical activity among men and women, but the association between income and physical activity is only significant for women. Men with primary (odds ratios (OR) = 1.71) and

---

[2] Data are based on the BMI sub-sample.

secondary or higher education (OR = 2.68) have higher odds of participating in physical activities than those who have no education. The odds of participating in physical activities increase from 1.74 to 3.73 as occupational position moves from unskilled labor to professional jobs among men. While the association between education, lifetime occupation and physical activity is strong and significant among women, the magnitude of the association is smaller than that for men. Older adults with any asset are also more likely to participate in physical activities than those with no assets. Physical activity in later life is not only patterned by one's own SES but also related to one's early life conditions. Men (OR = 1.93) and women (OR = 1.49) with a high SES of family origin have significantly higher odds of physical activity. Physical activity is associated with childhood material resources among women (OR = 1.58) but not among men. Thus, older adults' behavior in physical activity may track over the life-course. Moreover, social participation is associated with physical activity. While men with a high level of social participation have higher odds of participating in physical activities (OR = 1.40), the odds of physical activity are higher for women who engage in both medium (OR = 1.64) and high levels (OR = 2.97) of social activities. The latter findings suggest that health promotion activities such as group physical exercise may be an integral part of social activities, more so for women than for men.

With regard to smoking and drinking, the odds of smoking are significantly lower among men in professional jobs and those with highest income and assets (Table 5.5). Surprisingly, frequent drinking is not related to SES. But men with a medium level of social participation are more likely to be frequent drinkers (OR = 1.37) than those who are not socially engaged. Self-rated health status is assessed as a proxy for chronic conditions included in this study. All indicators of SES are positively and significantly associated with self-rated good health.

5.4 Social factors, health behaviors, and overall obesity

Table 5.6 presents results of univariate and multivariate multinomial logit models predicting the risk of overall obesity separately for men and women. The multinomial logit model contrasts the likelihood of being in overweight/obesity (BMI $\geq$ 25 kg/m^2) or underweight groups versus the normal weight group (reference group). Because the focus of this study is on overweight and obesity, results on underweight are not shown. The first column of the male and female panels present results from univariate multinomial regression models, which demonstrate the same associations between social, behavioral factors and overweight/obesity as those shown in Table 5.3. That is, there is a positive association between childhood family economic conditions, income, social participation, past smoking and overweight/obesity among men. While overweight/obesity is inversely related to education, it is positively associated with owning modest assets (one item) for women. Overweight/obese individuals are more likely to be involved in less physically demanding jobs than agricultural work in the life time.

[Table 5.6 about here]

The relationship between social, behavioral, health characteristics and overweight/obesity is assessed by conducting a sequence of multinomial logit models.

The odds ratios of overweight/obesity by indicators of SES and social participation are adjusted for demographic characteristics in model 1 of Table 5.6. Health behaviors being studied are added in model 2. Model 3 adjusts for the effect of a series of chronic conditions.

Results from model 1 of the male panel in Table 5.6 show that the odds ratios associated with family economic conditions in childhood, being in semi-skilled/services jobs through lifetime and a high level of social participation among men increase modestly after controlling for other indicators of SES and demographic characteristics. However, the bivariate association between income and overweight/obesity attenuates to a statistically insignificant level after SES and demographic variables are controlled. Adding health behaviors in model 2 and health status in model 3 slightly change the odds ratios associated with childhood family economic conditions, semi-skilled/service jobs and social participation. In the full model (model 3), after adjustment for health behaviors, health status and demographic characteristics, the relative probability of a man being overweight/obese versus having a normal weight is higher if he grew up in a well-to-do family (OR = 1.67), he has a semi-skilled/service job (OR = 1.80), and he has a high level of social participation (OR = 1.37, $p<0.10$) than those whose childhood family economic conditions were average or poor, who do agricultural work, and who are not socially engaged.

Turning to model 1 in the female panel, the effect of secondary or more education on overweight/obesity increases, but the effect of occupation and household assets decreases after adjustment for other SES and demographic variables. When physical activity is added in model 2 and health conditions are added in model 3, the odds ratios associated with education, occupation and assets change modestly. The results of the full model, when physical activity, health conditions and demographic variables are controlled, show that the effect of education is strong and significant. Compared to the normal weight group, women with secondary or higher education are 59 percent less likely to be overweight/obese than those who have no education. The effect of lifetime occupation on overweight/obesity reduces yet remains significant for skilled labor (OR = 1.83, $p<0.10$), managerial (OR = 1.95), and housewife (OR = 1.52) categories. The association between modest assets (one item) and overweight/obesity is marginally significant (OR = 1.34, $p<0.10$).

The above results, in support of our hypothesis, suggest that the health behaviors being considered cannot explain the association between SES, social participation and overweight/obesity. Despite their small mediating effects, two of these behavioral factors are significantly related to overweight/obesity. In model 3 of Table 5.6, compared to the normal weight group, men and women with moderate physical activities and women with vigorous physical activities are less likely to be overweight/obese than those who are sedentary. The risk of being overweight/obese versus having a normal weight is slightly higher among male past smokers than non-smokers. It should be noted that physical activity is not significantly associated with overweight/obesity in bivariate analyses but the association becomes significant after controlling for demographic and social factors (model 2, Table 5.6). Additional analyses (results not shown) show that the association between physical activity and overweight/obesity reaches a significant level after controlling for social factors. The findings indicate a complex interrelationship between social factors, physical activity and body weight. In addition, the results demonstrate strong positive associations between overweight/obesity and hypertension or arthritis for older adults and between overweight/obesity and functional limitations among women, even after controlling for demographic, social and behavioral characteristics. The causal order between body weight and chronic conditions cannot be elucidated in the cross-sectional data. But chronic diseases are likely to be the consequences of overweight and obesity as suggested by numerous clinic studies.

Some of the control variables are worth noting. For both men and women, the risk of overweight/obesity declines with age. Urban women are more susceptible to the risk of overweight/obesity than rural women, while urban residence has no effect for men. Indicators of how BMI is measured are not closely related to body weight, lending face validity for self-reported weight and height data used in this study.

To further assess social and behavioral determinants of overweight and obesity, multinomial logit models are estimated to contrast the likelihood of being overweight (BMI 25-27.5 kg/m^2), obese (BMI $\geq$ 27.5 kg/m^2) versus being in the normal weight group (reference group), as well as the likelihood of being obese versus being overweight (reference group). The results (Table 5.7) demonstrate strong positive effects of economic resources over the life course on the risk of overweight and obesity. Compared to the normal weight group, men who grew up in well-to-do families are 1.57 and 1.83 times as likely to be overweight and obese as those whose childhood family economic conditions were average or poor. The effect of childhood family economic condition is independent of adulthood SES. Further, the relative probability of a man's risk of being obese versus being in the normal weight group is 78 percent and 87 percent higher if he has middle or high income than those who have low income ($p<0.10$). The positive effect of the highest income (OR = 1.55) on women's risk of being obese versus having a normal weight is also marginally significant among women. Moreover, cumulative wealth is a strong risk factor for obesity among women. Women who reported having one asset (OR = 1.59) or two assets (OR = 1.62) have significantly higher odds of being obese than those with no assets, compared to the normal weight group. The relative probability of a women's risk of being obese versus being in the overweight group is 88 percent and 89 percent higher if she has one asset or two assets than those who have no assets. The results also highlight the protective effect of secondary or higher education on the risk of overweight and obesity among women. A woman who has secondary or higher education is 48 percent and 29 percent as likely to be overweight or obese as those who have no education, compared to the normal weight group. But the effect of primary education is inconsistent. While primary education is a modest protective factor against overweight among women, it increases women's risk of being in the obesity group (OR = 1.82) versus being in the overweight group. In support of our hypothesis, compared to the overweight group, women with a high level of social participation are 52 percent as likely to be in the obese group as those who are not socially engaged.

[Table 5.7 about here]

In terms of behavioral and health factors, moderate physical activity is a protective factor for both overweight and obesity (OR = 0.63, $p<0.10$) among men, and for overweight among women. As expected, chronic conditions such as hypertension, diabetes, heart disease, arthritis, functional limitations are noticeably more associated with obesity than overweight.

In sum, the results indicate that SES has considerable impacts on overall obesity for both men and women. Among women, secondary or more education is protective against overweight and obesity, but obesity is higher among those who have higher levels of cumulative wealth. Among men, childhood family economic conditions have positive effects on the presence of overweight and obesity independent of adulthood SES; income is positively related to obesity only. Both men and women who engage in less physically demanding work (i.e. semi-skilled/service, skilled and managerial jobs or housework) currently or over the lifetime are more likely to be overweight than agricultural workers. While a high level of social participation is related to an increased risk of overweight among men, it is protective against obesity among women. Health behaviors are socially patterned, but they do not mediate the association between SES, social participation and overweight and obesity. Leisure-time physical activity is a protective factor for overweight among women and for overweight and obesity among men.

5.5 Social factors, health behaviors, and central obesity

To identify social determinants of central obesity, the above analyses are replicated on respondents who provided waist circumference data. The first outcome measure is a dichotomous variable: central obesity (≥ 90 cm for men and ≥ 80 cm for women) or not. Hence, binomial logit models are conducted. Subsequent analysis considers a three-category measure of central obesity. Table 5.8 presents results of univariate and multivariate logit models predicting the risk of central obesity separately for men and women.

[Table 5.8 about here]

Model 1 of the male panel in Table 5.8 reveals that when SES and demographic characteristics are controlled, the positive effects of income and household wealth on central obesity remain strong and significant among men, the effect of childhood family economic conditions (OR = 1.41, $p<0.10$) decreases but remains borderline significant. The positive association between semi-skilled/services jobs and central obesity is explained away by SES and demographic variables. Adding health behavioral factors in model 2 barely changes the odds ratios associated with childhood family economic conditions, income and wealth among men. The effect of income and wealth on central obesity decreases but is still significant when health status variables are added in model 3. In model 3, after adjustment for health behaviors, health status and demographic characteristics, the relative probability of a man being abdominally obese versus having a normal waist size is higher if he is in middle-income (OR = 1.33, $p<0.10$) or high-income (OR = 1.51) groups, or he has one asset (OR = 1.39, $p<0.10$) or three or more assets (OR = 1.50) than those who are in the lowest income group or who have no assets. In contrast, the effect of early life family economic conditions on central obesity attenuates to a statistically insignificant level after adjusting for health condition variables.

With regard to social factors among women, model 1 on the female panel (Table 5.8) shows that after controlling for other SES variables and demographic characteristics the effect of household wealth on central obesity increases (OR = 1.51), and the effect of secondary or more education (OR = 0.56, $p<0.05$) and professional jobs (OR = 0.58, $p<0.10$) attenuates substantially yet remains significant. However, the bivariate effect of SES of family origin and income on central obesity becomes insignificant when SES and demographic variables are controlled. Additional analyses demonstrate that the association between SES of family origin and central obesity attenuates to a statistically insignificant level only when adulthood SES, particularly education, is adjusted. The result suggests that the impact of early life SES on central obesity is transmitted through education among women. The odds ratios associated with secondary or more education, professional jobs, wealth and central obesity change little after adding physical activity in model 2. However, when health conditions are adjusted in model 3, the effect of professional jobs and modest assets (one item) increases, whereas the effect of secondary or more education is no longer significant. In the full model, the relative probability of a professional woman being abdominally obese versus having a normal waist size is about the half of that of agricultural workers. Compared to the normal waist size group, women with modest assets are 1.66 times as likely to be abdominally obese as those who have no assets. Due to the problem of collinearity between education and occupation, I did some additional model testing (result not shown). Both secondary or more education and professional jobs are inversely associated with central obesity when adding into the model one at a time, indicating that higher education and high-status jobs are protective against central obesity for women, although the effect of the latter appears to be stronger than the former.

The findings, reinforcing our hypothesis, indicate that health behaviors being studied do not have mediating effects on the association between SES and central obesity. Nevertheless, physical activity appears to be a protective factor against central obesity among women. In model 3 of Table 5.8, after controlling for social factors, health conditions and demographic variables, women with vigorous activity (OR = 0.72, $p<0.10$) are less likely to be in the central obesity group versus the normal waist size group than those who are sedentary. Similar to what is found about overall obesity, central obesity is closely related to hypertension, diabetes, arthritis, and functional limitations among men and women.

Finally, Table 5.9 presents results of multinomial logit models contrasting the likelihood of being in the medium-risk central obesity group, high-risk central obesity group versus being in the normal waist size group (reference group)[3]. I ran alternative models to compare social determinants of high-risk central obesity with those of the medium-risk central obesity (reference group). Economic resources over the life course

---

[3] Medium-risk waist circumference is defined as waist circumference between 80 cm and 95 cm for women and between 90 cm and 97 cm for men; high-risk waist circumference is defined as waist circumference ≥ 96 cm for women and ≥ 98 cm for men.

have similar effects on central obesity as that for overall obesity. Compared to those with a normal waist size, men who grew up in well-to-do families are 1.81 times as likely to have a high-risk waist size as those whose childhood family economic conditions were average or poor. The effect of childhood family economic condition is independent of adulthood SES. In addition, income has a strong positive influence on high-risk waist size. Men with middle or high income are more than two times as likely to be in the high-risk waist size group versus the normal waist size group as those who have low income. Even compared with the medium-risk waist size group, men with middle or high income are 1.98 times and 1.83 times as likely to have a high-risk waist size as those with a low income. Owning modest assets (one item) is a strong risk factor for medium-risk and high-risk central obesity among women. Moreover, having a semi-skilled job appear to be a risk factor for higher-risk waist size among men. Men with a medium level of social participation are slightly more likely to be in the high-risk waist group versus the medium-risk waist group than those who are not socially engaged. Both secondary or more education and professional jobs are inversely associated with the risk of having a high-risk waist size when adding one at a time in the model (result not shown). Surprisingly, professional jobs are protective against the risk of having a medium-risk waist size even among men. Also, men with secondary or higher education are significantly (p<0.10) less likely to have a high-risk waist size than those who have no education.

In terms of health behaviors and health status, vigorous physical activity (OR = 0.58) is protective against high-risk central obesity among women only. Similar to what we have seen for the overall obesity, chronic conditions such as hypertension, arthritis and functional limitations among men and women and diabetes among women are more associated with high-risk central obesity than medium-risk central obesity.

[Table 5.9 about here]

To sum up, the above analyses show an overall similar pattern in the association between social factors and central obesity to that between social factors and overall obesity. Among women, while both secondary or higher education and professional jobs are inversely related to central obesity, central obesity is positively associated with a modest level of wealth. The inverse association between early life SES and central obesity is explained away by education. Among men, there is a strong positive association between childhood family economic conditions, income, household wealth and central obesity. A medium level of social participation increases men's likelihood of having a high-risk waist size. Unlike what we have found for overall obesity, secondary or higher education and professional jobs also have modest protective effects against men's risk of central obesity. Semi-skilled/service jobs increase men's risk of central obesity. Health behaviors being studied do not mediate the association between social factors and central obesity. Vigorous physical activity protects against the risk of central obesity for women.

5.6 Summary

Using the 2003 wave of the longitudinal HLSES data in Taiwan, the social determinants of weight status among men and women aged 57 years or older are examined in this chapter. In general, the prevalence of overweight and obesity among the elderly is relatively high. 28.5 percent of men and 29.7 percent of women are overweight, 3.7 percent of men and 8.1 percent of women are obese according to the WHO definition for overall obesity. While 27.1 percent of men and 54.8 percent of women have a medium-risk waist size (waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm for women), the prevalence of high-risk central obesity (an equivalent of 85^{th} percentile of the waist circumference for men and women, respectively) is about 15.9 percent for men and 14.6 percent for women. The prevalence of overweight and obesity among the elderly is consistent with the rise of obesity epidemic in Taiwan in recent decades (Pan et al. 2008).

The results demonstrate that childhood and adulthood SES have considerable impacts on overall and central obesity net of the effect of demographic characteristics, health behaviors and health conditions. In partial support of our hypotheses, education is a protective factor against overweight and obesity among women and to a much lesser extent for men, whereas both income and cumulative wealth are risk factors for overweight and obesity for both men and women. The risk of overall and central obesity decreases for women with secondary or higher education and increases for women with higher levels of household wealth. While income increases men's risk of overall obesity, their risk of central obesity is heightened with the increase of both income and wealth. Secondary or higher education has a modest protective effect on high-risk central obesity among men. The observed patterns in the relationship between education, material resources and overweight and obesity resemble the patterns of other transitional societies, despite the less distinctive gender differences among this elderly cohort than among young or middle-aged adults. The positive association between income, cumulative wealth and body weight may reflect the important role of material resources in food availability through most of the lifetime of the elderly in Taiwan. While material resources appear to continue to affect energy intake for this elderly population, the energy balance of individuals starts to be more dependent on informed choices regarding weight-related health behaviors as it is suggested in this study. The stronger inverse association between education and body weight among women than among men may suggest that women are more concerned about body weight and physical appearance than men. Although older Taiwanese women are less pressured to achieve the appearance goal than younger women, they may also conform to the Western ideal of thinness.

The association between lifetime occupation and body weight shows a mixed pattern. Semi-skilled or service jobs increase men's risk of overall and central obesity. Women who engage in less physically demanding work (i.e. skilled and managerial jobs) or household chores currently or over the lifetime are also more likely to be overweight/obese than agricultural workers. The modest positive association between occupation and body weight may be a consequence of rapid structural shifts in Taiwan over the past decades. As a society moves from agricultural to industrialized one, the amount of work-related physical labor decreases, particularly among men. The finding that older adults in professional jobs have a reduced risk for central obesity suggests that people with high-status jobs may have a shared belief about body shape and engage in more efforts to maintain their desired body size/shape, particularly women.

Overweight and obesity are not only related to adulthood SES but also associated with early life circumstances. Among men, childhood family economic conditions have positive effects on the presence of overall and central obesity net of the effect of adulthood SES. This result, consistent with existing studies, may suggest that differential exposure to body fatness and behavioral risk factors by early life SES have critical effects on men's body weight later in life. In contrast, the observed inverse association between SES of family origin and central obesity among women is explained away by adulthood SES, particularly education. Thus, the mechanism by which SES of family origin is related to central obesity among women is through its association with SES in adulthood.

Social participation has a modest effect on body weight for men and women but in opposite ways, partially supporting our hypotheses. Active social participation is associated with a higher risk of overall and central obesity among men, whereas it is related to a lower risk of obesity among women. One possible pathway through which social participation protects against obesity among women is that social participation promotes leisure-time physical activities. Although men who have a high level of social participation are more likely to engage in physical activities, social participation is also found to be associated with heavy drinking as what is shown elsewhere (Seeman and Anderson 1983). Thus, it is possible that a high level of social activities is linked to unhealthy weight through frequent alcohol use because heavy drinking is a known risk factor for obesity. However, the cross-sectional study does not allow us to determine the causal order of the relationship between social participation and weight-related health behaviors and between social participation and body weight.

As expected, health behaviors, in spite of being socially patterned, have small mediating effects on the links between SES, social participation and cumulative body weight and waist size. This is probably due to incomplete measure of health behaviors, reporting errors on these behaviors, and more importantly, the cross-sectional measure of health behaviors. SES and social participation tap into a wide spectrum of weight-related factors over an individual's life course, but the data at hand do not allow us to include all important factors. To name a few, information about dietary and social support for weight control is not available. Although health behaviors have SES roots early in life, health behaviors being considered are measured at a particular time point. Physical activity is an independent protective factor against overall and central obesity among women and against overall obesity among men.

In conclusion, the findings indicate a transitional pattern in the relationship between life-course SES and overweight and obesity among the elderly in Taiwan. That is, education is a strong protective factor against overweight and obesity among women and to a much lesser extent among men. Both childhood and adulthood material resources (i.e. income and wealth) increase men's risk of overweight and obesity, but the risk of overweight and obesity in women is only related to adulthood material resources. While active social participation increases the risk of overweight and obesity among men, it is related to a lower risk of obesity among women. Despite its minimum mediating effect on the association between social factors and body weight, physical activity is an independent protective factor against overweight and obesity among men and women. The findings demonstrate the importance of education and material resources over the life course and, to some extent, social participation and physical activity in affecting individuals' cumulative body weight and waist size in late life. The remaining question is to what extent the same set of variables predicts weight change, the driving force behind cumulative weight status. I will assess this question in the following chapter.

Chapter 6: Who Gains Weight? Prevalence and Predictors of Weight Gain Among Elderly Men and Women?

This chapter presents results on social and behavioral predictors of weight change between 1999 and 2003 with a focus on weight gain. First, I describe the distribution of weight change and selected characteristics of male and female respondents in 1999 and 2003. Then, bivariate association between social and behavioral factors and weight gain and the association between social factors and patterns of physical activity are presented. Finally, results from multivariate OLS regression models and multivariate logit regression models to predict the risk of weight gain and the onset of overweight/obesity by baseline and change predictors are discussed.

6.1 Distribution of weight change

There is a modest change in the distribution of BMI between 1999 and 2003 for the elderly population under study. Table 6.1 shows that the proportion of underweight men and women increases by 1 percent or remains unchanged over the four-year period. Despite the general trend of weight loss among the elderly, the prevalence of overweight and obesity has increased by 2.4 percent for men and 3.3 percent for women. Based on the McNemar’s chi-square test for changes in the distribution of BMI between 1999 and 2003, the increase in overweight and obesity is statistically significantly among women and in the total population.

[Table 6.1 about here]

Table 6.2 offers a different picture of weight change when weight change is assessed by change in body weight (in kg) between 1999 and 2003. The elderly population has experienced both substantial weight loss and weight gain over the four-year period. 21.2 percent of men and 26.3 percent of women have lost more than 3.5 kg. Similarly, over 10 percent of men and women have gained more than 2.5 kg and up to 5 kg; another 10 percent of men and women have gained more than 5 kg. Among those who maintain a stable weight or who gain weight, the average weight gain is 3.1 kg. For those who have a normal weight in 1999, 15.1 percent of men and 17.6 percent of women have become overweight or obese by 2003. Furthermore, although the proportion of older adults who lose substantial weight increases with age, the proportion of men and women who gain substantial weight is evenly distributed across age groups (Figures 6.1 & 6.2). The distribution of weight change by various measures provides justification for the working definitions of weight change in the present analysis.

[Table 6.2 about here]

[Figures 6.1 & 6.2 about here]

6.2 Selected sample characteristics in 1999 and 2003

Selected characteristics of male and female respondents in 1999 and 2003 are presented in Table 6.3. A larger proportion of women than men become widowed between 1999 and 2003. A considerable proportion of older adults retired over the period – 43.9 percent of men and 19.3 percent of women are employed in 1999, the corresponding figures decrease to 29.0 percent and 11.9 percent by 2003 for men and women, respectively.

[Table 6.3 about here]

Table 6.3 highlights change and stability in older adults' material resources and social participation. While women are more disadvantaged in income and cumulative wealth relative to men, both men and women experience a substantial income decline. Based on the same cutoffs for income tertile, 53.6 percent of men and 35.3 percent of women fall into the highest income group in 1999, but the corresponding figures decrease to 40.5 percent and 25.4 percent in 2003. The proportion of individuals who fall into low and middle income groups increase. In contrast, the level of assets remains pretty stable over this period for both men and women. Older adults tend to participate less in social activities over time – 42.3 percent of men and 56.2 percent of women are not socially engaged in 1999 compared to 51.1 percent of men and 62.2 percent of women in 2003.

Although the health conditions of older adults deteriorate over time, they manage to maintain or increase level of physical activity (Table 6.3). The proportion of older adults who have chronic conditions such as hypertension, diabetes, heart disease, stroke, cancer and arthritis increases, as does the severity of functional limitations. In the same period, more than two-thirds of men remain moderately or vigorously active, and the proportion of women who are active increases from 55.1 to 63.2. The proportion of male smokers decreases from 45.3 to 37.5. The results suggest that the favorable behavioral changes are well under way among the elderly population in Taiwan.

6.3 Bivariate analyses[1]

Table 6.4 shows considerable associations between baseline social and behavioral characteristics and weight gain between 1999 and 2003. Women with a high SES of family origin are less likely to gain moderate weight than those whose SES of family origin is low. As expected, older adults who have secondary or more education are less likely to gain excess weight than those who have no education. The prevalence of large weight gain is also lower among men who have primary education than those who have no education. In addition, older adults in the high income group are less likely to gain excess weight than those in the low income group. Older men and women who reported having three or more assets are less likely to gain moderate and large weight respectively than those who have no assets. Moreover, the prevalence of large weight gain is lower among older adults who are in semi-skilled/service jobs and professional jobs than agricultural workers. Compared to those who are not socially engaged, men with medium and high levels of social participation are less likely to have moderate weight gain, and women with a high level of social participation are less likely to gain excess weight. The prevalence of large weight gain is also lower for women who exercise vigorously relative to sedentary women.

[Table 6.4 about here]

[1] Since the focus of this study is on weight gain, results on weight loss and weight stability are not shown.

Weight gain is related to several change predictors. Table 6.5 demonstrates that the prevalence of large weight gain is lower among women who have persistently moderate or high income, and who have a persistently high level of assets, relative to those whose household income and assets are persistently low during the four-year period. Furthermore, a persistently high level of social participation is associated with a lower prevalence of moderate weight gain among men and a lower prevalence of large weight gain among women. Older adults who stick to vigorous physical activities are less likely to gain excess weight compared to those who remain sedentary over the period. Additionally, men who start to consume alcohol more than once a week between 1999 and 2003 are more likely to gain excess weight than those who do not drink or drink less frequently over this period.

[Table 6.5 about here]

6.4 Association between social factors and patterns of physical activity

Physical activity is one of the most important modifiable behaviors standing in the causal pathways of the relationship between social factors and weight gain. Individuals who are best positioned with regard to SES and social participation are expected to be the first ones to make behavioral adjustments and are more likely to stick to these healthy behaviors. The association between life-course SES, social participation and patterns of physical activity is estimated using age-adjusted multinomial logit regression models. Patterns of physical activity between 1999 and 2003 are classified into three categories: persistently active, become active, and remain or become sedentary (reference group). SES and social participation are measured by 1999 data and by change between 1999 and 2003.

[Table 6.6 about here]

After controlling for age, all indicators of SES are significantly associated with persistent physical activity between 1999 and 2003, except for childhood family economic conditions for men and change in household wealth for women (Table 6.6). Education and lifetime occupation have the strongest positive impacts on persistent physical activity for both men and women, but the magnitude of the association is relatively smaller among women than among men. For example, compared to those who are sedentary, men with primary and secondary or higher education are 1.84 times and 3.78 times as likely to be persistently active as those who have no education. The corresponding odds ratios associated with primary and secondary or more education among women are 1.43 and 2.34. Compared to the sedentary group, the odds of persistent physical activity increase from 2.22 to 6.47 as occupational position moves from unskilled labor to professional jobs relative to the base category of agricultural work among men. Among women, the odds increase from 1.88 to 3.28 as occupation moves from semi-skilled/service jobs to professional jobs. Moreover, older adults who have high income or a medium level of assets (two items) at baseline are more likely to exercise persistently over the period. Further, men and women with a high cumulative income over the period are 1.80 and 2.24 times as likely to stick to physical activity versus remaining sedentary as those who have persistently low income. Men with a persistently moderate and high level of assets are 2.36 and 2.11 times as likely to be in the persistently active group versus the sedentary group as those who have no assets over the period. Patterns of persistent physical activity are not only influenced by adulthood SES but also have roots in childhood SES. The relative odds of men and women with high SES of family origin being persistently active versus remaining sedentary are 2.27 and 1.78 times those with a low SES of family origin. Growing up in a well-to-do family increases women's odds (odds ratios (OR) = 1.75) of sticking to physical activity versus being sedentary, but the association does not exist among men. The latter findings suggest that the influence of early life material resources on health behaviors later in life may be gender-specific.

Social participation has significant influences on patterns of physical activity, especially for women (Table 6.6). Compared to women who remain sedentary, women who engage in medium and high levels of social activities in 1999 are 1.99 times and 1.80 times as likely to stick to physical activity as those who are not socially engaged. Men with a high level of social participation in 1999 also have higher odds of sticking to physical activity (OR = 1.53) versus remaining sedentary than those who are not socially engaged. Furthermore, compared to the sedentary group, men with persistently high social participation are 1.99 times as likely to stick to physical activity as those who are not socially engaged over the period. In contrast, the odds associated with persistent physical activity are 2.59 and 4.45 for women who engage in moderate or high levels of social activities throughout the period. Women who start to participate in social activities (OR = 1.78) during the period appear to be more likely to stick to physical activity versus those who remain sedentary. But we cannot determine the causal order for the associations between change in social participation and patterns of physical activity in the period.

The associations between SES, social participation and the initiation of physical activity over the period are relatively weak. Initiation of physical activity is only related to income for older adults and social participation for women. Specifically, men with middle-income at baseline are more likely (OR = 1.76) to become physically active versus remaining sedentary than those with low income. Among women, compared to the sedentary group, the odds of becoming physically active are higher for those who have a high income (OR = 1.62) at baseline, who have a high cumulative income over the period (OR = 2.45), or who maintain a high level of social participation (OR = 2.11) than their counterparts who have a low income at baseline or persistently low income, or who are not socially engaged throughout the period.

Overall, childhood and adulthood SES and social participation have significant impacts on persistent physical activity in late life, but their impacts on the initiation of physical activity are much weaker. Those with cumulative socioeconomic advantages are more likely to adopt healthy behaviors and to stick to these behaviors once adopted. The weaker influence of SES and social participation on the initiation of physical activity is not surprising since initiating physical activity is pretty rare (14.3% of respondents become active over the period). Given the relatively high level of physical activity among this elderly population, it is plausible that large-scale behavioral shifts have happened before the survey period we studied. Thus, the behavioral change observed here may reveal a tail of a whole picture.

6.5 Effects of baseline characteristics on weight gain

Preliminary multivariate analyses indicate that health behaviors have modest mediating effects on the relationship between SES, social participation and weight gain. Therefore, I only present results of fully adjusted OLS or logit models. The effects of social and behavioral factors on various weight gain outcomes presented below are independent of demographic and health variables and net of the effects of each other.

[Table 6.7 about here]

First, OLS regression models are used to examine the determinants of weight change as a continuous variable. As mentioned earlier, weight losers are dropped from this analysis. Table 6.7 offers a first look at which social and behavioral factors are important predictors of weight gain. As expected, men with primary and secondary or higher education gains significantly less weight than those who have no education. Secondary or higher education is inversely associated with weight gain among women ($p<0.10$). Also, women with a medium level of assets (two items) at baseline gain significantly less weight than those who have no assets ($p<0.10$). A high level of social participation and vigorous physical activity at baseline are strong protective factors against greater weight gain in women.

Next, the effects of social and behavioral factors on the magnitude of weight gain are assessed. Table 6.8 presents results of multinomial logit models predicting four possible patterns of weight change: substantial weight loss, stable weight, moderate weight gain and large weight gain. The multinomial logit results compare the likelihood of being in each of the weight change groups versus the reference group (stable weight).

Education is a protective factor against weight gain among men and to a lesser extent for women. Compared to those who maintain a stable weight, men with secondary or more education are 49 percent ($p<0.10$) and 58 percent less likely to experience moderate or large weight gain in later life than those with no education. Men who have primary education (OR = 0.52) are also less likely to be in the large weight gain group versus the stable weight group than those who have no education. In contrast, the education effect on weight gain for women is attenuated yet remains marginally significant when childhood SES is adjusted. After controlling for childhood SES, women with secondary or more education are less likely to be in the moderate weight gain (OR = 0.42, $p<0.10$) group versus the weight stable group than those who have no education. However, education is no longer associated with large weight gain. Further analyses (Appendix Table 6.12) show that both SES of family origin and education are inversely associated with weight gain among women when they are added in the model one at a time, suggesting that the influence of early life SES on women's later weight gain is mainly transmitted through education.

Consistent with our expectation, baseline wealth predicts subsequent weight gain among women only. Women with a medium level of assets (two items) at baseline (OR = 0.53) are less likely than those who have no assets to be in the moderate weight gain group versus the weight stable group. However, additional analyses contrasting the large weight gain group with the moderate weight gain group show that women with modest assets (one item) (OR = 1.89, $p<0.10$) at baseline are more likely to be in the large weight gain group versus the moderate weight gain group than those who have no assets (Appendix Table 6.13). As expected, lifetime occupation has only a modest impact on weight gain except that women in semi-skilled/service jobs are less likely to be in the large weight gain group versus the weight stable group than agricultural workers.

[Table 6.8 about here]

Table 6.8 also highlights that social participation is a strong protective factor against weight gain. Compared to the stable weight group, men who engage in social activities at baseline are less likely to gain moderate weight than those who are not socially engaged. However, men with a high level of social participation at baseline (OR = 1.89, $p<0.10$) are more likely than those who are not socially engaged to be in the large weight gain group relative to the moderate weight gain group (Appendix Table 6.13). Among women, the relative probability of gaining excess weight versus maintaining a stable weight is 67 percent lower among those with a high level of social participation at baseline than their counterparts who are not socially engaged.

Baseline physical activity is a protective factor against weight gain among women but not among men. Women who exercise vigorously at baseline are significantly less likely than those who are sedentary to be in the large weight gain group versus both the stable weight group (Table 6.8) and the moderate weight gain group (Appendix Table 6.13). Even moderate activity at baseline (OR = 0.60, $p<0.10$) is protective against women's risk of excess weight gain compared to the moderate weight gain group (Appendix 6.13).

Interestingly, self-rated health status at baseline is related to subsequent weight gain for men and women in different ways (Table 6.8). Compared to the stable weight group, men with a self-rated good health at baseline (OR = 0.61) are less likely than those in the fair/poor health group to gain excess weight, whereas healthy women at baseline (OR = 1.53, $p<0.10$) are more likely to gain moderate weight than those whose health status is fair or poor. In addition, women with functional limitations at baseline (OR = 1.14, $p<0.10$) are also more likely to gain excess weight relative to the stable weight group.

The effects of several control variables are worth noting (Table 6.8). Compared to the stable weight group, men who are employed at baseline are less likely (OR = 0.61) to gain excess weight than men who are not working. This result may suggest that work-related physical activity benefits men's health, regardless of type of occupations. It is also possible that men who had stopped working may have had a condition which predisposed them to gain weight and to stop working. For women, being married at baseline appears to be a protective factor against moderate weight gain. However, women who reside in urban areas at baseline are 1.92 times as likely as rural residents to be in the large weight gain group versus the moderate weight gain group (Appendix Table 6.13). Baseline BMI and BMI square are related to subsequent weight gain among women in opposite directions. The result indicates that the larger the baseline BMI the less likely a woman gains excess weight subsequently. But excess weight gain decreases with larger baseline BMI at a decelerating rate as BMI increases.

While the main focus of this study is weight gain, some factors associated with weight loss deserve mentioning (Table 6.8). Education is a strong protective factor against weight loss among women such that women with both primary and secondary education are less likely than uneducated women to lose substantial weight. In contrast, women who grew up in well-to-do families and who own a medium level of assets (two items) at baseline are slightly less likely to lose substantial weight, indicating the beneficial effect of material resources over the life course for maintaining a healthy weight. Men and women are more likely to lose weight after they turn 65 and 70 years, respectively. However, older adults who remain physically active at baseline are less likely to experience large weight loss subsequently. In addition, employment at baseline appears to be a protective factor against subsequent weight loss among women. Women with a larger baseline BMI (OR = 1.33, $p<0.10$) are more likely to lose substantial weight. But we cannot distinguish between intentional and unintentional weight loss with the current data. It is plausible that women with a large body size put more efforts into weight control.

Table 6.9 presents results of logit models predicting the incidence of overweight/obesity between 1999 and 2003 by baseline social and behavioral characteristics. The sample is restricted to respondents who have a normal weight in 1999 but become overweight/obese by 2003. Childhood family economic condition[2] is

[2] Childhood family economic condition is not significantly associated with the onset of overweight/obesity either for men or for women in bivariate analyses.

dropped because it causes colinearity problem with other SES measures in the male model. For comparison purposes, this variable is also dropped from the female model.

[Table 6.9 about here]

Even controlling for baseline demographic characteristics, health behaviors and health conditions, education still appears to be a strong protective factor against the risk of becoming overweight/obese over the four-year period. Men and women who have secondary or higher education are 65 percent and 77 percent less likely, respectively, to become overweight/obese than those who have no education. Even men with primary education are 55 percent less likely to become overweight/obese than those who have no education. Women with a medium level of assets (two items) at baseline are 55 percent less likely to become overweight/obese subsequently than those who have no assets. Interestingly, women who are in skilled labor and managerial jobs are 2.82 times and 3.06 times as likely to become overweight/obese as agricultural workers. Earlier findings show that women in skilled labor and managerial jobs are more likely to engage in persistent physical activity than agricultural workers over this period (Table 6.6). The latter findings may suggest that skilled labor and managerial jobs for women are mostly sedentary.

6.6 Association between change predictors and weight gain

Finally, I present results of multinomial logit models examining the association between change predictors and weight gain. The change predictors are constructed based on information from baseline and follow-up surveys. The contemporaneous nature of this analysis does not allow us to determine the causal relationship between change predictors and weight gain.

[Table 6.10 about here]

Table 6.10 highlights the protective effect of cumulative social advantages against weight gain. Compared to the stable weight group, men who have a high level of social participation between 1999 and 2003 are significantly less likely than those who are not socially engaged (OR = 0.45) to be in the moderate weight gain group. In contrast, the bivariate association between persistent social participation and weight gain among women is attenuated to an insignificant level when patterns of physical activity and baseline health conditions are added in the model subsequently. Previous results show that persistent and newly initiated social participation are strongly associated with persistent physical activity among women (Table 6.6). A persistently high level of social participation is also related to the initiation of physical activity. Thus, physical activity has mediating effects on the association between social participation and weigh gain among women. The results also indicate an interaction between social participation and health conditions. Moreover, compared to the stable weight group, women with persistently high assets over the period are 59 percent less likely than those who have no assets to be in the moderate weight gain group.

[Table 6.11 about here]

Although physical activity is not the focus of this study, the analyses show several important patterns in the association between physical activity and weight change. The results indicate that being sedentary or becoming sedentary are risk factors for weight gain. Compared to the stable weight group, women who reported being sedentary at both baseline and follow-up surveys are 2.04 times ($p<0.10$) as likely to gain excess weight as those who are persistently involved in vigorous physical activity (Table 6.10). Women who are sedentary at both baseline and follow-up surveys are 4.33 times as likely to be in the large weight gain group versus the moderate weight gain group as those who maintain vigorous activity at both surveys (Table 6.11). Moreover, men who become inactive over the period are 2.20 times as likely as those who exercise vigorously at both surveys to be in the large weight gain group versus the stable weight group (Table 6.10). Men (OR = 2.23, $p<0.10$) and women (OR = 5.35) who become inactive also have higher odds of being in the large weight gain group versus the moderate weight gain group (Table 6.11). In contrast, women who become active over the period are less likely to be in the moderate weight gain group (OR = 0.57, $p<0.10$) and more likely to be in the weight loss group (OR = 1.88) compared to the stable weight group (Table 6.10). But we cannot tell if the weight loss is intentional or unintentional. However, the initiation of physical activity over the period is associated with higher odds of gaining excess weight (OR = 1.83, $p<0.10$) rather than maintaining a stable weight among men (Table 6.10). Similarly, women who become active over the period are 3.19 times as likely to be in the large weight gain group versus moderate weight gain as those who are involved in vigorous activity in both surveys (Table 6.11). The causal order is probably reversed such that older adults who experience a large or moderate weight gain are more likely to become active. Such a dose-response relationship between body weight and physical activity may be more apparent among women. For example, remaining (OR = 0.47) or becoming sedentary (OR = 0.38) are significantly associated with lower odds of gaining moderate weight versus the weight stable group (Table 6.10). This is probably because women with a stable weight are less likely to exercise or become active. It should be noted that older adults who remain sedentary or become sedentary are significantly more likely to lose weight compared to those in the weight stable group. The findings may suggest that those who lose substantial weight may have a deteriorating health condition which becomes a barrier for remaining physically active.

Consistently with other studies, the analysis shows that heavy drinking is a risk factor for substantial weight gain among men. Men who start to drink alcohol more than once per week over the period are 1.73 and 1.97 times as likely as those who do not drink or drink less frequently at both surveys to be in the moderate or large weight gain group versus the stable weight group (Table 6.10).

Two of the control variables are worth noting. Women who become widowed, divorced or separated over the period are 1.90 times ($p<0.10$) and 1.98 times as likely to be in the moderate weight gain or substantial weight loss groups versus the weight stable group as those who remain married at both surveys. The results suggest that women who experience spouse loss, divorce or separation are worse off in terms of body weight. Retirement (OR = 1.69, $p<0.10$) is a risk factor for moderate weight gain among men, but unemployment is a risk factor for substantial weight loss (OR = 1.71, $p<0.10$) among women.

6.7 Summary

Using the 1999-2003 panel data, this chapter assesses social and behavioral predictors of weight gain among men and women aged 53 years or older in 1999. Older adults experience significant weight change over the four-year period. About a quarter of men and women have lost substantial weight. But unlike what is generally assumed, over one-fifth of men and women have gained substantial weight. For those who have a normal weight in 1999, 15.1 percent of men and 17.6 percent of women have become overweight or obese by 2003.

Education is a strong protective factor against weight gain and the onset of overweight or obesity, more so among men than among women. Men with primary and secondary or more education are not only less likely to gain excess weight, they also have a lower risk of becoming overweight or obese over the four-year period. While secondary or higher education is protective against women's risk of becoming overweight or obese, the impact of education on weight gain is substantially attenuated after controlling for SES of family origin. As a result of gender inequalities in Taiwanese society, older women have had less chance for upward social mobility through education than older men. Therefore, own education is more important for weight gain than childhood SES among men, but both childhood SES and own education are important for maintaining a healthy weight in later life among women. In a transitional society like Taiwan, the knowledge, behavioral skills and the sense of control over one's life and health obtained through education appear to be important in preventing weight gain among both men and women. However, women may not have enough knowledge and cognitive skills to avoid excessive weight gains due to their lower educational attainment.

Cumulative wealth is a persistent protective factor against weight gain among women but not among men. Women with a medium level of assets at baseline have a lower risk of weight gain and becoming overweight/obese subsequently. Persistently high assets are protective against moderate weight gain among women. However, owning modest assets increases women's risk of excessive weight gain. The findings suggest that cumulative advantage in material resources, in addition to education, plays an important role in maintaining a healthy weight among women. The fact that the protective effect of cumulative wealth on weight gain emerges later than education for men relative to women indicates that gender norms about body image may be at work. In this study, cumulative wealth is positively associated with persistent physical activity among both men and women, more so in men than in women. This indicates that wealth may also affect weight gain among men through other behavioral pathways such as diet. Although older adults with higher income and high cumulative income are more likely to become physically active and to stick to physical activity, income is not related to weight gain. The findings reinforce the importance of cumulative material resources on maintaining a healthy body weight, particularly for women.

Social participation is protective against weight gain for both men and women. While men with any or a persistently high level of social participation are less likely to gain moderate weight, a high level of social participation reduces the risk of large weight gain among women. However, the inverse association between persistent social participation and weight gain among women is explained away by patterns of physical activity. Clearly, one of the pathways through which social participation affects weight gain is through its influence on persistent physical activity and the initiation of physical activity, particularly among women. Active social participation predicts both persistent physical activity and increased risk for large weight gain among men. The findings may suggest that social participation benefits men and women by providing support for healthy behaviors such as physical activity. However, active social participation may involve both health-enhancing and health-damaging behaviors among men.

While patterns of physical activity mediate the association between persistent social participation and weight gain for women, health behaviors being considered have modest mediating effects for the relationship between social factors and short-term weight gain in general. Clearly, some important mediating factors, for example, dietary, dieting and knowledge about weight change and weight control, are not included in this study. Nonetheless, the findings demonstrate that vigorous physical activity, especially persistent vigorous activity, are highly protective against weight gain among women. The initiation of physical activity is related to weight loss among women. The findings also suggest a dose-response effect in the relationship between physical activity and weight gain among men and women.

Overall, the findings provide evidence for the theory of fundamental causes of disease by showing a pattern of social disparities in weight gain among older adults in Taiwan. Education is protective against the risk of substantial weight gain and becoming overweight/obese for both men and women. Cumulative advantages in material resources (i.e. wealth), in addition to education, benefit women by lowering the risk of substantial weight gain and the incidence of overweight/obesity. The effect of high SES of family origin on maintaining a healthy weight among women is transmitted through adulthood SES, particularly education. While social participation is a strong protective factor against weight gain among both men and women, active social participation increases men's risk of excess weight gain. Physical activity is one of the mechanisms through which socioeconomic advantages influence the risk of weight gain. Physical activity, especially persistent physical activity, is an independent protective factor for maintaining a healthy weight in late life.

Chapter 7: Conclusion and Discussion

7.1 Summary of empirical findings

The dissertation has investigated the impact of socioeconomic changes on one aspect of health – exposure to the risk of overweight and obesity among the elderly in Taiwan. As a result of dramatic socioeconomic and nutrition transitions over the past forty years, the prevalence of overweight and obesity has increased rapidly. Overweight and obesity have severe health consequences and have increasingly become public health problems in Taiwan. Elsewhere in the world, obesity increases disproportionately among lower SES groups. Therefore, the social process leading to differential exposure to the risk for, or protection against, excess body weight is important for understanding unequal distributions of overweight and obesity as well as the production of social inequalities in health in a transitional society.

Using data from 1999 and 2003 waves of the longitudinal Survey of Health and Living Status of the Near Elderly and Elderly in Taiwan, this dissertation examines the effects of SES and social participation on overweight and obesity in 2003 and on weight gain between 1999 and 2003 for adults aged 53 years or older. Gender differences in the links between social factors and excess body weight were also assessed. The current study is the first comprehensive analysis of social disparities in excess body weight among the elderly in an Asian society. The study recognizes the importance of SES over the life course and social participation on the risk of overall and central obesity among the elderly. The assessment of social predictors of weight gain can shed light on the processes leading to social disparities in overweight and obesity.

Under the influence of common risk factors, the prevalence of overweight and obesity among the elderly in Taiwan has also increased. Between 1999 and 2003, although about a quarter of the elderly have lost substantial weight ($\geq$ 3.5 kg), more than one-fifth of them have gained large weight ($\geq$ 2.5 kg). Among those who had a normal weight in 1999, about 15 percent of men and 18 percent of women have become overweight or obese by 2003. Overall, the elderly experienced a statistically significant increase in the prevalence of overweight and obesity (BMI $\geq$ 25 kg/m^2) over the four year period, particularly for women. By 2003, about one-third of men and 38 percent of women were overweight and obese. The risk of central obesity is even higher among this elderly population. While abdominal obesity was prevalent among 43 percent of men, the prevalence was more than 69 percent among women, based on the Asian standard for central obesity (waist circumference $\geq$ 90 cm for men and $\geq$ 80 cm for women).

The study found that education is a strong protective factor against excess body weight among the elderly in Taiwan. Men and women with a secondary or higher education are less likely to experience the onset of overweight and obesity between 1999 and 2003. While education significantly lowers men's risk of gaining excess weight, the effect of secondary or higher education on weight gain among women is substantially attenuated when childhood SES is taken into account. The observed gender difference in the effect of education on weight gain is not surprising given the enormous gender gap in educational attainment between elderly men and women. In contrast to the stronger education effect on weight gain for men than for women, secondary or higher education has strong protective effects against the risk of overall and central obesity for women, but its protective effect on weight status is very modest for men. Clearly, education has more important influences on cumulative body weight for women than for men, but it is more important for weight change among men than among women. These findings suggest that the protective effect of education on overweight and obesity occurs earlier among women than among men. It is likely that the Western ideal of female thinness also affects weight control practices among older Taiwanese women. The stronger protective effect of education on weight gain among men than among women reflects that better-educated men benefit greatly as social and health conditions change. In sum, there is a hierarchical distribution of overweight and obesity by levels of education for women and the pattern is likely to emerge among men.

In addition, the findings reveal that wealth becomes a potentially important protective factor against overweight and obesity among elderly women. While both income and wealth increase the risk of overweight and obesity among men and women, women in families with higher levels of wealth or cumulative wealth are less likely to gain excess weight or to become overweight/obese. The observed positive association between income or wealth and cumulative body weight suggest that material resources have played an important role in getting access to food through most of the lifetime of the elderly in Taiwan. While material resources are no longer related to energy intake among the elderly as development progresses, they provide differential means for weight control practices among older women. Consequently, cumulative advantages in material resources have started to play an important role in maintaining a healthy weight among women.

Overweight and obesity in later life are not only affected by adulthood SES but also by childhood living circumstances. Again, the influence of early life conditions differs for men and women. Among men, a well-to-do family at childhood increases the risk of overweight/obesity, suggesting that differential exposures to body fatness by early life economic conditions have critical effects on men's body weight later in life. In contrast, while the protective effect of a high childhood SES on women's risk of central obesity are explained away by education, both childhood SES and education have protective effects against weight gain.

The exploratory analyses about the influence of social participation on excess body weight partially support our hypotheses. Active social participation has strong protective effects against substantial weight gain among both men and women, but it also increases men's risk for excessive weight gain. Given Taiwan's very recent history of the development of social organizations, those who participate in social activities currently may not have participated in the past. This may be reflected in the modest association between current participation and cumulative body weight among the elderly. Despite this, active social participation is found to be associated with a higher risk of obesity among men and a reduced risk of obesity among women, showing similar patterns to longitudinal analyses. While social participation benefits men and women by providing support for healthy behaviors such as leisure-time physical activities, active social activities may involve both health-enhancing and health-damaging behaviors among men.

In sum, the study demonstrates that social gradients in overweight and obesity among elderly men and women in Taiwan are mainly shaped by educational attainment, and to a lesser extent by levels of social participation. Cumulative advantages in material resources have also emerged as a protective factor against excess weight gain among women. This study contributes to the existing body of literature on social inequalities in health and to inform social policies and health interventions in a transitional society like Taiwan in a number of ways.

7.2 Discussion and policy implications

First, in light of dramatic socioeconomic and health transitions in Taiwan, patterns of risk factors and excess body weight have shifted in ways that are particularly favorable to individuals with better education, greater cumulative wealth, and better social connections. As a result of these processes, social disparities in overweight and obesity are produced among the elderly, particularly for women. This study provides support for the theory of fundamental causes of disease, showing enduring effects of fundamental social conditions on health risks in a transitional society. As long as differentiations in education, material resources and social participation persist, the disparities in excess body weight are likely to compound the already widening health disparities for obesity-related chronic diseases among the elderly in Taiwan. The public health approach to obesity interventions mainly targets modifiable risk factors such as diet and physical activity. While focusing on individual risk factors may reduce the prevalence of overweight and obesity associated with low SES in the short-term, greater attention needs to be paid to broader social inequalities if health interventions are to have maximum effect in the long run.

Second, the sequential effects of education and wealth may reflect some unique pathways through which social and economic resources translate into disparities in overweight and obesity in Taiwan. Similar to other transitional societies, the protective effect of education emerges earlier than material resources among the elderly in Taiwan. Also, the protective effects of education for men appear earlier in Taiwan than do other transitional societies and Western countries at the same stage of development. The prominent role of education in body weight among both men and women suggests that knowledge and cognitive assets gained through schooling are important for maintaining a healthy weight when health conditions have changed. Due to men's educational advantage over women, the beneficial effects of education for maintaining a healthy weight is expected to increase among men. However, low educational attainment may become a barrier for older women's choice for healthy lifestyles. The protective effects of wealth on weight gain have emerged among women but not among men, suggesting that gender norms about body image are at work. The unequal access to tangible resources at the individual and community level is expected to lead to an inverse association between wealth and overweight and obesity among women. The findings underscore the importance of informing the poor and poorly educated elderly, particularly women, of weight-related health risks and healthy lifestyles. It is equally important to improve community facilities and food supplies that have consequences for body weight.

Third, the independent effects of childhood SES and own education on weight gain among women suggest that social gradients in overweight and obesity are shaped by exposure to socioeconomic disadvantages in childhood and maintained in early adulthood. This pattern is similar to Western societies. In contrast, own education is more important for weight gain than childhood SES among men. The gender differences reflect gender inequalities in access to important life chances for the elderly in Taiwan. The findings suggest that the period of adolescence to early adulthood is important in the development, adoption and maintenance of certain health protective and health-risk behaviors, even among this elderly cohort. In light of the rapid spread of the obesity epidemic in Taiwan, this study underscores the critical importance of interventions on weight-related risk behaviors early in life.

Finally, the strong protective effects of social participation on substantial weight gain among both men and women have important policy implications. While social participation taps into a wide range of health-enhancing behaviors, norms and resources, the study finds that social participation plays an important facilitating role in persistent physical activity and the initiation of physical activity, particularly among women. Due to structural barriers and traditional gender role expectations, older Taiwanese women, especially those in lower SES groups, continue to participate less in both physical and social activities than elderly men. Thus, support for community or social activities, particularly among women and disadvantaged groups, may have some buffering effects for unhealthy lifestyles and adverse weight outcomes.

7.3 Limitations

While the strengths of the study include the use of large representative panel data, measured waist circumference, the availability of SES indicators at different stages of the life course and measures of social participation, there are a number of limitations.

First, selection bias may have contributed to an attenuation of the social gradients in overweight and obesity and weight gain. As noted in Chapter 4, individuals in lower SES groups or without social participation were significantly underrepresented in the sample mainly due to death between 1993 and 2003 and non-response in body weight/height in both surveys. Thus, the magnitude of the relationship between SES, social participation and BMI or weight gain found may have been underestimated.

Second, there may be age and cohort effects that reduce the magnitude of the association between social factors and body weight outcomes in old age. The elderly cohort under study (born between 1905 and 1946) were born before the drastic educational expansion in Taiwan. Their overall low level of education may become barriers for them to benefit from new health knowledge. Also, this elderly cohort has lived through a period when social organizations were restricted. They may follow the same trajectory and participate less in social activities than younger generations. The smaller variations in SES and social participation may contribute to an overall moderate association between social factors and excess body weight. Further, overrepresentation of diseases among the elderly with low SES may lead to weight reduction among low SES people and hence smaller differentials in body weight by SES.

Third, the reliance on self-reported data on weight/height and health behaviors may be another source of bias for the analyses. The elderly who generally experience a loss of weight and height are more likely to misreport weight and height. However, in our analysis BMI is not significantly different between those whose weight/height were self-reported and measured, lending face validity to self-reported weight/height data for the elderly in this sample. Moreover, self-reported physical activity yielded different patterns in its relationship with body weight and weight gain for men and women, probably due to reporting error in physical activities.

Fourth, childhood SES data were collected retrospectively and are therefore subject to recall bias. This may result in an under-estimation of the effects of childhood SES compared with adult SES since the latter may be better measured.

Fifth, the short follow-up period in the longitudinal analysis limits our ability to investigate the shifting relationship between SES and overweight and obesity.

Lastly, health behaviors measures included in the analyses are too limited to elucidate the mechanisms underlying social disparities in excess body weight.

7.4 Future directions

The study identified several social determinants of overweight and obesity, the mechanisms underlying social disparities in overweight and obesity have important policy implications but remains largely unknown. Existing studies and current findings suggest that health behaviors such as patterns of physical activity and diet are not the major mechanisms accounting for social disparities in excess body weight. To what extent do self-efficacy, nutrition and health knowledge, and social support mediate the association between education, social participation and excess body weight? Also, to what extent do community characteristics such as safety of neighborhoods, community social capital, and availability of space and exercise facilities explain the relationship between wealth, social participation and excess body weight? To answer these questions, future surveys should collect more detailed and accurate data on scale of mastery, health knowledge as well as community characteristics.

While cumulative social dis/advantages are hypothesized to have important influences on health risks, this hypothesis has not been explored extensively. This study touched upon this issue and showed some preliminary results about the effects of cumulative social experiences and behavioral patterns on body weight status or weight gain. Future analysis can take advantage of the longitudinal data and examines the pathways through which cumulative social dis/advantages affect the risks for, or protection against, excess body weight among the elderly over a longer period of time.

Although young and middle-aged adults in Taiwan are more exposed to the risk factors for overweight and obesity than the elderly, little is known about the social patterns of overweight and obesity and the mechanisms among young and middle-aged adults. From a policy perspective, it is important to extend the current analysis to young and middle-aged adults using alternative data. Such a study may also shed some lights on age/cohort differences in the links between SES and overweight/obesity. To make cross-country comparisons, the present analysis can be replicated in other social settings with different levels of development or different cultural traditions.

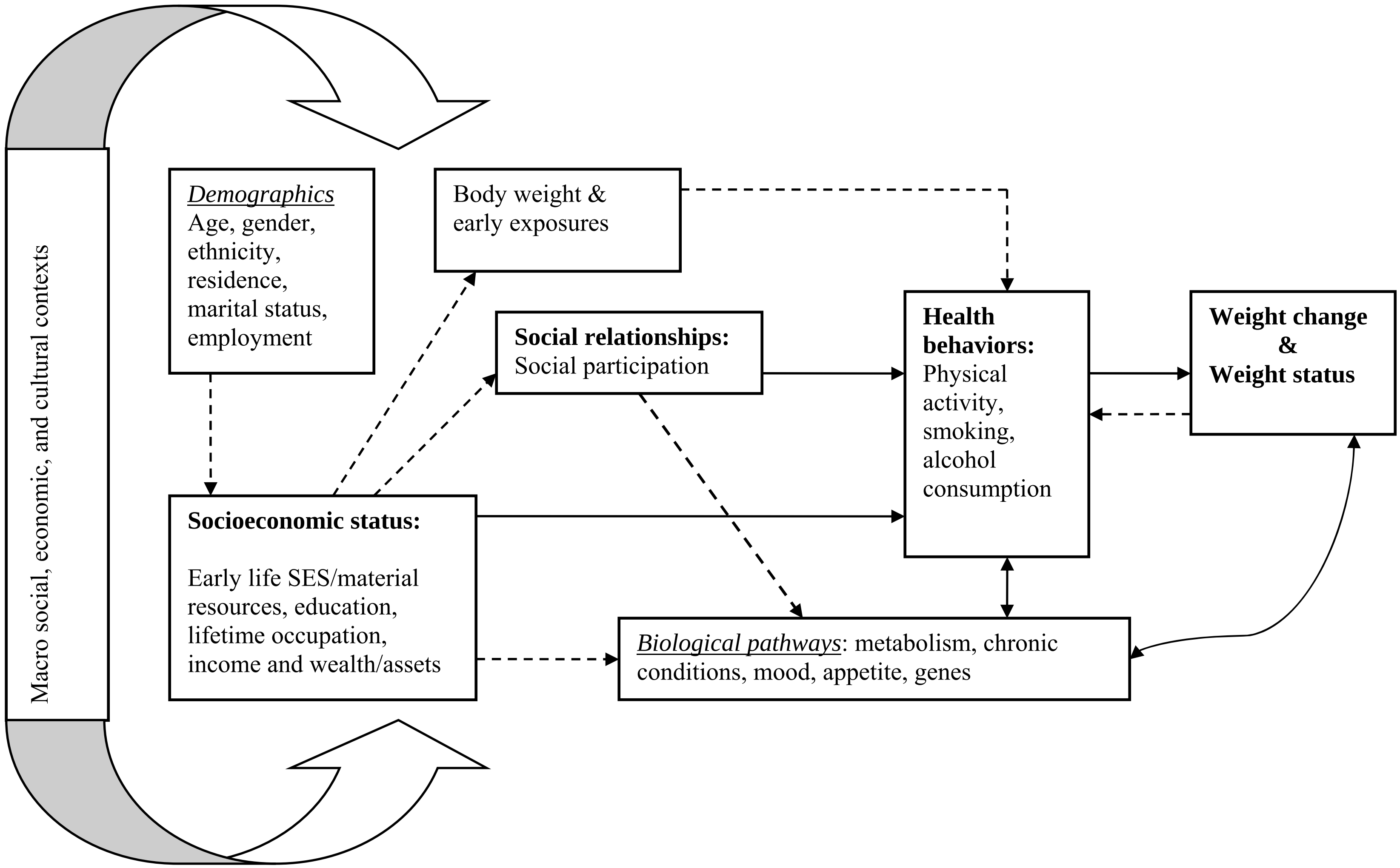

Figure 3.1 Conceptual model for the study of body weight among the elderly. Relationships presented are considered to operate at the level of the individual within a life course, cumulative effects framework. Relationships are hypothesized to be influenced by macro-level factors within which the individual lives during their life span. This study focuses on the relationship between factors linked by solid lines.

Table 4.1 Sample attrition across years: HLSES 1999-2003

Among 4,440 respondents who were interviewed in 1999, 3,537 (79.7% of the 1999 sample) were alive and re-interviewed in 2003. Among the survivors, 3,103 (70% of the 1999 sample) provided complete data on baseline characteristics in 1999 and weight change between 1999 and 2003.

Distribution of lost cases

Verified death	727	54.4%
Lost to follow-up	176	13.2%
Missing data on weight change	288	21.5%
Missing baseline data	146	10.9%
Total	1,337	100%

Table 4.2 Characteristics of survivors in 2003 and respondents lost between 1999 and 2003

	Survivors in 2003 (%)	Drop-outs between 1999 and 2003 (%)				
		Died	Lost to follow-up	Missing weight change	All	p-value[1]
Number of cases	3,249	727	176	288	1,191	
Age						<0.001
53-59	24.2	4.7	35.2	9.7	10.4	
60-64	16.5	6.3	14.2	11.8	8.8	
65-69	13.6	6.2	10.8	11.8	8.2	
70-74	25.2	23.9	15.9	24.3	22.8	
75+	20.6	58.9	23.9	42.4	49.7	
Sex						0.24
Male	52.6	61.8	49.4	39.6	54.6	
Female	47.4	38.2	50.6	60.4	45.4	
Residence						<0.001
Rural	30.7	37.1	19.3	45.5	36.5	
Urban	69.3	62.9	80.7	54.5	63.5	
Father's occupation						
Low-status	73.1	75.8	67.1	78.1	75.1	0.05
High-status	23.6	19.0	31.8	18.1	20.7	
Missing	3.3	5.2	1.1	3.8	4.3	
Childhood family economic condition[2]						
Average or poor	86.9			91.2	91.2	0.14
Well-to-do	12.5			7.8	7.8	
Missing	0.7			1.0	1.0	
Education						<0.001
No education	28.7	39.0	27.8	55.6	41.3	
Primary	46.9	44.4	39.8	35.8	41.6	
Secondary or above	24.4	16.7	32.4	8.7	17.1	
Yearly income						<0.001
1st tertile	24.5	40.0	24.4	40.3	37.8	
2nd tertile	31.0	33.7	24.4	38.5	33.5	
3rd tertile	40.4	22.7	43.2	18.1	24.6	
Missing	4.2	3.6	8.0	3.1	4.1	
Number of assets						<0.001
0	21.2	38.4	27.8	40.3	37.3	
1	33.8	33.8	35.8	34.7	34.3	
2	29.0	17.9	25.0	19.1	19.2	
3+	16.0	9.9	11.4	5.9	9.2	
Social participation						<0.001
Low	48.8	62.6	58.5	57.6	60.8	
Medium	32.3	25.5	31.3	29.9	27.4	
High	19.0	12.0	10.2	12.5	11.8	
Physical activity						<0.001
Sedentary	37.4	57.4	42.6	51.4	53.7	
Moderate	36.3	30.0	29.0	31.6	30.2	
Vigorous	26.3	12.7	28.4	16.7	16.0	

[1] Based on Pearson's Chi-square test between survivors and those who dropped out in 2003.
[2] Data is only available in 2003.

Table 4.3 Age-adjusted Pearson's correlation coefficients between indicators of socioeconomic status for men (n = 1,672) and women (n = 1,484) aged 57 years or older, Taiwan, 2003

	Father's occupation	Well-to-do family at childhood	Education	Lifetime occupation	Yearly income	Assets
Father's occupation						
Men	1.00					
Women	1.00					
Well-to-do family at childhood						
Men	0.11***	1.00				
Women	0.04	1.00				
Education						
Men	0.25***	0.20***	1.00			
Women	0.33***	0.20***	1.00			
Lifetime occupation						
Men	0.27***	0.15***	0.53***	1.00		
Women	0.32***	0.16***	0.49***	1.00		
Yearly income						
Men	0.13***	0.14***	0.30***	0.32***	1.00	
Women	0.15***	0.08**	0.29***	0.26***	1.00	
Assets						
Men	0.02	0.05*	0.15***	0.05	0.21***	1.00
Women	0.01	0.06*	0.15***	0.07*	0.23***	1.00

*p <0.05, **p <0.01, ***p <0.001.

Table 5.1 Means and percent distribution of body mass index (BMI) and waist circumference among men and women aged 57 years or older, Taiwan, 2003

Variable	Men (n = 1,672)[1, 2]	Women (n = 1,484)[1, 2]
Body mass index (BMI) (kg/m^2)	Mean (*s.d.*)	Mean (*s.d.*)
	23.8 (3.1)	24.3 (3.8)***
BMI by WHO cutoffs	%	%
Underweight (BMI <18.5)	4.1	5.2***
Normal (18.5 ≤ BMI <25)	63.7	57.0
Overweight (25 ≤ BMI <30)	28.5	29.7
Obese (BMI ≥ 30)	3.7	8.1
Overweight or obese (BMI ≥ 25)	32.3	37.8**
Obese by Asian cutoff (BMI ≥ 27.5)	12.0	18.7***
	Men (N = 1,696)[1, 2]	Women (N = 1,581)[1, 2]
Waist circumference (cm)	Mean (*s.d.*)	Mean (*s.d.*)
	88.5 (9.1)	84.7 (9.9)***
Asian cutoffs	%	%
Normal	57.0	30.6
At risk (≥ 80 for women, ≥ 90 for men)	43.0	69.4
Medium-risk (80-95 for women, 90-97 for men)	27.1	54.8
High-risk (≥ 96 for women, ≥ 98 for men)[3]	15.9	14.6

[1] Weighted means or percentages and unweighted sample sizes.

[2] Difference between men and women were estimated using the Pearson χ^2 test for categorical variables and the T test for continuous variables. ** $p < 0.01$, *** $p < 0.001$

[3] These cutoffs are based on the 85th percentile of the waist circumference for men and women.

Figure 5.1 Body mass index (BMI) by age group for men and women, Taiwan, 2003

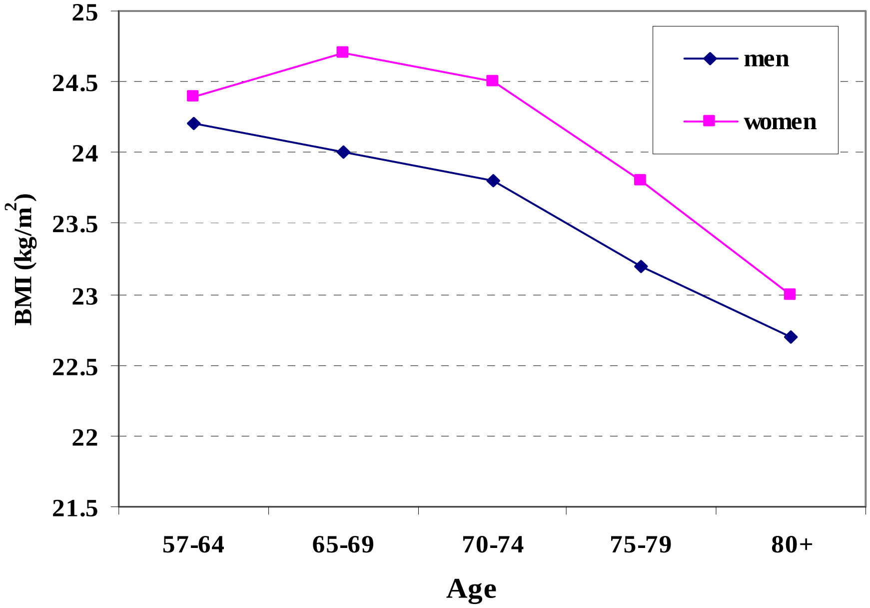

Figure 5.2 Waist circumference by age group for men women, Taiwan, 2003

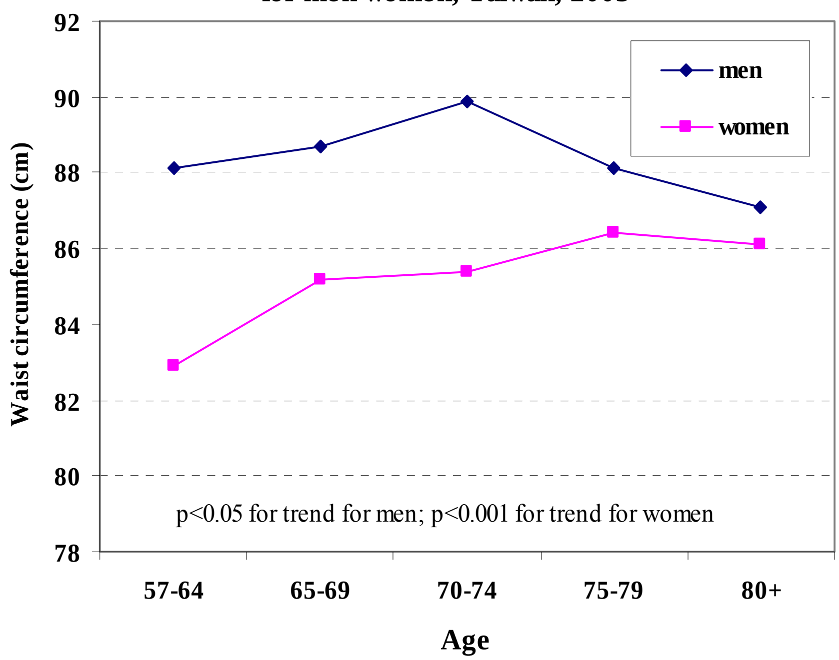

Table 5.2 Percentage distribution on demographic characteristics for men and women aged 57 years or older, and percentage overweight/obese, Taiwan, 2003[1,2]

	Men (n = 1,672)		Women (n = 1,484)	
	Total	% Overweight/ obese	Total	% Overweight/ obese
	%		%	
Age (years)				
57-64	33.9	38.0	35.7	40.1
65-69	21.0	32.1	23.6	40.5
70-74	19.8	31.7	18.1	38.3
75-79	15.1	25.7	11.9	33.6
80+	10.2	24.3	10.8	27.8
Ethnicity				
Fukienese/Hakka	81.3	32.4	95.2	37.9
Mainlander	18.7	31.6	4.8	35.5
Marital status				
Unmarried	17.5	27.7	39.4	34.6
Married	82.5	33.2	60.6	39.8
Resident				
Rural	22.7	32.2	35.4	34.3
Urban	67.3	32.3	64.6	39.7
Currently employed				
No	71.2	31.6	88.2	37.7
Yes	28.8	33.9	11.8	38.6

[1] Weighted percentages and unweighted sample sizes.

[2] Overweight/obesity is defined as body mass index (BMI) ≥ 25 kg/m^2. Data on underweight (BMI<18.5 kg/m^2) and normal weight (BMI 18.5-24.9 kg/m^2) are not shown.

Table 5.3 Percentage distribution and means on social, behavioral and health characteristics for men and women aged 57 years or older, and percentage overweight/obese, Taiwan, 2003[1, 2]

	Men (n = 1,672)		Women (n = 1.484)	
	Total	% Overweight/ obese	Total	% Overweight/ obese
	%		%	
Socioeconomic characteristics				
Father's occupation				
Low-status	73.5	32.8	77.2	38.5
High-status	22.7	30.1	20.3	34.9
Missing	3.8	35.4	2.5	39.5
Childhood family economic condition				
Average or poor	91.1	31.4	91.3	37.9
Well-to-do	8.9	41.2	8.7	36.2
Education				
No education	10.5	31.7	45.2	38.1
Primary	52.7	33.1	42.7	41.3
Secondary or above	36.8	31.3	12.1	23.8
Lifetime occupation				
Agricultural	26.6	27.9	23.0	33.2
Unskilled labor	10.5	36.2	15.0	37.3
Semi-skilled/service	17.3	40.5	14.9	36.8
Skilled labor	9.2	29.2	4.4	49.9
Managerial	20.3	33.0	6.5	49.2
Professional	16.0	28.8	6.4	25.2
House wife			22.6	42.4
Self-employed/unemployed			7.3	34.5
Yearly income				
1st tertile	21.2	26.6	35.6	35.4
2nd tertile	36.0	33.3	39.1	38.8
3rd tertile	40.1	35.0	25.3	39.4
Missing flag	2.7	22.6		
Number of assets				
0	16.3	29.2	27.9	33.6
1	32.0	31.8	35.1	41.5
2	31.0	33.9	25.2	37.6
3+	20.7	32.8	11.9	36.7
Social participation				
Low	50.8	31.2	62.3	37.8
Medium	29.5	30.6	24.9	37.4
High	19.8	37.5	12.9	38.2

[1] Weighted means or percentages and unweighted sample sizes.
[2] Overweight/obesity is defined as body mass index (BMI) ≥ 25 kg/m^2. Data on underweight (BMI<18.5 kg/m^2) and normal weight (BMI 18.5-24.9 kg/m^2) are not shown.

Table 5.3 ***Cont'd***

	Men (n = 1,672)		Women (n = 1.484)	
	Total	% Overweight/ obese	Total	% Overweight/ obese
	%		%	
Health behaviors				
Physical activity				
Sedentary	32.3	33.9	36.7	40.1
Moderate	33.8	29.6	38.2	36.3
Vigorous	33.9	33.3	25.1	36.5
Smoker				
Never	28.6	30.7	96.7	37.9
Current	37.2	29.4	2.3	33.5
Past	34.2	36.7	1.0	32.9
Alcohol consumption more than once a week				
No	77.2	31.6	96.9	37.6
Yes	22.8	34.5	3.1	43.5
Health Status				
Self-rated health status				
Fair/poor	57.9	32.6	68.6	38.2
Excellent/good	42.1	31.8	31.4	36.8
Hypertension				
No	64.8	26.7	59.7	33.6
Yes	35.2	42.5	40.3	43.9
Diabetes				
No	84.7	30.8	80.8	35.9
Yes	15.3	40.2	19.2	45.6
Heart disease				
No	83.9	31.0	75.4	36.5
Yes	16.1	39.0	24.6	41.7
Stroke				
No	93.8	32.0	94.3	38.2
Yes	6.2	35.7	5.7	31.3
Cancer				
No	97.0	32.4	96.3	37.7
Yes	3.0	28.4	3.7	39.1
Arthritis				
No	83.1	30.8	67.9	33.0
Yes	16.9	39.2	32.1	47.9
	Mean (*s.d.*)	Mean (*s.d.*)	Mean (*s.d.*)	Mean (*s.d.*)
Functional limitations	0.93 (1.49)	0.92 (1.51)	1.74 (1.87)	1.88 (1.93)
Depressive symptoms	0.39 (0.46)	0.37 (0.45)	0.58 (0.55)	0.55 (0.55)

Table 5.4 Percent distribution of central obesity by social, behavioral and health characteristics for men and women aged 57 years or older, Taiwan, 2003[1]

	Men (n = 1,696)		Women (n = 1,581)	
	Central obesity[2,3]		Central obesity[2,3]	
	%	p-value	%	p-value
Socioeconomic characteristics				
Father's occupation		0.83		0.04
Low-status	42.5		70.9	
High-status	44.4		63.2	
Missing	44.2		69.1	
Childhood family economic condition		0.02		0.71
Average or poor	42.1		69.5	
Well-to-do	52.5		67.9	
Education		0.85		<0.001
No education	43.3		73.1	
Primary	42.3		69.6	
Secondary or above	43.9		53.7	
Lifetime occupation		0.02		<0.001
Agricultural	40.5		74.7	
Unskilled labor	46.1		70.1	
Semi-skilled/service	50.2		64.8	
Skilled labor	33.5		66.3	
Managerial	44.4		73.2	
Professional	40.9		50.7	
House wife			73.8	
Self-employed/unemployed			61.3	
Yearly income		0.04		0.007
1st tertile	36.2		72.4	
2nd tertile	44.3		71.2	
3rd tertile	45.5		63.5	
Missing	42.8		56.0	
Number of assets		0.07		0.07
0	37.4		68.5	
1	45.9		73.5	
2	40.9		66.1	
3+	46.2		66.1	
Social participation		0.78		0.55
Low	43.5		70.4	
Medium	41.6		67.8	
High	43.9		67.5	

1 Weighted percentages and unweighted sample sizes.

2 Central obesity is defined as waist circumference ≥ 90 cm for men and ≥ 80 cm for women.

3 Significant differences between waist circumference categories are estimated using the Pearson χ^2 test.

Table 5.4 ***Cont'd***

	Men (n = 1,696)		Women (n = 1,581)	
	Central obesity		Central obesity	
	%	p-value	%	p-value
Health behaviors				
Physical activity		0.17		0.04
Sedentary	40.5		73.0	
Moderate	42.2		68.5	
Vigorous	46.3		65.3	
Smoker		0.05		0.70
Never	39.8		69.5	
Current	41.6		63.0	
Past	47.2		71.8	
Alcohol consumption more than once a week		0.26		0.05
No	42.2		68.9	
Yes	45.7		82.4	
Health Status				
Self-rated health status		0.32		0.03
Fair/poor	44.1		71.2	
Excellent/good	41.5		65.3	
Hypertension		<0.001		<0.001
No	36.4		63.1	
Yes	55.2		79.0	
Diabetes		<0.001		<0.001
No	41.1		66.4	
Yes	54.0		82.4	
Heart disease		0.003		<0.001
No	41.4		67.0	
Yes	51.6		76.6	
Stroke		0.01		0.03
No	42.2		68.7	
Yes	56.0		80.5	
Cancer		0.46		0.005
No	42.9		70.0	
Yes	48.5		51.3	
Arthritis		<0.001		<0.001
No	41.0		66.0	
Yes	53.2		76.5	

Table 5.5 Age-adjusted odds ratios (OR) from logistic regression models examining the association between social factors and health behaviors or self-rated health status among men and women aged 57 years or older, Taiwan, 2003

	Men (n = 1,672)				Women (n = 1,484)	
	Physical activity	Ever smoked	Frequent drinker	Self-rated good health	Physical activity	Self-rated good health
Socioeconomic status						
Father's occupation (ref: low-status)						
High-status	1.93***	1.08	0.98	1.49**	1.49**	1.46**
Well-to-do family at childhood (ref: average or poor)	1.29	1.33	0.96	1.78**	1.58*	1.64*
Education (ref: no education)						
Primary	1.71**	1.27	1.47	1.49*	1.38**	1.15
Secondary or above	2.68***	0.71	1.35	2.28***	1.87**	1.97***
Lifetime occupation						
Agricultural (ref)						
Unskilled labor	1.74**	1.20	1.06	1.23	1.20	1.33
Semi-skilled/service	1.76***	1.01	0.80	1.30	1.63*	1.43
Skilled labor	2.04***	0.83	0.72	1.67*	1.76	2.00*
Managerial	2.19***	1.01	1.07	1.65**	1.85*	2.14**
Professional	3.73***	0.48***	0.95	2.04***	2.30**	2.16**
House wife					1.49*	1.26
Self-employed/unemployed					0.93	0.82
Yearly income (ref: 1st tertile)						
2nd tertile	1.27	0.77	1.14	1.13	1.59***	1.37*
3rd tertile	1.34	0.56***	1.38	1.95***	2.07***	1.39*
Number of assets (ref: 0 item)						
1	1.71**	0.97	1.16	1.47*	1.50**	1.32
2	1.73**	0.71	1.08	1.74**	1.47*	1.70**
3+	1.52*	0.55**	1.12	1.80**	0.99	1.32
Social participation						
Low (ref)						
Medium	1.09	0.93	1.37*	1.21	1.64***	1.14
High	1.40*	0.90	1.27	1.21	2.79***	1.11

*p<0.05, **p<0.01, ***p<0.001.

Table 5.6 Crude and adjusted odds ratios (OR) from multinomial logistic regression models examining the risk of overweight/obesity[1], by social, behavioral, and health characteristics for men and women aged 57 years or older, Taiwan, 2003

	Men (n = 1,672)				Women (n = 1,484)			
	Crude OR	Adjusted OR			Crude OR	Adjusted OR		
		Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Demographic characteristics								
Age (ref: 57-64)								
65-69	0.81	0.82	0.79	0.73^{+}	0.97	0.97	0.96	0.90
70-74	0.78	0.72^{+}	0.65*	0.55**	0.89	0.89	0.90	0.76
75-79	0.61**	0.58**	0.51**	0.41***	0.78	0.77	0.75	0.58**
80+	0.58**	0.55**	0.48**	0.42***	0.64**	0.59*	0.57**	0.41***
Mainlander (ref: Hakka & Fukienese)	0.98	1.00	1.03	0.95	0.92	1.30	1.27	1.41
Married	1.24	1.04	1.02	1.00	1.19	1.00	0.98	0.90
Urban	0.99	1.03	1.07	1.08	1.29*	1.33*	1.34*	1.34*
Currently employed	1.07	0.84	0.81	0.82	1.03	0.94	0.89	1.04
Socioeconomic characteristics								
Father's occupation (ref: low-status)								
High-status	0.88	0.82	0.85	0.89	0.88	0.99	1.00	0.96
Well-to-do family at childhood	1.58*	1.71**	1.71**	1.67*	0.91	0.94	0.97	0.95
Education (ref: no education)								
Primary	1.02	0.83	0.83	0.79	1.18	0.99	1.01	0.98
Secondary or above	0.96	0.75	0.74	0.71	0.52**	0.39**	0.39**	0.41**
Lifetime occupation								
Agricultural (ref)								
Unskilled labor	1.42	1.36	1.38	1.31	1.16	1.02	1.04	1.00
Semi-skilled/service	1.74**	1.83**	1.86**	1.80**	1.19	1.04	1.07	1.01
Skilled labor	1.03	0.98	0.96	0.96	2.21**	2.05*	2.11*	1.83^{+}
Managerial	1.27	1.29	1.30	1.19	2.03**	1.97*	2.04*	1.95*
Professional	1.06	1.12	1.15	1.10	0.69	0.92	0.95	0.84
Housewife					1.56*	1.50*	1.53*	1.52*
Self-employed/unemployed					1.08	1.05	1.03	0.93
Yearly income (ref: 1st tertile)								
2nd tertile	1.32^{+}	1.26	1.26	1.22	1.08	0.99	1.03	0.97
3rd tertile	1.42*	1.31	1.28	1.22	1.16	1.21	1.28	1.23

[1] Body weight is defined based on WHO cutoffs. Underweight = BMI<18.5 kg/m^2; normal = BMI 18.5-24.9 kg/m^2 (reference group); overweight/obese = BMI≥ 25 kg/m^2. Results for underweight are not shown.

^{+}p <0.10, *p <0.05, **p <0.01, ***p <0.001.

Table 5.6 ***Cont'd***

	Men (n = 1,672)				Women (n = 1,484)			
	Crude OR	Adjusted OR			Crude OR	Adjusted OR		
		Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Number of assets (ref: 0 item)								
1	1.03	0.96	0.97	0.97	1.39*	1.30^{+}	1.33^{+}	1.34^{+}
2	1.19	1.11	1.13	1.11	1.19	1.15	1.18	1.16
3+	1.09	1.00	1.00	0.94	1.09	1.14	1.13	1.18
Social participation (ref: low)								
Medium	0.96	0.97	0.97	0.96	0.92	0.91	0.94	0.98
High	1.33^{+}	1.41*	1.42*	1.37^{+}	0.96	1.02	1.08	1.04
Health behaviors								
Physical activity (ref: sedentary)								
Moderate	0.79		0.72*	0.65**	0.80		0.74*	0.73*
Vigorous	0.91		0.87	0.83	0.80		0.72^{+}	0.73^{+}
Smoker (ref: non-smoker)								
Current	0.93		0.86	0.88				
Past	1.29^{+}		1.37*	1.31^{+}				
Consumed alcohol more than once a week	1.11		1.11	1.19				
Health status								
Self-rated good health	0.93			1.01	0.92			1.05
Hypertension	2.02***			2.08***	1.56***			1.51**
Diabetes	1.45*			1.17	1.45*			1.30
Heart disease	1.44*			1.30	1.23			1.04
Stroke	1.19			1.07	0.73			0.56^{+}
Cancer	0.80			0.73	1.19			1.29
Arthritis	1.46**			1.44*	1.86***			1.91***
Functional limitations	1.02			1.07	1.07*			1.14**
Depressive symptoms	0.87			0.72*	0.86			0.59***
Flag for BMI measures (ref: measured)								
Self-reported		0.65	0.66	0.56^{+}		0.81	0.79	0.80
Self-reported and measured		0.60	0.62	0.56^{+}		1.11	1.09	1.07
Log likelihood ratio		-1253.07	-1235.73	-1188.24		-1192.33	-1187.72	-1141.21
Pseudo R^2		0.04	0.06	0.09		0.05	0.05	0.09

Table 5.7 Adjusted odds ratios from multinomial logit models examining the risk of overweight and obesity[1], by selected social, behavioral, and health characteristics for men and women aged 57 years or older, Taiwan, 2003[2]

	Men (n = 1,672)			Women (n = 1,484)		
	Overweight vs. Normal	Obesity vs. Normal	Obesity vs. Overweight	Overweight vs. Normal	Obesity vs. Normal	Obesity vs. Overweight
Socioeconomic characteristics						
Father's occupation (ref: low-status)						
High-status	0.86	0.95	1.10	1.02	0.90	0.88
Well-to-do family at childhood	1.57^{+}	1.83*	1.16	1.07	0.84	0.78
Education (ref: no education)						
Primary	0.81	0.73	0.91	0.72^{+}	1.31	1.82**
Secondary or above	0.78	0.59	0.75	0.48*	0.29**	0.60
Lifetime occupation						
Agricultural (ref)						
Unskilled labor	1.21	1.50	1.24	0.88	1.11	1.28
Semi-skilled/service	1.93**	1.61	0.84	1.18	0.88	0.76
Skilled labor	1.07	0.77	0.72	2.42*	1.34	0.55
Managerial	1.44	0.83	0.58	2.34*	1.59	0.68
Professional	1.29	0.82	0.63	1.02	0.74	0.72
Housewife				1.74*	1.31	0.75
Self-employed/unemployed				0.90	0.97	1.08
Yearly income (ref: 1st tertile)						
2nd tertile	1.03	1.78^{+}	1.73	1.10	0.83	0.75
3rd tertile	1.00	1.87^{+}	1.86^{+}	0.97	1.55^{+}	1.60
Number of assets (ref: 0 item)						
1	1.07	0.82	0.76	1.14	1.59*	1.40
2	1.13	1.07	0.95	0.87	1.62*	1.88*
3+	0.90	1.01	1.12	0.87	1.64	1.89^{+}
Social participation (ref: low)						
Medium	0.93	1.04	1.12	0.96	1.00	1.05
High	1.45*	1.23	0.85	1.35	0.69	0.52*
Health behaviors						
Physical activity (ref: sedentary)						
Moderate	0.66*	0.63^{+}	0.96	0.69*	0.78	1.14
Vigorous	0.79	0.90	1.14	0.77	0.69	0.90
Health status						
Hypertension	1.82***	2.63***	1.44	1.41	1.68**	1.19
Diabetes	1.24	1.06	0.86	1.04	1.62*	1.55^{+}
Heart disease	1.07	1.78*	1.67^{+}	1.04	1.09	1.05
Arthritis	1.18	2.01**	1.71*	1.84***	2.00***	1.09
Functional limitations	1.05	1.10*	1.04	1.07	1.18**	1.10
Depressive symptoms	0.81	0.57	0.70	0.61**	0.59**	0.97

[1] Underweight = BMI<18.5 kg/m^2; normal = BMI 18.5-24.9 kg/m^2 (reference group); overweight = BMI 25-27.4 kg/m^2; obese = BMI ≥ 27.5 kg/m^2. Results for underweight are not shown.
[2] Age, ethnicity, marital status, residence, employment status, other indicators of health conditions, BMI measurement flag, somking and drinking (men only) are controlled in these models.
$^{+}p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

Table 5.8 Crude and adjusted odds ratios (OR) from logistic regression models examining the risk of central obesity[1], by social, behavioral, and health characteristics for men and women aged 57 years or older, Taiwan, 2003

	Men (n = 1,696)				Women (n = 1,581)			
	Crude OR	Adjusted OR			Crude OR	Adjusted OR		
		Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Demographic characteristics								
Age (ref: 57-64)								
65-69	1.29^{+}	1.39^{+}	1.38^{+}	1.32	1.52**	1.35^{+}	1.36^{+}	1.21
70-74	1.84***	1.79**	1.72**	1.54*	1.62**	1.43^{+}	1.45^{+}	1.14
75-79	1.25	1.25	1.21	1.01	1.76**	1.40^{+}	1.38^{+}	0.99
80+	1.09	1.09	1.07	0.91	1.60*	1.19	1.13	0.80
Mainlander (ref: Hakka & Fukienese)	1.47**	1.12	1.12	1.02	1.03	1.35	1.32	1.37
Married	0.95	0.83	0.83	0.79	0.81^{+}	0.82	0.80	0.72*
Urban	1.11	1.10	1.12	1.15	0.73**	0.81	0.81	0.80
Currently employed	0.90	0.91	0.95	1.04	0.67*	0.72	0.67^{+}	0.76
Socioeconomic characteristics								
Father's occupation (ref: low-status)								
High-status	1.08	0.94	0.93	0.91	0.70*	0.92	0.92	0.87
Well-to-do family at childhood	1.52*	1.41^{+}	1.40^{+}	1.36	0.93	1.00	1.03	0.99
Education (ref: no education)								
Primary	0.96	0.88	0.85	0.80	0.85	0.90	0.91	0.93
Secondary or above	1.02	0.89	0.86	0.84	0.43***	0.56*	0.57*	0.67
Lifetime occupation								
Agricultural (ref)								
Unskilled labor	1.26	1.32	1.30	1.25	0.80	0.91	0.91	0.86
Semi-skilled/service	1.48*	1.33	1.33	1.33	0.62*	0.79	0.80	0.80
Skilled labor	0.74	0.77	0.75	0.75	0.67	0.79	0.80	0.65
Managerial	1.17	1.05	1.03	0.96	0.92	1.22	1.25	1.14
Professional	1.02	0.82	0.81	0.76	0.35***	0.58^{+}	0.59^{+}	0.49*
Housewife					0.95	1.03	1.05	1.03
Self-employed/unemployed					0.54**	0.57*	0.55*	0.49**
Yearly income (ref: 1st tertile)								
2nd tertile	1.40*	1.40*	1.39*	1.33^{+}	0.94	1.11	1.16	1.07
3rd tertile	1.47**	1.62**	1.59**	1.51*	0.66**	1.08	1.14	1.06

[1] Central obsity is defined as waist circumference ≥ 80 cm for women and ≥ 90 cm for men, based on Asian standard.

$^{+}p<0.10$, $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$.

Table 5.8 ***Cont'd***

	Men (n = 1,696)				Women (n = 1,581)			
	Crude OR	Adjusted OR			Crude OR	Adjusted OR		
		Model 1	Model 2	Model 3		Model 1	Model 2	Model 3
Number of assets (ref: 0 item)								
1	1.42*	1.41*	1.39*	1.39+	1.28+	1.51**	1.57**	1.66**
2	1.16	1.17	1.16	1.16	0.90	1.17	1.19	1.21
3+	1.44*	1.56*	1.55*	1.50*	0.90	1.33	1.32	1.45
Social participation (ref: low)								
Medium	0.93	0.90	0.88	0.89	0.88	0.86	0.89	0.88
High	1.02	1.00	0.98	0.96	0.87	0.95	1.02	0.97
Health behaviors								
Physical activity (ref: sedentary)								
Moderate	1.07		1.01	0.99	0.80		0.80	0.84
Vigorous	1.27+		1.16	1.19	0.69*		0.67*	0.72+
Smoker (ref: non-smoker)								
Current	1.08		1.06	1.13				
Past	1.35*		1.30+	1.18				
Consumed alcohol more than once a week	1.15		1.18	1.27+				
Health status								
Self-rated good health	0.90			1.00	0.76*			1.11
Hypertension	2.15***			1.97***	2.20***			1.91***
Diabetes	1.68***			1.39*	2.37***			1.93**
Heart disease	1.51**			1.18	1.61***			1.16
Stroke	1.74*			1.31	1.87*			1.12
Cancer	1.26			1.06	0.45**			0.48*
Arthritis	1.64***			1.46*	1.67***			1.51**
Functional limitations	1.11**			1.16**	1.22***			1.18***
Depressive symptoms	0.79*			0.57***	1.08			0.70**
Log likelihood ratio		-1128.27	-1124.16	-1077.42		-938.50	-934.99	-880.58
Pseudo R^2		0.03	0.03	0.07		0.04	0.04	0.10

Table 5.9 Multinomial logit regresson estimates of the relative odds of medium-risk and high-risk central obesity[1], by selected social, behavioral, and health characteristics for men and women aged 57 years or older, Taiwan, 2003[2]

	Men (n = 1,696)			Women (n = 1,581)		
	Medium-risk vs. normal	High-risk vs. normal	High-risk vs. Medium risk	Medium-risk vs. normal	High-risk vs. normal	High-risk vs. Medium risk
Socioeconomic characteristics						
Father's occupation (ref: low-status)						
High-status	1.02	0.88	0.86	0.89	0.78	0.88
Well-to-do family at childhood	1.15	1.81*	1.57	1.05	0.77	0.73
Education (ref: no education)						
Primary	0.87	0.70	0.80	0.93	0.96	1.03
Secondary or above	1.03	0.56^{+}	0.55^{+}	0.68	0.57	0.83
Lifetime occupation						
Agricultural (ref)						
Unskilled labor	1.08	1.58	1.45	0.87	0.84	0.96
Semi-skilled/service	1.06	1.91*	1.81^{+}	0.82	0.67	0.81
Skilled labor	0.87	0.46^{+}	0.53	0.68	0.57	0.85
Managerial	0.88	1.11	1.27	1.15	1.10	0.96
Professional	0.62^{+}	1.07	1.72	0.50*	0.45	0.90
Housewife				1.03	1.08	1.05
Self-employed/unemployed				0.52*	0.37*	0.71
Yearly income (ref: 1st tertile)						
2nd tertile	1.06	2.09**	1.98**	1.10	0.97	0.88
3rd tertile	1.25	2.28**	1.83*	1.09	0.93	0.85
Number of assets (ref: 0 item)						
1	1.37	1.38	1.00	1.59**	1.96**	1.23
2	1.09	1.23	1.13	1.16	1.47	1.26
3+	1.46^{+}	1.54	1.05	1.49	1.07	0.72
Social participation (ref: low)						
Medium	0.79	1.11	1.41^{+}	0.88	0.86	0.07
High	0.92	1.03	1.12	1.01	0.70	0.69
Health behaviors						
Physical activity (ref: sedentary)						
Moderate	1.02	0.97	0.94	0.84	0.78	0.91
Vigorous	1.23	1.13	0.91	0.76	0.58*	0.77
Health status						
Hypertension	1.79***	2.37***	1.32	1.86***	2.13***	1.14
Diabetes	1.40^{+}	1.37	0.98	1.77**	2.76***	1.56*
Heart disease	1.10	1.28	1.16	1.12	1.40	1.26
Arthritis	1.39^{+}	1.58*	1.13	1.40*	2.13***	1.52*
Functional limitations	1.05	1.36***	1.29***	1.12*	1.43***	1.28***
Depressive symptoms	0.59**	0.54**	0.93	0.76*	0.50***	0.66*

[1] Medium-risk waist circumference (WC) is defined as WC ≥ 90 cm for men and WC ≥ 80 cm for women; high-risk WC is defined as WC ≥ 98 cm for men and WC ≥ 96 cm for women (an equivalent of 85th percentile for men and women, respectively).

[2] Age, ethnicity, marital status, residence, employment status, other indicators of health conditions, and smoking and drinking (men only) are controlled in these models.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

Table 6.1 Percent distribution of body mass index (BMI) for older men and women in 1999 and 2003 and change in BMI categories over this period, Taiwan[1,2]

	Men (n = 1,632)			Women (n = 1,471)			Total (N = 3,103)		
Weight catetory	1999	2003	Change	1999	2003	Change	1999	2003	Change
Body mass index									
Underweight (BMI <18.5)	3.1	4.1	1.0	4.9	4.9	0	4.0	4.5	0.5
Normal (18.5 ≤ BMI <25)	67.1	63.7	-3.4+	60.7	57.4	-3.3+	64.0	60.7	-3.3**
Overweight (25 ≤ BMI <30)	27.0	28.7	1.7	28.6	29.9	1.3	27.8	29.3	1.5
Obese (BMI ≥ 30)	2.8	3.5	0.7	5.8	7.8	2.0*	4.2	5.6	1.4*
Overweight or obese (BMI ≥ 25)	29.8	32.2	2.4	34.4	37.7	3.3+	32.0	34.9	2.9*

[1] Weighted percentages and unweighted sample sizes.

[2] McNemar's chi-square test for matched data is used to test for significance in the change of BMI between 1999 and 2003.

[+]p<0.10, *p<0.05, **p<0.01

Table 6.2 Means and percent distribution of weight change between 1999 and 2003 for older men and women, Taiwan[1]

	Men (n = 1,632)	Women (n = 1,471)
Substantial weight change[2]	%	%
Weight loss	21.2	26.3
Stable weight	58.4	53.0
Weight gain		
Moderate weight gain	10.5	10.9
Large weight gain	9.9	9.8
	Mean (*s.d.*)	Mean (*s.d.*)
Weight gain[3] (kg)	3.1 (4.0)	3.1 (4.2)

	Men (n = 1,093)	Women (n = 893)
	%	%
Become overweight/obese[4]	15.1	17.6
Maintain normal weight	81.0	78.8
From normal to underweight	3.8	3.7

[1] Weighted means or percentages and unweighted sample sizes.

[2] Weight loss is defined as ≥ 5% decrease (>-3.5 kg) over 1999 body weight; moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight; weight stability is defined as a change between -4.9% and 4.9% (-3.5 kg to 2.5 kg).

[3] Among respondents who gained zero or more weight (n = 893 for men and n = 774 for women).

[4] Defined as having a normal weight in 1999 and becoming overweight/obese by 2003.

Underweight = BMI <18.5 kg/m^2; normal = BMI 18.5-24.9 kg/m^2; overweight/obese = BMI≥ 25 kg/m^2.

Figure 6.1 Percent distribution of weight change by age group for men, Taiwan, 1999-2003

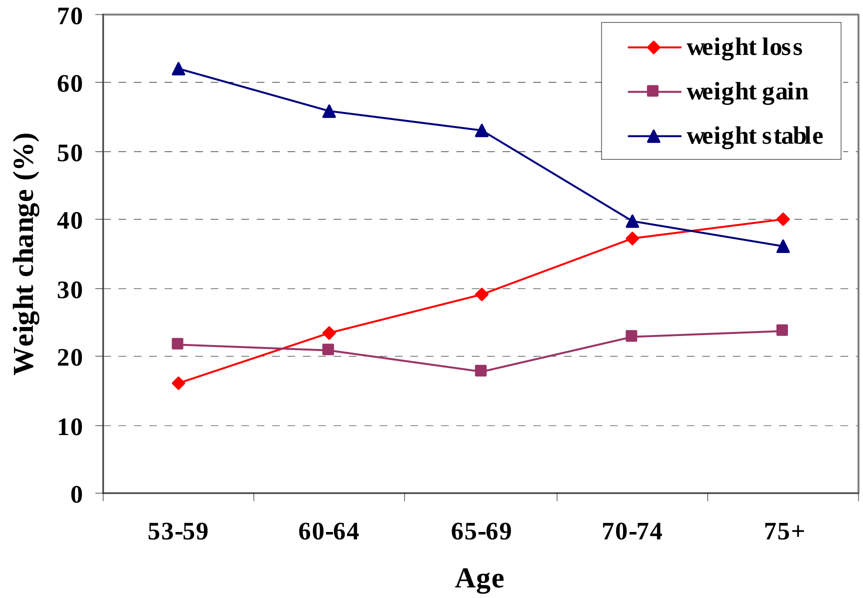

Figure 6.2 Percent distribution of weight change by age group for women, Taiwan, 1999-2003

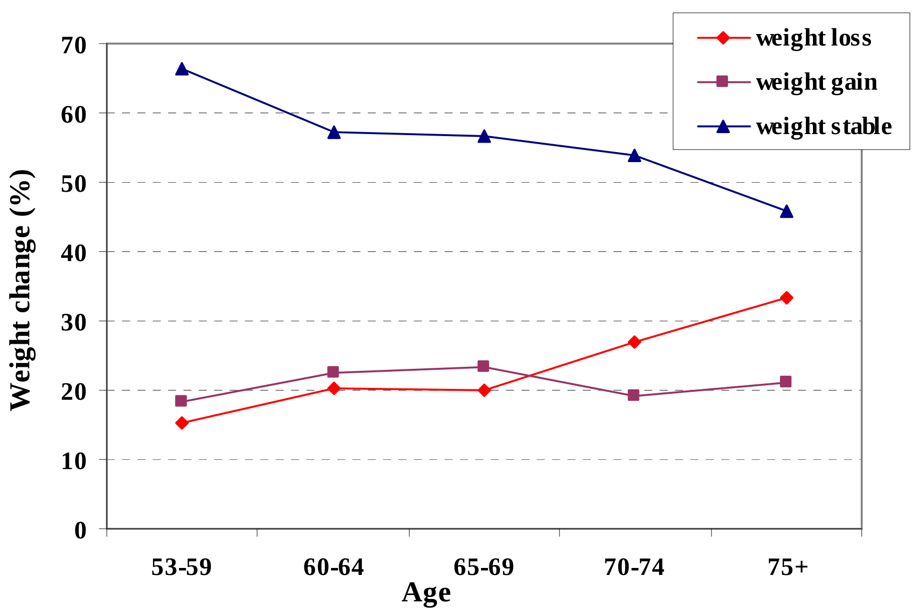

Table 6.3 Description of selected characteristics of older men and women in 1999 and 2003, Taiwan

	Men (n = 1,632)			Women (n = 1,471)		
	Sample size	1999	2003	Sample size	1999	2003
	n	%	%	n	%	%
Demographic characteristics						
Married	1339	84.9	82.9	918	68.5	61.3
Currently employed	595	43.9	29.0	232	19.3	11.9
Socioeconomic status						
Yearly income						
1st tertile	274	15.3	20.7	469	27.2	34.0
2nd tertile	474	26.9	36.3	488	32.8	37.8
3rd tertile	820	53.6	40.5	448	35.3	25.4
Missing	64	4.2	2.5	66	4.7	2.7
Number of assets						
0	259	14.6	16.1	402	22.9	26.9
1	528	31.1	32.2	515	35.4	35.4
2	521	32.6	30.8	378	27.8	25.7
3+	324	21.8	20.9	176	13.9	12.0
Social participation						
Low	682	42.3	51.1	836	56.2	62.2
Medium	576	35.4	29.4	427	29.2	24.8
High	374	22.3	19.6	208	14.6	13.0
Health behaviors						
Physical activity						
Sedentary	515	33.9	31.9	643	45.0	36.7
Moderate	593	35.7	33.7	530	34.3	38.0
Vigorous	524	30.4	34.3	298	20.8	25.2
Smoker						
Never	481	30.1	28.8	1400	95.8	96.4
Current	697	45.3	37.5	51	3.2	2.5
Past	454	24.7	33.7	20	1.1	1.1
Alcohol consumption more than once a week	403	25.7	22.9	31	2.0	3.2
Health Status						
Self-rated good health	755	48.5	42.6	450	33.2	30.9
Hypertension	477	27.3	35.0	535	33.9	40.1
Diabetes	185	11.2	15.1	211	13.8	18.9
Heart disease	240	13.0	15.8	292	17.7	24.7
Stroke	64	3.3	6.1	43	2.5	5.3
Cancer	31	1.8	2.9	50	3.4	3.8
Arthritis	252	14.4	16.9	434	28.3	32.5
		Mean (*s.d.*)	Mean (*s.d.*)		Mean (*s.d.*)	Mean (*s.d.*)
Functional limitations		0.49 (1.23)	0.91 (1.47)		1.22 (1.71)	1.72 (1.86)
Depressive symptoms		0.41 (0.50)	0.39 (0.46)		0.59 (0.60)	0.58 (0.55)

Weighted means or percentages and unweighted sample sizes.

Table 6.4 Percent distribution of weight gain by selected baseline characteristics among older men and women, Taiwan, 1999-2003[1, 2]

	Men (n = 1,632)			Women (n = 1,471)		
	Sample size	Moderate weight gain	Large weight gain	Sample size	Moderate weight gain	Large weight gain
	n	%	%	n	%	%
Socioeconomic status						
Father's occupation						
Low-status	1,185	10.1	10.9	1,119	12.1	10.0
High-status	390	11.9	6.1	311	6.9	8.2
Missing	57	9.8	15.2	41	7.0	16.4
Family economic condition at childhood						
Average or poor	1,468	10.7	10.0	1,342	11.2	9.9
Well-to-do	164	8.6	9.9	129	8.0	9.0
Education						
No education	185	11.7	20.0	704	12.1	12.3
Primary	841	10.9	10.4	598	10.8	8.4
Secondary or above	606	9.6	6.6	169	7.3	5.9
Lifetime occupation						
Agricultural	447	9.6	13.8	372	13.7	12.7
Unskilled labor	152	10.8	15.2	195	10.7	9.7
Semi-skilled/service	290	9.7	6.8	190	13.9	6.5
Skilled labor	141	13.4	6.7	67	5.8	8.2
Managerial	331	9.6	9.9	93	10.4	8.9
Professional	271	12.4	5.5	91	9.8	4.5
House wife				377	9.1	11.8
Self-employed/unemployed				86	6.7	7.9
Yearly income						
1st tertile	274	13.4	13.8	469	9.1	14.0
2nd tertile	474	9.5	11.7	488	11.0	8.3
3rd tertile	820	10.7	8.2	448	11.7	7.9
Missing flag	64	4.4	7.8	66	14.3	11.4
Number of assets						
0	259	14.5	11.5	402	12.7	12.0
1	528	10.2	9.7	515	10.1	10.9
2	521	10.5	9.6	378	10.0	8.1
3+	324	8.4	9.8	176	12.0	6.9
Social participation						
Low	682	13.6	9.8	836	12.0	11.9
Medium	576	8.6	9.3	427	9.1	8.9
High	374	7.8	11.2	208	10.2	3.5
Physical activity						
Sedentary	515	11.1	12.0	643	9.7	11.7
Moderate	593	10.1	9.5	530	11.9	10.1
Vigorous	524	10.4	8.2	298	12.0	5.2

[1] Moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight. Data on weight loss and weight stability are not shown.

[2] Weighted percentages and unweighted sample sizes.

Table 6.5 Percent distribution of weight gain by change predictors among older men and women, Taiwan, 1999-2003[1, 2]

	Men (n = 1,632)			Women (n = 1,471)		
	Sample size	Moderate weight gain	Large weight gain	Sample size	Moderate weight gain	Large weight gain
	n	%	%	n	%	%
Marital status						
Remain or become married	1,276	10.5	14.2	782	10.2	9.2
Unmarried	269	9.7	8.0	549	11.7	11.5
Become widowed/ divorced/separated	87	14.2	17.5	140	13.6	8.6
Employment status						
Unemployed	993	10.6	11.2	1,213	10.3	10.1
Employed	373	8.6	9.9	134	12.5	7.2
Retired	266	13.3	6.8	124	13.4	10.5
Income						
Persistently low	147	15.0	11.3	317	9.5	16.8
Persistently moderate or variable	904	10.7	11.3	844	11.2	8.6
Persistently high	480	10.1	7.4	209	10.6	7.7
Missing	101	6.4	9.3	101	12.1	8.3
Assets						
Persistently low	133	13.2	8.9	264	12.6	13.7
Persistently moderate or variable	918	11.5	11.7	877	11.8	10.2
Persistently high	581	8.7	7.8	330	8.0	6.7
Social participation						
Low at both waves	483	13.5	9.9	667	11.3	12.1
Persistently moderate	358	10.7	13.0	238	8.6	7.6
Persistently high	235	6.4	8.3	130	10.7	4.6
No to yes	199	13.9	9.6	169	14.5	11.3
Yes to no	357	7.2	8.4	267	9.6	7.9
Physical activity						
Remain sedentary	282	9.5	11.6	373	8.8	12.9
Moderate, moderate	413	10.5	8.4	375	11.8	8.6
Vigorous, vigorous	477	10.8	6.4	259	15.2	4.8
Become active	233	13.1	12.6	270	10.8	10.2
Become inactive	227	8.3	14.9	194	6.8	13.2
Smoking						
Non-smoker	893	10.9	9.3			
Smoker or started to smoke	558	9.6	9.8			
Quit smoking	181	12.0	13.7			
Alcohol consumption						
No or low at both waves	1,104	9.9	9.4			
Frequent user at both waves	219	11.8	8.5			
Started after 1999	125	13.4	17.7			
Quitted after 1999	184	10.7	9.0			

[1] Moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight. Data on weight loss and weight stability are not shown.

[2] Weighted percentages and unweighted sample sizes.

Table 6.6 Age-adjusted odds ratios of multinomial logistic models examining the association between social factors and patterns of physical activity among older men and women, Taiwan, 1999-2003

	Men (n = 1,632)		Women (n = 1,471)	
	Persistently active vs. sedentary	Become active vs. sedentary	Persistently active vs. sedentary	Become active vs. sedentary
Socioeconomic status				
Father's occupation (ref: low-status)				
High-status	2.27***	0.96	1.78***	0.97
Well-to-do family at childhood (ref: average or poor)	1.32	1.00	1.75*	1.60
Education (ref: no education)				
Primary	1.84**	1.51	1.43*	1.11
Secondary or above	3.78***	1.02	2.34***	0.81
Lifetime occupation				
Agricultural (ref)				
Unskilled labor	2.22**	1.20	1.13	1.25
Semi-skilled/service	2.59***	0.81	1.88**	1.32
Skilled labor	3.30***	0.70	2.48**	0.82
Managerial	3.28***	0.93	2.19**	1.34
Professional	6.47***	0.62	3.28***	1.15
House wife			1.79**	1.32
Self-employed/unemployed			1.32	0.56
Yearly income in 1999 (ref: 1st tertile)				
2nd tertile	1.13	1.76*	1.16	1.34
3rd tertile	1.78**	1.22	1.73**	1.62*
Change in income				
Persistently low (ref)				
Persistently moderate or variable	1.30	1.35	1.34	1.49
Persistently high	1.80*	1.00	2.24**	2.45**
Missing	1.09	1.17	1.62	0.97
Number of assets in 1999 (ref: 0 item)				
1	1.35	1.56	1.15	0.78
2	1.56*	1.29	1.56*	1.13
3+	1.24	0.85	1.11	0.98
Change in assets				
Persistently low (ref)				
Persistently moderate or variable	2.36***	1.29	1.37	1.15
Persistently high	2.11**	1.01	1.39	0.89
Social participation in 1999				
Low (ref)				
Medium	1.31	1.22	1.99***	1.21
High	1.53**	1.19	1.80**	1.14
Change in social participation				
Low at both waves (ref)				
Persistently moderate	1.35	0.97	2.59***	1.26
Persistently high	1.99**	1.41	4.45***	2.11*
No to yes	1.39	1.23	1.78**	1.09
Yes to no	1.44*	1.55	1.39	0.94

*p <0.05, **p <0.01, ***p <0.001.

Table 6.7 Linear regression coefficients predicting weight gain[1] over a 4-year period by selected baseline characteristics among older men and women, Taiwan, 1999-2003[2]

	Men (n = 893)		Women (n = 774)	
	ß	*s.e.*	ß	*s.e.*
Father's occupation (ref: low-status)				
High-status	-0.49	0.30	-0.03	0.37
Education (ref: no education)				
Primary	-1.20*	0.59	-0.32	0.37
Secondary or above	-1.47*	0.62	-0.89+	0.47
Number of assets (ref: 0 item)				
1	-0.10	0.52	-0.21	0.45
2	-0.15	0.53	-0.77+	0.44
3+	-0.13	0.54	-0.16	0.63
Social participation (ref: low)				
Medium	-0.35	0.35	-0.46	0.39
High	0.07	0.35	-0.97**	0.31
Physical activity (ref: sedentary)				
Moderate	0.03	0.37	-0.38	0.37
Vigorous	0.06	0.45	-0.89*	0.44
R^2	0.08		0.12	

[1] Weight gain (in kg) is a continous variable. Weight loss group was excluded from this analysis.

[2] Baseline BMI, age, marital status, residence, employment status, income, smoking and drinking (men only), health conditions, ethnicity, childhood family economic conditions and lifetime occupation are controlled.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$.

Table 6.8 Adjusted odds ratios of multinomial logistic models predicting weight change[1] over a 4-year period by baseline characteristics among older men and women, Taiwan, 1999-2003

	Men (n = 1,632)			Women (n = 1,471)		
	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight
BMI in 1999	0.93	0.63	0.76	1.33^{+}	0.83	0.52**
BMI square in 1999	1.00	1.01	1.00	1.00	1.00	1.01*
Demographic characteristics						
Age (ref: 53-59)						
60-64	1.51^{+}	1.16	1.17	1.43	0.96	0.61
65-69	1.27	1.07	1.20	2.04**	0.67	0.81
70-74	1.99**	0.87	0.74	3.53***	0.62	1.24
75+	2.63***	0.75	1.02	3.76***	0.42*	1.17
Mainlander (ref: Hakka & Fukienese)	1.26	1.55^{+}	0.92	0.61^{+}	1.24	1.14
Married	0.78	1.05	1.48	1.19	0.67^{+}	1.05
Urban	1.05	1.08	0.77	0.90	0.68	1.31
Currently employed	0.89	0.98	0.61*	0.63*	0.83	0.69
Socioeconomic characteristics						
Father's occupation (ref: low-status)						
High-status	0.82	1.25	0.66	1.14	0.67	0.97
Well-to-do family at childhood	1.37	0.90	1.71	0.65^{+}	0.66	0.90
Education (ref: no education)						
Primary	0.72	0.67	0.52*	0.62**	0.71	0.71
Secondary or above	0.97	0.51^{+}	0.42*	0.54*	0.42^{+}	0.48
Lifetime occupation						
Agricultural (ref)						
Unskilled labor	0.76	0.90	1.16	0.84	0.65	0.60
Semi-skilled/service	0.45**	0.72	0.58	0.61^{+}	0.75	0.40*
Skilled labor[2]	0.99	1.30	0.69	0.94	0.38	0.61
Managerial	0.65	0.89	1.15	0.73	0.77	0.71
Professional	0.77	1.13	0.59	0.96	0.90	0.37
Housewife				0.70^{+}	0.60^{+}	0.67
Self-employed/unemployed				0.63	0.33*	0.46

[1] Weight loss is defined as ≥ 5% decrease (>-3.5 kg) over 1999 body weight; moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight; weight stability is defined as a change between -4.9% and 4.9% (-3.5 kg to 2.5 kg).

[2] The estimate for moderate weight gain among women in skilled-labor jobs is unreliable due to small n in this category.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

Table 6.8 C*ont'd*

	Men			Women		
	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight
Yearly income (ref: 1st tertile)						
2nd tertile	1.26	0.75	1.00	0.86	1.22	0.70
3rd tertile	1.04	0.78	1.07	1.00	1.51	0.91
Number of assets (ref: 0 item)						
1	1.03	0.73	0.90	1.01	0.64	1.22
2	0.94	0.73	0.84	0.68^{+}	0.53*	0.87
3+	1.03	0.62	0.95	0.69	0.70	0.91
Social participation (ref: low)						
Medium	0.92	0.58*	0.86	1.13	0.69	0.77
High	1.01	0.61^{+}	1.15	1.23	0.73	0.33**
Health behaviors						
Physical activity (ref: sedentary)						
Moderate	0.89	0.81	0.84	0.66*	1.41	0.84
Vigorous	0.62*	0.85	0.82	0.47***	1.35	0.44*
Smoker (ref: non-smoker)						
Current	0.86	0.78	1.11			
Past	0.83	0.87	1.30			
Consumed alcohol more than once a week	1.13	1.17	0.90			
Health status						
Self-rated good health	1.00	0.84	0.61*	1.07	1.53^{+}	1.15
Hypertension	0.86	1.18	1.06	0.76^{+}	1.03	0.79
Diabetes	1.37	0.69	0.64	1.13	0.80	1.01
Heart disease	0.96	1.16	1.20	0.99	1.19	0.92
Stroke[3]	0.80	0.59	0.68	1.70	0.11*	0.84
Cancer[4]	1.27	2.43	0.53	1.93^{+}	1.53	1.72
Arthritis	1.04	0.63	0.91	0.62**	0.85	1.24
Functional limitations	1.00	1.04	1.13	1.01	1.06	1.14^{+}
Depressive symptoms	1.35^{+}	1.09	1.37	1.03	1.30	1.12
Log likelihood ratio		-1666.47			-1523.68	
Pseudo R^2		0.08			0.10	

[3] The estimates for moderate weight gain among men and women with stroke is unreliable due to small ns in these categories.

[4] The estimate for large weight gain among men with cancer is unreliable due to small n in this category.

Table 6.9 Adjusted odds ratios of logistic regression models predicting the risk of becoming overweight/obese[1] over a 4-year period by selected baseline characteristics among older men and women, Taiwan, 1999-2003[2]

	Men (n = 1,040)	Women (n = 850)
BMI in 1999	0.03	0.007*
BMI square in 1999	1.10	1.13*
Socioeconomic characteristics		
Father's occupation (ref: low-status)		
High-status	0.97	1.03
Education (ref: no education)		
Primary	0.45*	0.68
Secondary or above	0.35**	0.23**
Lifetime occupation		
Agricultural (ref)		
Unskilled labor	1.36	0.93
Semi-skilled/service	1.24	1.08
Skilled labor	0.73	2.82*
Managerial	0.84	3.06*
Professional	0.88	0.98
Housewife		1.34
Self-employed/unemployed		0.80
Yearly income (ref: 1st tertile)		
2nd tertile	0.92	0.97
3rd tertile	1.09	1.50
Number of assets (ref: 0 item)		
1	1.07	0.61
2	0.98	0.45*
3+	0.86	0.50
Social participation (ref: low)		
Medium	0.81	1.12
High	0.98	1.00
Physical activity (ref: sedentary)		
Moderate	0.96	0.96
Vigorous	1.14	0.86
Log likelihood ratio	-345.97	-322.87
Pseudo R^2	0.24	0.20

[1] Defined as having a normal weight in 1999 and becoming overweight/obese between 1999 and 2003. The small group of individuals who changed from normal weight to underweight over this period are excluded from this analysis. Normal = BMI 18.5-24.9 kg/m^2; overweight/obese = BMI$\geq$ 25 kg/m^2.

[2] Baseline age, marital status, residence, employment status, smoking and drinking (men only), health conditions and ethnicity are controlled.

$^+p<0.10$, $*p<0.05$, $**p<0.01$.

Table 6.10 Adjusted odds ratios of multinomial logistic models predicting weight change[1] over a 4-year period by selected change predictors among older men and women, Taiwan, 1999-2003[2]

	Men (n = 1,632)			Women (n = 1,471)		
	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight	Weight loss vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight
Marital status						
Remain or become married (ref)						
Unmarried	1.21	0.81	0.62+	1.00	1.41	0.90
Become widowed/ divorced/separated	1.12	1.74	1.51	1.98**	1.90+	1.17
Employment status (ref: employed)						
Unemployed	1.29	1.21	1.09	1.71+	1.15	1.42
Retired	1.36	1.69+	0.78	1.18	1.20	1.83
Income						
Persistently low (ref)						
Persistently moderate or variable	0.97	0.67	1.31	1.33	1.24	0.71
Persistently high	0.77	0.59	1.55	1.49	1.64	0.82
Assets						
Persistently low (ref)						
Persistently moderate or variable	1.06	0.99	1.76	0.84	0.72	1.04
Persistently high	1.17	0.70	1.05	0.58*	0.41*	0.74
Social participation						
Low at both waves (ref)						
Persistently moderate	0.99	0.84	1.45	0.92	0.60+	0.67
Persistently high	0.79	0.45*	0.76	0.89	0.62	0.51
No to yes	0.90	0.96	1.01	0.60*	0.97	0.99
Yes to no	1.02	0.46**	0.78	1.32	0.87	0.67
Physical activity						
Vigorous, vigorous (ref)						
Moderate, moderate	1.33	0.98	1.21	1.19	0.75	1.54
Sedentary, sedentary	1.85**	1.08	1.47	1.70*	0.47*	2.04+
Become active	1.48	1.38	1.83+	1.88*	0.57+	1.81
Become inactive	1.67*	0.99	2.20*	1.07	0.38*	2.03
Smoking (ref: non-smoker)						
Smoker or started to smoke	0.82	0.69+	0.76			
Quit smoking	1.14	1.12	1.32			
Alcohol consumption						
No or low at both waves (ref)						
Frequent user at both waves	1.05	1.38	1.13			
Started after baseline	0.64	1.73+	1.97*			
Quitted after baseline	1.19	1.09	0.93			
Log likelihood ratio		-1640.36			-1510.95	
Psedo R^2		0.09			0.11	

[1] Weight loss is defined as ≥ 5% decrease (>-3.5 kg) over 1999 body weight; moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight; weight stability is defined as a change between -4.9% and 4.9% (-3.5 kg to 2.5 kg).

[2] Baseline BMI, age, residence, health conditions, ethnicity, childhood SES, education and lifetime occupation are controlled.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$.

Table 6.11 Adjusted odds ratios of multinomial logistic models predicting large weight gain versus moderate weight gain[1] over a 4-year period, by change in physical activity among older men and women, Taiwan, 1999-2003[2]

	Men (n = 1,632)	Women (n = 1,471)
	Large weight gain vs. Moderate weight gain	Large weight gain vs. Moderate weight gain
Vigorous, vigorous (ref)		
Moderate, moderate	1.24	2.06
Sedentary, sedentary	1.36	4.33**
Become active	1.32	3.19*
Become inactive	2.23^{+}	5.35**

[1] Moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight. Moderate weight gain is the reference group. Results for weight loss and weight stability are not shown.

[2] All other demographic, social, bahavioral varaibles and health conditions are controlled.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$.

Appendices

Table A4.4 Linear regression coefficients predicting weight gain[1] over a 4-year period by selected baseline characteristics among older men and women, Taiwan, 1999-2003[2]

	Men				Women			
	Whole sample (n = 1,632)		Weight loss sample (n = 739)		Whole sample (n = 1,471)		Weight loss sample (n = 697)	
	ß	*s.e.*	ß	*s.e.*	ß	*s.e.*	ß	*s.e.*
Father's occupation (ref: Low-status)								
High-status	0.16	0.33	0.50	0.37	-0.18	0.36	0.42	0.34
Education (ref: no education)								
Primary	-0.42	0.57	0.29	0.55	0.14	0.35	0.73*	0.34
Secondary or above	-0.88	0.64	0.04	0.61	-0.66	0.52	-0.10	0.56
Number of assets (ref: 0 item)								
1	-0.22	0.49	-0.02	0.47	-0.25	0.42	-0.69	0.38
2	0.06	0.51	0.50	0.47	-0.02	0.43	-0.02	0.41
3+	-0.06	0.55	0.30	0.57	0.22	0.56	-0.14	0.54
Social participation (ref: low)								
Medium	-0.35	0.34	0.11	0.34	-0.16	0.34	0.05	0.32
High	-0.26	0.38	0.33	0.38	-0.53	0.35	0.28	0.38
Physical activity (ref: sedentary)								
Moderate	0.10	0.36	0.49	0.36	0.68+	0.35	0.52	0.34
Vigorous	0.72+	0.40	1.01**	0.37	0.77*	0.39	1.13**	0.36
R^2	0.07		0.17		0.08		0.19	

[1] Weight gain (in kg) is a continous variable.

[2] Baseline BMI, age, marital status, residence, employment status, income, smoking and drinking (male sub-sample only), health conditions, ethnicity, childhood family economic conditions and lifetime occupation are controlled.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$.

Table A5.10 Sample distribution of demographic variables for men and women aged 57 years or older, and by overweight/obesity, Taiwan, 2003[1,2]

	Men (n = 1,672)		Women (n = 1,484)	
	Total	Overweight/ obesity	Total	Overweight/ obesity
	n	n	n	n
Age (years)				
57-64	403	153	389	156
65-69	249	80	257	104
70-74	242	77	198	76
75-79	461	117	334	110
80+	317	77	306	85
Ethnicity				
Fukienese/Hakka	1,267	379	1,387	500
Mainlander	405	125	97	31
Marital status				
Unmarried	371	93	706	231
Married	1,301	411	778	300
Resident				
Rural	546	162	522	163
Urban	1,126	342	962	368
Currently employed				
No	1,292	378	1,350	480
Yes	380	126	134	51

[1] Unweighted sample sizes.
[2] Overweight/obesity is defined as body mass index (BMI) ≥ 25 kg/m^2. Data on underweight (BMI<18.5 kg/m^2) and normal weight (BMI 18.5-24.9 kg/m^2) are not shown.

Table A5.11 Sample distribution of social, behavioral and health variables for men and women aged 57 years or older, and by overweight/obesity, Taiwan, 2003[1, 2]

	Men (n = 1,672)		Women (n = 1.484)	
	Total	Overweight/ obesity	Total	Overweight/ obesity
	n	n	n	n
Socioeconomic characteristics				
Father's occupation				
Low-status	1,217	373	1,134	411
High-status	397	113	310	106
Missing	58	18	40	14
Childhood family economic condition				
Average or poor	1,508	443	1,353	486
Well-to-do	164	61	131	45
Education				
No education	194	55	721	258
Primary	866	265	598	233
Secondary or above	612	184	165	40
Lifetime occupation				
Agricultural	464	114	381	112
Unskilled labor	155	52	208	78
Semi-skilled/service	299	118	189	69
Skilled labor	146	40	68	29
Managerial	332	103	94	44
Professional	276	77	89	23
House wife			370	148
Self-employed/unemployed			85	28
Yearly income				
1st tertile	387	94	614	199
2nd tertile	619	188	552	206
3rd tertile	625	211	318	126
Missing flag	41	11		
Number of assets				
0	313	86	492	153
1	563	171	511	200
2	496	154	329	125
3+	300	93	152	53
Social participation				
Low	857	246	947	338
Medium	501	149	366	129
High	314	109	171	64

[1] Unweighted sample sizes.

[2] Overweight/obesity is defined as body mass index (BMI) $\geq$ 25 kg/m^2. Data on underweight (BMI<18.5 kg/m^2) and normal weight (BMI 18.5-24.9 kg/m^2) are not shown.

Table A5.11 *Cont'd*

	Men (n = 1,672)		Women (n = 1.484)	
	Total	Overweight/ obesity	Total	Overweight/ obesity
	n	n	n	n
Health behaviors				
Physical activity				
Sedentary	530	166	574	213
Moderate	575	158	568	193
Vigorous	567	180	342	125
Smoker				
Never	469	138	1,425	514
Current	569	149	39	11
Past	634	217	20	6
Alcohol consumption more than once a week				
No	1,322	394	1,442	515
Yes	350	110	42	16
Health Status				
Self-rated health status				
Fair/poor	1,022	313	1,044	373
Excellent/good	650	191	440	158
Hypertension				
No	1,046	256	848	266
Yes	626	248	636	265
Diabetes				
No	1,421	409	1,195	401
Yes	251	95	289	130
Heart disease				
No	1,362	390	1,090	372
Yes	310	114	394	159
Stroke				
No	1,549	465	1,387	503
Yes	123	39	97	28
Cancer				
No	1,618	489	1,431	512
Yes	54	15	53	19
Arthritis				
No	1,363	389	993	313
Yes	309	115	491	218

Table A5.12 Sample distribution of central obesity[1] by social, behavioral and health characteristics for men and women aged 57 years or older, Taiwan, 2003[2]

	Men (n = 1,696)	Women (n = 1,581)
	Central obesity	Central obesity
	n	n
Socioeconomic characteristics		
Father's occupation		
Low-status	525	872
High-status	171	213
Missing	28	30
Childhood family economic condition		
Average or poor	641	1,023
Well-to-do	83	92
Education		
No education	81	590
Primary	375	427
Secondary or above	268	98
Lifetime occupation		
Agricultural	181	299
Unskilled labor	79	163
Semi-skilled/service	154	133
Skilled labor	47	45
Managerial	156	75
Professional	107	51
House wife		291
Self-employed/unemployed		58
Yearly income		
1st tertile	147	472
2nd tertile	282	416
3rd tertile	277	205
Missing	18	22
Number of assets		
0	120	367
1	263	404
2	203	239
3+	138	105
Social participation		
Low	362	707
Medium	220	283
High	142	125

[1] Central obesity is defined as waist circumference ≥ 90 cm for men and ≥ 80 cm for women by Asian standard.

[2] Unweighted sample sizes.

Table A5.12 *Cont'd*

	Men (n = 1,696)	Women (n = 1,581)
	Central obesity	Central obesity
	n	n
Health behaviors		
Physical activity		
Sedentary	216	443
Moderate	247	432
Vigorous	261	240
Smoker		
Never	188	1,075
Current	231	28
Past	305	12
Alcohol consumption more than once a week		
No	565	1,076
Yes	159	39
Health Status		
Self-rated health status		
Fair/poor	450	804
Excellent/good	274	311
Hypertension		
No	374	586
Yes	350	529
Diabetes		
No	584	865
Yes	140	250
Heart disease		
No	567	794
Yes	157	321
Stroke		
No	662	1,041
Yes	62	74
Cancer		
No	699	1,090
Yes	25	25
Arthritis		
No	559	721
Yes	165	394

Table A6.12 Adjusted odds ratios of multinomial logit models predicting weight gain[1] over a 4-year period by baseline characteristics among older women (n = 1,471), Taiwan, 1999-2003[2]

	Model 1		Model 2	
	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight	Moderate weight gain vs. stable weight	Large weight gain vs. stable weight
Socioeconomic characteristics				
Father's occupation (ref: low-status)				
High-status	0.55*	0.83		
Well-to-do family at childhood	0.61	0.82	0.68	0.89
Education (ref: no education)				
Primary			0.68^{+}	0.70
Secondary or above			0.36*	0.46^{+}
Lifetime occupation				
Agricultural (ref)				
Unskilled labor	0.64	0.59	0.65	0.60
Semi-skilled/service	0.69	0.36**	0.74	0.40*
Skilled labor	0.38	0.60	0.35	0.62
Managerial	0.68	0.64	0.73	0.70
Professional	0.65	0.28^{+}	0.80	0.37
Housewife	0.57^{+}	0.64	0.59^{+}	0.67
Self-employed/unemployed	0.31*	0.43	0.33*	0.45^{+}
Yearly income (ref: 1st tertile)				
2nd tertile	1.19	0.67	1.22	0.70
3rd tertile	1.43	0.85	1.50	0.89
Number of assets (ref: 0 item)				
1	0.64	1.19	0.65	1.23
2	0.51*	0.85	0.53*	0.86
3+	0.65	0.86	0.72	0.89
Social participation (ref: low)				
Medium	0.68	0.76	0.67^{+}	0.78
High	0.72	0.33**	0.73	0.34**
Health behaviors				
Physical activity (ref: sedentary)				
Moderate	1.39	0.83	1.40	0.86
Vigorous	1.30	0.43*	1.30	0.46*
Log likelihood ratio	-1531.29		-1527.14	
Pseudo R^2	0.10		0.10	

[1] Weight loss is defined as ≥ 5% decrease (>-3.5 kg) over 1999 body weight; moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight; weight stability is defined as a change between -4.9% and 4.9% (-3.5 kg to 2.5 kg). Results for weight loss are not shown.

[2] Baseline BMI, age, marital status, residence, employment status, health conditions and ethnicity are controlled. Results for weight loss are not shown.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

Table A6.13 Adjusted odds ratios of multinomial logistic models predicting large weight gain[1] over a 4-year period, by selected demographic, social and behavioral factors for older men and women, Taiwan, 1999-2003

	Men (n = 1,632)	Women (n = 1,471)
	Large weight gain vs. Moderate weight gain	Large weight gain vs. Moderate weight gain
Demographic characteristics		
Urban	0.72	1.92*
Socioeconomic characteristics		
Father's occupation (ref: low-status)		
High-status	0.53^{+}	1.46
Number of assets (ref: 0 item)		
1	1.23	1.89^{+}
2	1.13	1.64
3+	1.55	1.30
Social participation (ref: low)		
Medium	1.49	1.11
High	1.89^{+}	0.46
Physical activity (ref: sedentary)		
Moderate	1.02	0.60^{+}
Vigorous	1.06	0.33**

[1] Moderate weight gain is defined as 5%-9.3% increase (2.5-4.9 kg) over 1999 body weight; large weight gain is defined as ≥ 9.4% increase (≥ 5 kg) over 1999 body weight. Moderate weight gain is the reference group. Results for weight loss and weight stability are not shown.

[2] Childhood economic conditions, education, lifetime occupation, ethnicity, baseline BMI, age, marital and employment status, income, smoking and drinking (men only), health conditions are controlled.

$^{+}p<0.10$, $*p<0.05$, $**p<0.01$.

References

Adams, K.F., A. Schatzkin, T.B. Harris, V. Kipnis, T. Mouw, R. Ballard-Barbash et al. 2006. "Overweight, Obesity, and Mortality in a Large Prospective Cohort of Persons 50 to 71 Years Old." *New England Journal of Medicine* 355(8): 763-78.

Allaz, A., M. Bernstein, P. Rouget, M. Archinard, and A. Morabia. 1998. "Body Weight Preoccupation in Middle-Age and Ageing Women: A General Population Survey." *International Journal of Eating Disorder* 23:287-94.

Alwin, Duane F. and Linda A. Wray. 2005. "A Life-Span Developmental Perspective on Social Status and Health." *Journals of Gerontology: Series B (Psychological Science and Social Science)* 60B:S7-S14.

American College of Sports Medicine. 1998. "The Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness and Flexibility in Healthy Adults." *Medicine and Science in Sports and Exercise* 30:975-91.

Ball, Kylie and David Crawford. 2005. "Socioeconomic Status and Weight Change in Adults: A Review." *Social Science & Medicine* 60(9):1987-2010.

Ball, Kylie, G. Mishra, and D. Crawford. 2002. "Which Aspects of Socioeconomic Status Are Related to Obesity Among Men and Women?" *International Journal of Obesity* 26:559-65.

______. 2003. "Social Factors and Obesity: An Investigation of the Role of Health Behaviors." *International Journal of Obesity* 27:394-403.

Baltrus, P.T., S.A. Everson-Rose, J.W. Lynch, T.E. Raghunathan, and G.A. Kaplan. 2007. **"**Socioeconomic Position in Childhood and Adulthood and Weight Gain Over 34 Years: The Alameda County Study." *Annals of Epidemiology 17*:608-14.

Bell, A.C., K.Y. Ge, and B.M. Popkin. 2001. "Weight Gain and Its Predictors in Chinese Adults." *International Journal of Obesity*. 25:1079-86.

______. 2002. "The Road to Obesity or the Path to Prevention: Motorized Transportation and Obesity in China." *Obesity Research* 10(4):277-83.

Blane, D., C.L. Hart, G. Davey Smith, C.R. Gillis, D.J. Hole, and V.M. Hawthorne. 1996. "Association of Cardiovascular Disease Risk Factors with Socioeconomic Position During Childhood and During Adulthood." *British Medical Journal* 313:1434-8.

Berkman, Lisa F. and Thomas Glass. 2000. "Social Integration, Social Networks, Social Support, and Health." Pp. 137-173 in *Social Epidemiology*, edited by L.F.

Berkman and I. Kawachi. New York: Oxford University Press.

Bordo, Susan. 1993. *Unbearable Weight: Feminism, Western Culture, and the Body*. Berkeley: University of California Press.

Bourdieu, Pierre. 1984. *Distinction: A Social Critique of the Judgement of Taste*. London: Routledge.

Bovbjerg, V.E., B.S. McCann, D.J. Brief, W.C. Follette, B.M. Retzlaff et al. 1995. "Spouse Support and Long-Term Adherence to Lipid-Lowering Diets." *American Journal of Epidemiology* 141:451-60.

Brinton, Mary C. 2001. "Married Women's Labor in East Asian Economics." Pp. 1-37 in *Women's Working Lives in East Asia*, edited by Brinton. California: Stanford University Press.

Brunner, E., M.J. Shipley, D. Blane, G. Davey Smith, and M.G. Marmot. 1999. "When Does Cardiovascular Risk Start? Past and Present Socioeconomic Circumstances and Risk Factors in Adulthood." *Journal of Epidemiology and Community Health* 53:757-764.

Chen, Dung-Sheng. 2001. "Taiwan's Social Changes in the Patterns of Social Solidarity in the 20th Century." *China Quarterly* 165:61-82.

Chen, Honglei, Odilia I. Bermudez, and Katherine L. Tucker. 2002. "Waist Circumference and Weight Change Are Associated With Disability Among Elderly Hispanics." *Journal of Gerontology: Medical Sciences* 57A(1):M19-M25.

Chen, L.J., K.R. Fox, A. Haase, and J.M. Wang. 2006. "Obesity, Fitness and Health in Taiwanese Children and Adolescents." *European Journal of Clinical Nutrition* 60:1367-75.

Christakis, Nicholas and James H. Fowler. 2007. "The Spread of Obesity in a Large Social Network over 32 Years." *New England Journal of Medicine* 357:370-9.

Chu, N.F. 2005. "Prevalence of Obesity in Taiwan." *Obesity Reviews* 6:271-74.

Davey Smith, George and John Lynch. 2004. "Life Course Approaches to Socioeconomic Differentials in Health." Pp 77-115 in *A Life Course Approach to Chronic Disease Epidemiology,* edited by D. Kuh and Y. Ben Shlomo. Oxford: Oxford University Press.

Directorate-General of Budgets, Accounts and Statistics. *Statistical Yearbook of the Republic of China 2007.* http://eng.dgbas.gov.tw/lp.asp?CtNode=2351&CtUnit=1072&BaseDSD=36&xq_xCat, edited in 2008, accessed on January 3rd, 2009.

Dornbusch, S.M., J.M. Carlsmith, P.D. Duncan, R.T. Gross, J.A. Martin, P.L. Ritter et al.1984. “Sexual Maturation, Social Class, and the Desire to Be Thin Among Adolescent Females.” *Journal of Developmental & Behavioral Pediatrics* 5:308-14.

Drewnowski, A., C.L. Kurth, and D.D. Krahn, 1994. “Body Weight and Dieting in Adolescence: Impact of Socioeconomic Status.” *International Journal of Eating Disorders* 16:61–65.

Elder, G.H. 1998. “The Life Course as Developmental Theory.” *Child Development* 69(1):1-12.

Eyler, A.A., R.C. Brownson, R.J. Donatelle, A.C. King, D. Brown., and J.F. Sallis. 1999. “Physical Activity Social Support and Middle- and Older-Aged Minority Women: Results from a US Survey.” *Social Science & Medicine* 49:781-89.

Ferraro, Kenneth F., Roland J. Thorpe, Jr., and Jody A. Wilkinson. 2003. “The Life Course of Severe Obesity: Does Childhood Overweight Matter?” *Journal of Gerontology: Social Sciences* 58B(2):S110-S119.

Fu, T., T Wen, P Yeh, and H Chang. 2008. “Costs of Metabolic Syndrome-Related Diseases Induced by Obesity in Taiwan.” *Obesity Reviews* 9(Suppl. 1):68-73.

Gillman, Matthew W. 2004. “A Life Course Approach to Obesity.” Pp 189-217 in *A Life Course Approach to Chronic Disease Epidemiology,* edited by D. Kuh and Y. Ben-Shlomo. Oxford: Oxford University Press.

Giskes, K., F.J. van Lenthe, G. Turrell, C.B.M. Kamphuis, J. Brug, and J.P. Mackenback. 2008. “Socioeconomic Position at Different Stages of the Life Course and Its Influence on Body Weight and Weight Gain in Adulthood: A Longitudinal Study With 13-Year Follow-Up. *Obesity* 16:1377-81.

Glass, Thomas A. and Matthew J McAtee. 2006. “Behavioral Science at the Crossroads in Public Health: Extending Horizons, Envisioning the Future.” *Social Science & Medicine* 62:1650-71.

Greenhalgh, Susan. 1985. “Sexual Stratification: the Other Side of ‘Growth with Equity’in East Asia.” *Population and Development Review* 11(2):265-314.

Greiner, K.A, C.Y. Li, I. Kawachi, D.C. Hunt, and J.S. Ahluwalia. 2004. “The Relationships of Social Participation and Community Ratings to Health and Health Behaviors in Areas with High and Low Population Density.” *Social Science & Medicine* 59:2303-12.

Grichting, W.L. 1971. “Occupational Prestige Structure in Taiwan.” *National Taiwan University Journal of Sociology* 7:67-79.

Grzywacz, Joseph G. and Nadine F. Marks. 2001. “Social Inequalities and Exercise

During Adulthood: Toward An Ecological Perspective." *Journal of Health and Social Behavior* 42 (2):202-20.

Grundy, E. and G. Holt. 2001. "The Socioeconomic Status of Older Adults: How Should We Measure it in Studies of Health Inequalities?" *Journal of Epidemiology and Community Health* 55:895-904.

Hatch, Stephani L. 2005. "Conceptualizing and Identifying Cumulative Adversity and Protective Resources: Implications for Understanding Health Inequalities." *Journal of Gerontology: Series B* 60B(Special Issue):130-34.

Hardy, R., M. Wadsworth, and D. Kuh. 2000. "The Influence of Childhood Weight and Socioeconomic Status on Change in Adult Body Mass Index in a British National Birth Cohort." *International Journal of Obesity* 24:725-34.

Hermalin, Albert, Paul K. C. Liu, and Deborah S. Freedman. 1994. "The Social and Economic Transformation of Taiwan." Pp. 49-87 in *Social Change and the Family in Taiwan*, edited by Arland Thornton and Hui-Sheng Lin. Chicago: University of Chicago Press.

Holtgrave, D.R. and R. Crosby. 2006. "Is Social Capital a Protective Factor Against Obesity and Diabetes? Findings from an Exploratory Study." *Annals of Epidemiology* 16:406-08.

House, James, Ronald C. Kessler, A. Regula Herzog et al. 1990. "Age, Socioeconomic Status, and Health." *Milbank Quarterly* 68(3):383-411.

House, James, James M. Lepkowski, Ann M. Kinney Richard P. Mero, Ronald C. Kessler, and A. Regula Herzog. 1994. "The Social Stratification of Aging and Health." *Journal of Health and Social Behavior* 35(3):213-34.

House, James, Karl R. Landis, and Debra Umberson. 1988. "Social Relationships and Health." *Science* 241(4865):540-45.

Huang, Jikun and Howarth Bouis. 2001. "Structural Changes in the Demand for Food in Asia: Empirical Evidence From Taiwan." *Agricultural Economics* 26:57-69.

Huang, K.C. 2008. "Obesity and Its Related Diseases in Taiwan." *Obesity Reviews* 9(Suppl. 1):32-34.

Huang, K.C, M.S. Lee, S.D. Lee, Y.H. Chang, Y.C. Lin, S.H. Tu et al. 2005. "Obesity in the Elderly and Its Relationship with Cardiovascular Risk Factors in Taiwan." *Obesity Research* 13:170-78.

Hsu, H.C. 2007. "Does Social Participation by the Elderly Reduce Mortality and Cognitive Impairment?" *Aging & Mental Health* 11(6):699-707.

Jeffery, R.W., S.A. French, J.L. Forster, and V.M. Spry. 1991. "Socioeconomic Status Differences in Health Behaviors Related to Obesity: the Healthy Worker Project." *International Journal of Obesity* 15:690-96.

Jeffery, R.W. and S.A. French.1996. "Socioeconomic Status and Weight Control Practices Among 20- To 45-Year-Old Women." *American Journal of Public Health* 86:1005-10.

Jenkins, Kristi Rahrig, Nan E. Johnson, and Mary Beth Ofstedal. 2007. "Patterns and Associations of Body Weight Among Older Adults in Two Asian Societies." *Journal of Cross-Cultural Gerontology* 22:83-99.

Kaplan, M., N. Huguet, J.T. Newsom, B.H. McFarlan, and J. Lindsay. 2003. "Prevalence and Correlates of Overweight and Obesity among Older Adults: Findings From The Canadian National Population Health Survey." *Journal of Gerontology: Medical Sciences* 58A(11):1018-30.

Kim, Daniel, S.V. Subramanian, Steven L. Gortmaker, and Ichiro Kawachi. 2006. "U.S. State-and County-Level Social Capital in Relation to Obesity and Physical Inactivity: A Multilevel, Multivariable Analysis." *Social Science & Medicine* 63: 1045-59.

Kim, Soowon, Soojae Moon, and Barry M. Popkin. 2000. "The Nutrition Transition in South Korea." *American Journal of Clinical Nutrition* 71:44-53.

Kim, Soowon, Michael Symons and Barry M. Popkin. 2004. "Contrasting Socioeconomic Profiles Related To Healthier Lifestyles in China and the U.S." *American Journal of Epidemiology* 159(2):184-91.

Kuczmarski, Marie F., Robert J. Kuczmarski, and Matthew Najjar. 2001. "Effects of Age on Validity of Self-Reported Height, Weight, and Body Mass Index: Findings From the Third National Health and Nutrition Examination Survey, 1988-1994." *Journal of American Diet Association* 101:28-34.

Ku, Po-Wen, Kenneth R. Fox, Jim McKenna, and Tai-Lin Peng. 2006. "Prevalence of Leisure-Time Physical Activity in Taiwanese Adults: Results of Four National Surveys, 2000-2004." *Preventive Medicine* 43:454-57.

Ku, Po-Wen, Kenneth R. Fox and Li-Jung Chen. 2009. "Physical Activity and Depressive Symptoms in Taiwanese Older Adults: A Seven-Year Follow-Up Study." *Preventive Medicine* http://dx.doi.org/10.1016/j.ypmed.2009.01.006.

Kuh, Diana, Chris Power, David Blane, and Mel Bartley. 2004. "Socioeconomic Pathways Between Childhood and Adult Health." Pp 371-98 in *A Life Course Approach to Chronic Disease Epidemiology,* edited by D. Kuh and Y. Ben Shlomo. Oxford: Oxford University Press.

Kuh, Diana and Yoav Ben-Shlomo. 2004. “Introduction.” Pp 3-14 in *A Life Course Approach to Chronic Disease Epidemiology,* edited by D. Kuh and Y. Ben Shlomo. Oxford: Oxford University Press.

Kushi, L.H., A.R. Folsom, D.R. Jacobs Jr, R.V. Luepker, P.J. Elmer, and H. Blackburn. 1988. “Educational Attainment and Nutrient Consumption Patterns: the Minnesota Heart Survey.” *Journal of American Dietetic Association* 88:1230-36.

James, S.A., A. Fowler-Brown, T.E. Raghunathan, and J. van Hoewyk. 2006. “Life-Course Socioeconomic Position and Obesity in African American Women: the Pitt County Study.” *American Journal of Public Health* 96(3):554-60.

Lahmann, P.H., L Lissner, B Gullberg, and G Berglund. 2000. “Sociodemographic Factors Associated With Long-Term Weight Gain, Current Body Fatness and Central Adiposity in Swedish Women.” *International Journal of Obesity* 24:685-94.

Langenberg, C., R Hardy, D Kuh, E Brunner, and M Wadsworth. 2003. “Central and Total Obesity in Middle Aged Men and Women in Relation To Lifetime Socioeconomic Status: Evidence From a National Birth Cohort.” *Journal of Epidemiology and Community Health* 57:816-822

Launer, Lenore J, Tamara Harris, Catherine Rumpel, and Jennifer Madans. 1994. ”Body Mass Index, Weight Change, and Risk of Mobility Disability in Middle-Aged and Older Women.” *Journal of American Medical Association* 271:1093-98.

Lawlor, Debbie A., Shah Ebrahim, and George Davey Smith. 2002. “Socioeconomic Position in Childhood and Adulthood and Insulin Resistance: Cross Sectional Survey Using Data From British Women’s Heart and Health Study.” *British Medical Journal* 325:805-09.

Lee, Sing. 1999. “Fat, Fatigue and the Feminine: the Changing Cultural Experience of Women in Hong Kong.” *Culture, Medicine and Psychiatry* 23:1-73.

Lee, Yu-Feng. 2008. “Economic Growth and Income Inequality: the Modern Taiwan Experience.” *Journal of Contemporary China* 17(55):361-74.

Li, R.M. 1994. “Aging trends – Taiwan.” *Journal of Cross-Cultural Gerontology* 9:389-402.

Lieberson, Stanley. 1985. *Making It Count: The Improvement of Social Research and Theory*. Berkeley, California: University of California Press.

Lin, Nan and M.K. Peek. 1999. “Social Networks and Mental Health.” Pp. 241-58 in *A Handbook for the Study of Mental Health: Social Contexts, Theories, and Systems*, edited by A. Horwitz and T. Scheid. N.Y.: Cambridge University Press.

Lin, Wei and Ya-Wen Lee. 2005. “Nutrition Knowledge, Attitudes, and Dietary Restriction Behavior of the Taiwanese Elderly.” *Asia Pacific Journal of Clinical Nutrition* 14(3):221-229.

Lindstrom, M., B.S. Hanson, and P. Ostergren. 2001. ”Socioeconomic Differences in Leisure-Time Physical Activity: the Role of Social Participation and Social Capital in Shaping Health Related Behavior.” *Social Science & Medicine* 52:441-51.

Link, Bruce G. and Jo Phelan. 1995. “Social Conditions As Fundamental Causes of Disease.” *Journal of Health and Social Behavior* 35:80-94.

Luo, Ye, William Parish, and Edward O. Laumann. 2005. “A Population-Based Study of Body Image Concerns Among Urban Chinese Adults.” *Body Image* 2:333-45.

Lynch, J.W., G.A. Kaplan, and J.T. Salonen. 1997. “Why Do Poor People Behave Poorly? Variation in Adult Health Behaviours and Psychosocial Characteristics by Stages of the Socioeconomic Lifecourse.” *Social Science & Medicine* 44(6):809-19.

Mirowsky, John and Catherine E. Ross. 2003. *Education, Social Status and Health.* NY: Aldine de Gruyter.

McLaren, Lindsay and Diana Kuh. 2004. “Body Dissatisfaction in Midlife Women." *Journal of Women and Aging* 16(1/2):35-54.

McLaren, Lindsay. 2007. “Socioeconomic Status and Obesity.” *Epidemiologic Reviews* 29:29-48.

Molarius, Anu. 2003. “The Contribution of Lifestyle Factors to Socioeconomic Differences in Obesity in Men and Women - A Population-Based Study In Sweden." *European Journal of Epidemiology* 18:227-34.

Monda, Keri L., Penny Gordon-Larsen, June Stevens, and Barry M. Popkin. 2007. “China’s Transition: the Effect of Rapid Urbanization on Adult Occupational Physical Activity.” *Social Science & Medicine* 64:858-70.

Monteiro, Carlos, Erly C. Moura, Woley L. Conde, and Barry M. Popkin. 2004. “Socioeconomic Status and Obesity in Adult Populations of Developing Countries: A Review.” *Bulletin of the World Health Organization* 82(12):940-46.

Monteiro, Carlos A., Wolney L. Conde, and Barry M. Popkin. 2001. “Independent Effects of Income and Education on the Risk of Obesity in the Brazilian Adult Population.” *Journal of Nutrition* 131:881s-86s.

Mujahid, M.S., A.V. Diez Roux, M.W. Shen, D. Gowda, B. Sanchez, S. Shea et al. 2008. “Relation Between Neighborhood Environments and Obesity in the Multi-Ethnic Study of Atherosclerosis.” *American Journal of Epidemiology* 167(11):1349-57.

O'Rand, Angela. 1996. "The Precious and Precocious: Understanding Cumulative Disadvantage and Cumulative Advantage Over The Life Course." *Gerontologist* 36(2):230-38.

Paeratakul, S, BM Popkin, Keyou Ge, LS Adair, and J Stevens. 1998. "Changes in Diet and Physical Activity Affect the Body Mass Index of Chinese Adults." *International Journal of Obesity* 22:424-31.

Palloni, Alberto. 2006. "Reproducing Inequalities: Luck, Wallets, and the Enduring Effects of Childhood Health." *Demography* 43(4):587-615.

Pan, W.H., M.S. Lee, S.Y. Chuang, Y.C. Lin, and M.L. Fu. 2008. "Obesity Pandemic, Correlated Factors and Guidelines to Define, Screen and Manage Obesity in Taiwan." *Obesity Reviews* 9(Suppl. 1):22-31.

Parsons, T.J., C. Power, S. Logan, and C.D. Summerbell. 1999. "Childhood Predictors of Adult Obesity: A Systematic Review." *International Journal of Obesity* 23: S1-107.

Phelan, Jo C., Bruce G. Link, Ana Diez-Roux, Ichiro Kawachi, and Bruce Levin. 2004. "'Fundamental Causes' of Social Inequalities in Mortality: A Test of the Theory." *Journal of Health and Social Behavior* 45(September):265-85.

Pingali, Prabhu. 2004. "Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy." FAO: ESA Working Paper No. 04-17.

Pliner, P., S. Chaiken, and G. Flett. 1990. "Gender Differences in Concern with Body Weight and Physical Appearance Over the Life Span." *Personality and Social Psychology Bulletin* 16(2):263-73.

Poortinga, Wouter. 2006. "Perceptions of the Environment, Physical Activity, and Obesity." *Social Science & Medicine* 63:2835-46.

Popkin, Barry M., Sahasporn Paeratakul, Fengying Zhai, and Keyou Ge. 1995. "A Review of Dietary and Environmental Correlates of Obesity with Emphasis on Developing Countries." *Obesity Research* 3(Suppl. 2):145s-153s.

Popkin, B.M., A.M. Siega-Riz, and P.S. Haines. 1996. "A Comparison of Dietary Trends among Racial and Socioeconomic Groups in the United States." *New England Journal of Medicine* 335:716-20.

Popkin, Barry M. 1999. "Urbanization, Lifestyle Changes and the Nutrition Transition." *World Development* 27(11):1905-16.

Popkin, B.M. and P Gordon-Larsen. 2004. "The Nutrition Transition: Worldwide Obesity Dynamics and Their Determinants." *International Journal of Obesity*

28:S2-S9.

Power, Chris and Sharon Matthews. 1997. "Origins of Health Inequalities in a National Population Sample." *Lancet* 350(29):1584-89.

Power, Chris and Tessa Parsons. 2002. "Overweight and Obesity from a Life Course Perspective". Pp. 304-28 in *A Life Course Approach to Women's Health*, edited by Diana Kub and Rebecca Hardy. London: Oxford University Press.

Power, C., H. Graham, P. Due, J. Hallqvist, I. Joung, D. Kuh et al. 2005. "The Contribution of Childhood and Adult Socioeconomic Position to Adult Obesity and Smoking Behaviour: An International Comparison." *International Journal of Epidemiology* 34:335-44.

Power, E.M. 2005. "Determinants of Healthy Eating Among Low-Income Canadians." *Canadian Journal of Public Health* 96(Suppl. 3): S37-8.

Population Reference Bureau. *Demographic Highlights: Taiwan*. http://www.prb.org/Datafinder/Geography/Summary.aspx?region=173&region_type=2, accessed on January 1st, 2009.

Regidor, E., J.L. Gutierrez-Fisac, J.R. Banegas, E. Lopez-Garcia, and F. Rodriguez-Artalejo. 2004. "Obesity and Socioeconomic Position Measured at Three Stages of the Life Course in the Elderly." *European Journal of Clinical Nutrition* 58:488-94.

Robert, Stephanie and James S. House. 1996. "SES Differentials in Health by Age and Alternative Indicators of SES." *Journal of Aging and Health* 8(3):359-88.

Rodin, Judith, Lisa Silberstein, and Ruth Striegel-Moore. 1984. "Women and Weight: A Normative Discontent." Pp. 267-303. in *Nebraska Symposium on Motivation, Psychology and Gender*. London: University of Nebraska Press.

Sa, Zhihong and Ulla Larsen. 2006. "Measures of overweight and obesity in the identification of metabolic syndrome among the elderly Taiwan". Unpublished manuscript.

Sabanayagam, C., A. Shankar, T.Y. Wong, S.M. Saw, and P.J. Foster. 2007. "Socioeconomic Status and Overweight/Obesity in An Adult Chinese Population in Singapore." *Journal of Epidemiology* 17(5):161-68.

Sallis, J.F., M.F. Hovell, and C.R. Hofstetter. 1992. "Predictors of Adoption and Maintenance of Vigorous Physical Activity in Men and Women." *Preventive Medicine* 21(2):151-277.

SAS Institute, Inc. 2002. *Sas Statistical Software: Version 9.0 for Windows*. Cary, NC: SAS Institute Inc.

Seeman, Melvin and Carolyn S. Anderson. 1983. “Alienation and Alcohol: the Role of Work, Mastery, and Community in Drinking Behavior.” *American Sociological Review* 48:60-77.

Selya, Roger M. 2004. *Development and Demographic Change in Taiwan*. New Jersey: World Scientific Publishing Co.

Seidell, J.C. and T.L.S Visscher**.** 2000. **“**Body Weight and Weight Change and Their Health Implications for the Elderly.” *European Journal of Clinical Nutrition* 54(Suppl. 3):S33̃S39

Shih, Ming-Ying and Chiharu Kubo. 2002. “Body Shape Preference and Body Satisfaction in Taiwanese College Students.” *Psychiatry Research* 111:215-28.

Silverman, Philip, Laura Hecht, and J. Daniel McMillin. 2002. “Social Support and Dietary Change among Older Adults.” *Ageing & Society* 22:29-59.

Smil, Vaclav. 2002. "Food Production." Pp. 25-50 in *The Nutrition Transition: Diet and Disease in the Developing World*, edited by Benjamin Caballero and Barry M. Popkin. Amsterdam: Academic Press.

Sobal, Jeffery. 1984. “Marriage, Obesity and Dieting.” *Marriage and Family Review* 7:115-39.

______. 1991. “Obesity and Socioeconomic Status: A Framework for Examining Relationships Between Physical and Social Variables." *Medical Anthropology* 13:231-47.

———. 1995. "Social Influences and Body Weight." Pp. 73-77 in *Eating Disorders and Obesity*, edited by Kelly D. Brownell and Christopher G. Fairburn. N.Y.: Guilford.

———. 2001. "Social and Cultural Influences on Obesity." Pp. 305-22 in *International Textbook of Obesity*, edited by Per Bjorntorp. London: John Wiley & Sons, Ltd.

Sobal, Jeffery and Albert J. Stunkard. 1989. “Socioeconomic Status and Obesity: A Review of the Literature." *Psychological Bulletin* 105(2):260-275.

StataCorp. 2006. *Stata Statistical Software: Release 9.0.* College Station, TX: Stata Corporation.

Sternfeld, B., H. Wang, C.P. Quesenberry, Jr., B. Abrams, S.A. Everson-Rose, G.A. Greendale et al. 2004. “Physical Activity and Changes in Weight and Waist Circumference in Midlife Women: Findings from the Study of Women’s Health Across the Nation.” *American Journal of Epidemiology* 160:912-22.

Stunkard, Albert J. and Janet M. Albaum. 1981. The Accuracy of Self-Reported

Weights. *American Journal of Clinical Nutrition* 34:1593-99.

Tsai, Shu-Ling. 1992. "Social Change and Status Attainment in Taiwan: Comparisons of Ethnic Groups." *International Perspectives on Education and Society* 2:225-56.

Tsai, Shu-Ling and Hei-Yuan Chiu. 1991. "Constructing Occupational Scales For Taiwan." Pp. 229-53 in *Research in Social Stratification and Mobility*, Vol. 10, edited by Robert Althauser and Michael Wallace. Connecticut: Jai Press Inc.

Tsai, Wen-Ling, Chun-Yuh Yang, Sheng-Fung Lin, and Fu-Min Fang. 2004. "Impact of Obesity on Medical Problems and Quality of Life in Taiwan." *American Journal of Epidemiology* 160(6):557-65.

van de Mheen, H., K. Stronks, C.W.N. Looman, and J.P. Mackenbach. 1998. "Does Childhood Socioeconomic Status Influence Adult Health Through Behavioural Factors?" *International Journal of Epidemiology* 27:431-37.

Venters, M.H., D.R. Jacob, Jr., R.V. Luepker, L.A. Maimaw, and R.F. Gillum. 1984. "Spouse Concordance of Smoking Patterns: the Minnesota Health Survey." *American Journal of Epidemiology* 120:608-16.

Wamala, S.P., A. Wolk, and K. Orth-Gomer. 1997. "Determinants of Obesity in Relation to Socioeconomic Status Among Middle-Aged Swedish Women." *Preventive Medicine* 26:734-44.

Wardle, J. and A. Steptoe. 2003. "Socioeconomic Differences in Attitudes and Beliefs about Healthy Lifestyles." *Journal of Epidemiology and Community Health* 57: 440-43.

Wardle, Jane, Jo Waller, and Martin J. Jarvis. 2002. "Sex Differences in the Association of Socioeconomic Status With Obesity." *American Journal of Public Health* 92:1299-1304.

Wardle, J. and J. Griffith. 2001. "Socioeconomic Status and Weight Control Practices in British Adults." *Journal of Epidemiology and Community Health* 55:185-90.

WHO. 1998. "Obesity: Preventing and Managing the Global Epidemic." Report of a WHO Consultation on Obesity, Geneva, 1997. *Obesity Research* 6:51S-210S.

WHO/IASO/IOTF. 2000. *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment*. Melbourne: Health Communications Australia.

WHO Expert Consultation. 2004. "Appropriate Body-Mass-Index for Asian Populations and Its Implications for Policy and Intervention Strategies." *Lancet* 363:157-63.

Williamson, D.F., J. Madans, R.F. Anda, J.C. Kleinman, H.S. Kahn, and T. Byers. 1993. "Recreational Physical Activity and Ten-Year Weight Change in a US

National Cohort." *International Journal of Obesity* 17: 279-86.

Wong, Yueching, Maurice R. Bennink, Ming-Fu Wang, and Shigeru Yamamoto. 2000. "Overconcern About Thinness in 10- To 14-Year-Old Schoolgirls in Taiwan." *Journal of American Dietetic Association* 100:234-36.

Wu, David Y.H. 2006. "McDonald's in Taipei: Hamburgers, Betel Nuts, and National Identity." Pp. 110-135 in *Golden Arches East: McDonald's in East Asia*, edited by James L. Watson. California: Stanford University Press.

Wu, S.J., Y.H. Chang, I.L. Wei, M.D. Kao, Y.C. Lin, and W.H. Pan. 2005. "Intake Levels and Major Food Sources of Energy and Nutrients in the Taiwanese Elderly." *Asia Pacific Journal of Clinic Nutrition* 14(3):211-20.

Yeh, W.T., H.Y. Chang, C.J. Yeh, K.S. Tsai, H.J. Chen, and W.H. Pan. 2005. "Do Centrally Obese Chinese with Normal BMI Have Increased Risk of Metabolic Disorders?" *International Journal of Obesity* 29(7):818-25.

Yoon, Yeong Sook, Sang Woo Oh, and Hye Soon Park. 2006. "Socioeconomic Status in Relation to Obesity and Abdominal Obesity in Korean Adults: A Focus on Sex Differences." *Obesity* 14(5):909-19.

Yu, Chia-Chen, Yin-Hua Liaw, and Susan M. Barnd. 2004. "Cultural and Social Factors Affecting Women's Physical Activity Participation in Taiwan." *Sport, Education and Society* 9(3):379-93.

Zablotsky, Diane and Karin Mack. 2004. "Changes in Obesity Prevalence among Women Aged 50 Years and Older." *Research on Aging* 26(1):13-30.

Zamboni, M., G. Mazzali, E. Zoico., T.B. Harris, J.B. Meigs, V.Di. Francesco, et al. 2005. "Health Consequences of Obesity in the Elderly: A Review of Four Unresolved Questions." *International Journal of Obesity* 29:1011-29.

Zhang, Qi and Youfa Wang. 2004. "Socioeconomic Inequality of Obesity in the United States: Do Gender, Age, and Ethnicity Matter?" *Social Science & Medicine* 58:1171-80.

Zeng, Min-Su. 1986. "The Change of Nutritional Status in Taiwan Area in Recent 10 Years." *Journal of the Chinese Nutrition Society* 11(1/2):43-50 (in Chinese).

Zveglich, Joseph E., Yana van der Meulen Rodgers, and Willliam M. Rodgers III. 1997. "The Persistence of Gender Earnings Inequality in Taiwan, 1978-1992." *Industrial and Labor Relations Review* 50(4):594-609.