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Obesity/Underweight Disparities by Gender and Education in Mainland China and Taiwan

by

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A short abstract (150 words)

The theory of fundamental causes of disease predicts that social inequalities in health are likely to emerge under health transitions. This research compares obesity and underweight disparities by education level in Mainland China and Taiwan after 1989, based on two recent surveys: (1) China Health and Nutrition Survey (CHNS), (2) Nutrition and Health Survey in Taiwan (NAHSIT). Researchers use sex-stratified random-effects logistic models to estimate the educational disparities in the odds of obesity/underweight. Result: The obesity and underweight disparities by education level in China and Taiwan do not support the theory of fundamental causes when gender is taken into account. The results show that the effect of educational level on obesity shifts from positive to negative as the level of development in China progresses from low to high, and social gradients in obesity appear first among women. The underweight prevalence is relatively low due to economic affluence, but the risk of underweight is beginning to appear in women of higher education in both Taiwan and China. The evidence indicates that an internalized social norm where being underweight (or skinny) represents attractiveness among women has impacted Chinese societies.

ABSTRACT

Having the same historical background and geographical proximity, Taiwan and Mainland China share many similarities in cuisines, traditions, cultural values, and language; simultaneously, there are striking differences in political system, social condition, economic circumstance, and the speed of modernization. The prevalence of obesity has been increasing in recent decades and is now recognized as an important public health issue in both China and Taiwan. This research intends to compare and contrast the prevalence of obesity/underweight and body weight disparities in Mainland China and Taiwan after 1989 based on two recent surveys: (1) China Health and Nutrition Survey (CHNS), (2) Nutrition and Health Survey in Taiwan (NAHSIT). The researcher uses sex-stratified random-effects logistic models to estimate the education-specific change in the odds of obesity (BMI $\geq$ 25) and underweight (BMI<18.5) over the survey period. Obesity and underweight disparities by education-years in both surveys are also investigated.

Result: The obesity and underweight disparities by educational level in China and Taiwan do not support fundamental cause theories when gender is taken into account. Economic and social development has brought with them a higher risk of obesity among Chinese males of higher education and among Taiwanese males of lower education. Women of high education in Taiwan and China are both less likely to be obese after controlling confounders. The underweight prevalence is relatively low due to economic affluence in Taiwan and China, but the highest risk of underweight starts to emerge in women of higher education. Obesity disparities by education have decreased among Chinese females during the survey years, but there was no evidence to indicate underweight disparities have increased by education in Taiwan or China during the survey years. It is a paradox that now Chinese and Taiwanese women of highest

education but men of lowest education suffer the highest risk of being underweight. The evidence may indicate the stigmatization of obesity and an internalized social norm for being underweight or skinny as an aspect of female attractiveness that has impacted Chinese and Taiwanese societies.

INTRODUCTION

Nutrition transition and obesity epidemics in China and Taiwan

There is strong evidence to indicate that obesity is increasing in most countries. Rising levels of obesity populations are a global trend. In 2008, more than 1.4 billion adults and 40 million children worldwide were overweight or obese, and the prevalence of obesity continues to increase in both developed and developing countries (World Health Organization, WHO, 2012).

The systematic review by Kim and Popkin (2006) proposes that there are clear links between obesity and adverse health and economic outcomes. Many other works also affirm that obesity has been shown to be an independent risk factor for many health conditions and is associated with increased hazard ratios for all-cause mortality (Calle, Rodriguez, Walker-Thurmond, & Thun, 2003; Adams, et al., 2006; Berrington de Gonzalez, et al., 2010). The relationship between Type 2 diabetes and obesity is well established (Calle, et al., 2003; Kopelman, 2000; [CDC], 2012).

While the prevalence of overweight and obese people in mainland China and Taiwan is relatively low, it is the rapid increase that is of most concern. The prevalence of obesity has been increasing in the recent decade and is now recognized as an important public health issue in both China and Taiwan (Wu, 2006; Huang, 2008). In China, the overweight and obese population for adults has increased considerably; from 14.6% to 21.8% in 1992 and 2002 using BMI ≥25 as the criteria (Wang, et al., 2007). In Taiwan, although the prevalence of overweight and obesity has decreased from 25.5% to 21.4% for female population; it has significantly increased, from 24.7% to 33.1%, for men from 1993–1996 to 2000–2001 using BMI ≥25 as the criteria (Chu, 2005).

Fundamental causes approach for obesity disparities by gender

Since the 1980's, the prevalence of obesity in all population groups, regardless of age, sex, race/ethnicity, socioeconomic status, or geographic region, has increased significantly ([CDC], 2012). Substantial research also shows that obesity disparities exist by socioeconomic status (SES), race/ethnicity, sex, and age ([CDC], 2012; Sobal & Stunkard, 1989; McLaren, 2007; Zhang & Wang, 2004; Wang & Beydoun, 2007). Current health and epidemiology researchers believe that the increasing prevalence of overweight and obesity in societies is largely attributed to rising populations adopting riskier health lifestyles, including a Westernized diet, sedentary routines, and technology use. A rising level of obese populations is a general trend; however, this approach fails to explain why rising national SES in countries will most likely lead to increased overall levels of obesity, while rising personal SES within these countries is most likely to lead to decreased levels of obesity. A review of international published studies on the relationship between socioeconomic status and obesity conducted by Sobal and Stuckard (1989) between the 1930's and the late 1980's indicates that obesity in developed countries was more prevalent among women of lower SES than among those of upper SES. The relationship is inconsistent for men and children. In developing countries, the opposite is true; a strong direct relationship of SES to risk of obesity exists among men, women, and children. The update of Sobal and Stunkard's by McLaren (2007), reported many of the same patterns among female populations during the years 1988–2004.

One hypothesis for this association is that when a country is relatively better off, people with higher SES are more capable of avoiding the risks of obesity by adopting currently available protective strategies; in addition, a lack of knowledge, commuting distance, and social instability of lower SES population all lead to a risky lifestyle. The association between

socioeconomic status and obesity disparities has persisted, despite strategies and knowledge being deployed to the public and encouragement to maintain healthier weight.

"Fundamental social causes" approach (Link & Phelan, 1995/2002) may offer a good framework to explain the transition of the risk of obesity from richest class to the poorest class; however, there are some limitations with this theory when gender is taken into account. The "fundamental social causes" theory does not properly address the changing body ideal/body image pressures as a country develops. Some evidence has shown that the higher the SES, the greater the prevalence of thinness among women (Goldblatt et al., 1965). This means that this segment of the population does not have as high a risk for obesity as the general population. The process of westernization that has occurred in Asian countries has changed body image perceptions and contributed to the increasing problem of body image disturbance, especially among young women (Shih & Kubo, 2002/2005)

Perceptions of obesity and thinness

Throughout history, a large body size was valued, and fatness was viewed as wealth and power (Cassidy, 1991). Desire for skinniness is a relatively new phenomenon. The growing economy and emerging leisure class in the early twentieth century has shifted the public value of fatness as beauty to thinness in Westernized countries (Cogan, Bhalla, Sefa-Dedeh, & Rothblum, 1996).

Becker (2004) identifies that the global distribution of westernization and consumer culture constructs the female concept of body image. She found that not only women in developed countries draw heavily on thinness as self-identity; women in developing countries look at thinness as beauty as well. The symbol of thinness has led to social hazards such as poor body image, eating disorders, and massive body plasticity (Gordon, 2000; Becker, 2004). Orbach

(2006) believes that behind the so-called obesity epidemic is a serious public emergency and fashion, cosmetic and media industry conspiracies.

Link and Phelan's (1995/2002) "fundamental social causes" approach argues that "individuals who control more resources of knowledge, money, power, prestige and social connections keep on achieving superior health, and the gap of economic and social factors in population health will continue to be persistent". "Fundamental social causes" explains why people with higher SES have more means to control their body weight and achieve better health; however, "fundamental social causes" fails to explain why the relationship of SES and obesity is inconsistent for men in developed societies (Sobal & Stunkard, 1989; McLaren, 2007). "Fundamental social causes" also fails to predict that women with higher SES are also more likely to be dissatisfied with their bodies (McLaren, & Kuh, 2004) and more likely to draw heavily on thinness and even underweight as self-identity.

Backgrounds

Taiwan, officially the Republic of China (ROC), is an island to the east of mainland China (or People's Republic of China, PRC). Taipei is the capital city and economic and cultural center of Taiwan. Most of the Taiwanese inhabitants are the Han Chinese descendants who emigrated from southeast China between the 17th and 19th centuries, and the second wave of migration, about 18% of population, drawn from all parts of mainland China, occurred with the Chinese Nationalist Party-- Kuomintang (KMT) government's arrival in Taiwan after the Chinese Civil War in 1949. China and Taiwan have been politically separated ever since. Taiwan received economic and managerial aid and adopted a free market, capitalist economy; while China implemented communism, following a planned and centralized economy without private businesses or capitalism.

Taiwan has experienced one of the highest growth rates of any economy and industry in the world, after separating from China, and was admired as one of the "Four Asian Tigers" alongside Hong Kong, South Korea and Singapore during the latter half of the 20th century. The annual economic growth rate was 9.7% during the 1970s and 8.5 % during the 1980s and significantly surpassed the growth of China. However, after 1978, China applied economic reforms directed by Chinese leader Xiaoping, Deng and moved toward a more market-oriented mixed economy under one-party rule. During this period, China began to enjoy extraordinary economic growth with 9.5% or higher growth rate each year since the 1990s, reaching an all-time high of 14.2 % by the end of 1992. Taiwanese annual GDP growth rate reached an all-time high of 17.06 % in 1978 and a record low of -8.12 % in 2009 (Trading Economic, 2012).

Currently, Taiwan is reporting Gross Domestic Product (GDP) of about 20,000 U.S. dollars per capita; while China is at 5,000 U.S. dollars. Taiwan's economy share of world total GDP, adjusted by purchasing power parity, is about 1 percent, while China is 12.5 times that of Taiwan (Trading Economic, 2012). China's economy is now one of the largest in the world, and Taiwan's economy has become increasingly dependent on China since the beginning of the 1990's.

HYPOTHESES

The focus of this paper is to make a connection between Chinese and Taiwanese body weight disparities on national and individual SES levels, Based on the degree of economic development between Taiwan and China, it is hypothesized that:

(1) There will be a higher prevalence of obesity and less prevalence of underweight in Taiwan compared to China based on the degree of their economic development after 1989.

(2) There will be a higher rate of increasing prevalence of obesity and decreasing prevalence of underweight in China compared to Taiwan based on the speed of the economic development and social condition after 1989.

Based on fundamental cause theories, it is hypothesized that:

(3) After 1989, the prevalence of obesity and underweight will be least likely to increase among those with high SES, both women and men.

However, based on the hypothesis that a growing number of women are drawing heavily on thinness as self-identity, it is hypothesized that:

(4) After 1989, the prevalence of underweight will be most likely to increase among women with high SES, but this will not be applicable to men

(5) The body weight disparities by SES among women will increase by year due to the heavy emphasis on thinness as beauty and the stigmatization of obesity in Chinese and Taiwanese culture

METHOD

Databases

Two databases will be used in the research analysis. The "China Health and Nutrition Survey (CHNS)" is a multilevel and longitudinal database used to represent China. The Taiwanese database contains data collected through the "Nutrition and Health Survey in Taiwan (NAHSIT)," a cross-sectional database used to represent Taiwan.

Both NAHSIT and CHNS were designed to examine how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. Both nutrition surveys provide information on dietary intake, body composition, blood pressure, health history, health-related behaviors (e.g., smoking, beverage consumption, and medication), chronic diseases, clinical measures of health and measurement of weight, height and waist-hip ratios taken by trained interviewers. The objective of this paper is to investigate nutrition transition on a national level and capture a gendered pattern in the transition of the SES-obesity in China and Taiwan based on CHNS and NAHSIT databases.

China Health and Nutrition Survey (CHNS)

The CHNS is a longitudinal and ongoing Sino-American project gathering data on health, nutrition, and socioeconomic variables at the individual, household, and community levels in China. CHNS data is not nationally representative, but previous research has found key physical composition and dietary data trends based on CHNS are similar to those revealed by nationally representative surveys. The first round of data collection was undertaken in 1989 using a multistage, random cluster process to draw a sample of about 4,020 households with a total of 15,927 individuals from 8 provinces (Guangxi, Guizhou, Henan, Hubei, Hunan, Jiangsu, Liaoning and Shandong), which vary substantially in geography, stage of economic development, public resources, and health indicators. Four counties in the nine provinces were stratified by three income levels (one low-, two middle-, and one high-income based on per-capita income reported by the National Bureau of Statistics) and a weighted sampling was randomly selected. The provincial capital and a lower income city were selected when feasible. Villages and townships within the counties and urban and suburban neighborhoods within the cities were

selected randomly with a total of 190 primary sampling units in 1989-1993, and a new province (Heilongjiang) and its sampling units were added in 1997.

Follow-up levels are high, but families that migrate from one community to a new one are not followed. Twenty randomly selected households were surveyed within each unit, and all individuals within a household were interviewed. The CHNS collected data in 1989, 1991, 1993, 1997, 2000, 2004, 2006, and 2009. Details of the CHNS are described elsewhere (http://www.cpc.unc.edu/projects/china).

Nutrition and Health Survey in Taiwan (NAHSIT)

NAHSIT contains national cross-sectional data gathered in 1993-1996 using a multi-stage, stratified, clustered and unequal probability survey sampling designed to examine the changes in nutrition and health status of the people in Taiwan. During 1993 and 1996, a representative sample was obtained from 9,962 individuals age 4 or older who did not live in institutions. Interview data includes household information, socio-demographics, 24-hour dietary recall, food frequency and eating habits, dietary and nutritional knowledge, attitudes and behaviors, physical activity, medical and health history. Among those interviewed, 6,464 individuals participated and completed the health examinations corresponding to a response rate of 74%. Health examinations included anthropometry, blood pressure, physical fitness, bone density, and blood/urine collection.

In 2004 -2008, a total of 6,189 individuals, age 0-6 and 19 or older were interviewed, and a three-stage stratified, clustered sampling scheme was adopted, similar to the one used in 1993-1996. Among those interviewed, 59% (3670 individuals) participated and completed the health examinations. NAHSIT, in 2004-2008, collected Taiwanese nutrition status, lifestyle, nutrition-related knowledge/attitude/practice, and nutrition-related disease status. The survey divided 359

Taiwanese townships into seven strata, including Hakka people areas, mountainous areas, East Coast areas, Peng-Hu islands, metropolitan cities, provincial cities, urbanization class I townships, and urbanization class II townships by the difference of residents' dietary styles, urbanization degree, and geographical regions. Details of the NAHSIT are described elsewhere (http://nahsit.nhri.org.tw/).

Analytic Sample

The comparison between CHNS and NAHSIT databases is limited to respondents whose ages are between 18 and 50 and who have completed the weight and height examinations. All the results have excluded pregnant women. The total analytic sample size is 43,003 in CHNS database and 2,278 in NAHSIT database.

Statistical analyses

Due to the restriction of Taiwanese databases, when comparing Chinese and Taiwanese Nutrition databases, this research will only focus on the comparison between the first survey year and the last survey year in both databases. Comparing on these two databases, this research investigates (1) the prevalence of obesity/underweight among Taiwanese and Chinese (2) The increasing and changing rate of obesity/underweight and BMI for men and women in Taiwan and China. Finally, the gender-specific disparities in obesity/underweight by socioeconomic status in CHNS and NAHSIT will be investigated separately and all survey years in both databases will be analyzed.

CHNS is a country-year database, which represents a form of data that has individual cases observed over time during 1989-2009. Since CHNS is panel data which contains observations on multiple phenomena observed over multiple time periods, the errors in a regression model for each individual will be correlated or dependent over time, and the

assumption of independence of the errors for regression analysis is violated. The random-effects model can solve the problem of correlated errors (Allison, 2009).

The researcher uses sex-stratified random-effects logistic models to estimate the education-specific change in the odds of obesity (BMI $\geq$ 25) over the study period and also estimated provincial fixed effects to capture the unobserved province effects. A random-effects model incorporates all available measurements from each individual, which maximized the analytic sample. In those models, the "cluster" is each individual, when repeated measurements are nested. The models include random intercepts for each participant to account for the correlation between "obesity/underweight" measurements within a person over time. The panel-level variance component or level 2 variance component is labeled as "lnsig2u" in the Stata 11 output.

Logistic Regression is used for prediction of the odds of being obese /non-obese and underweight/non-underweight in NAHSIT, by separately controlling the predictor variables: gender, age, socioeconomic status, and survey year.

Dependent variable

Measurement of body weight

According to the Centers for Disease Control and Prevention (CDC) growth charts, BMI is divided into standard categories for underweight (BMI<18.5), normal weight (18.5≤BMI<25), overweight (25≤BMI<30) and obese (BMI≧30).

James, Leach, Kalamara, and Shayeghi (2001) examine the worldwide obesity epidemic; they found that Asian investigators have supported an alternative classification system, and the absolute levels of diabetes and hypertension on the age- and sex-specific basis is higher for individuals of Asian origin. Therefore, this research will apply the World Health Organization

(WHO)-Asian criteria for the definition of underweight (BMI<18.5), normal weight (18.5≤BMI<23), overweight (23≤BMI<25) and obese (BMI ≥ 25).

Independent variables

In this research, the researcher has divided education into five categories in the CHNS database: No Education (including those whom never went to school; they could be either literate or illiterate); Elementary; Junior High School; Senior High School; and Occupational School/College/Graduate. Taiwanese government has applied compulsory elementary school education since 1943 and extended it to junior high school education in 1968; there were very few people with no education in the NAHSIT database. The researcher only divided education into four categories in NAHSIT database: Elementary; Junior High School; Senior High School; and Occupational School/College/Graduate.

The control variables included in CHNS database analysis included provincial fixed effects, residential area divided as rural and urban, survey years re-coded from 0 (1989) to 20 (2009) and entered as a continuous variable, age re-coded from 0 (18) to 32 (50) and entered as an ordinal variable, self-rated health status coded as a categorical variable (poor, average, good and excellent). The researcher also tests the assumption whether the obesity/ underweight disparities would increase by the interactions of education-year and rural/urban-year.

The NAHSIT has similar regression models to CHNS except for the self-rated health status measurement and residential area (rural or urban), so the NAHSIT regression models will not be able to control those two variables.

PRELIMINARY FINDINGS

Trends in the prevalence of obesity/underweight and average BMI in Taiwan and China

BMI

In Table 1, the CHNS database shows the comparison of average BMI of total population in China for each survey year with previous survey year. The researchers found that the average BMI has significantly increased between 1993 and 2004 in all populations age 18-50, both Chinese men and women. In general, Chinese male subjects had a greater increase of BMI during survey year 1989-2009. NAHSIT database also shows that the average BMI of the total population in Taiwan has increased significantly between 1993-6 and 2005-8 (t= 3.5650, p<.001***); most significantly among the male population (t=5.0721, p<.001***). There is no significant increase between 1993-6 and 2005-8 among the female population (t=0.5545, p=0.579)

In general, men in both Taiwan and China have significant and greatest increase in average BMI during the survey years in both databases.

Prevalence of obesity

The prevalence of the obesity trends shares similar outcomes with the trend of average body weight (BMI) in China and Taiwan. In Table 2, the CHNS database shows that the prevalence of obesity among Chinese female population was higher compared to the male population in 1989 (male: 6.15 %; female: 10.47%); but the prevalence of obesity among males has surpassed females in 2009 (male 30.22% and female 24.02% are obese).

The Taiwanese database indicates that one-third of the Taiwanese population were obese, both men and women, in 1993-6; prevalence of obesity increased to 41% among males and remained the same among the female population in 2005-8. Both databases indicate that males had the greatest increase in the prevalence of obesity during the survey years in Taiwan and China, but there was only a relative less increase of the prevalence of obesity among Chinese females and no significant increase among Taiwanese female.

Prevalence of underweight

There was no significant change in the prevalence of underweight since 1989 in Chinese population except in 1997; on the other hand, there was a slightly significant decrease in the prevalence of underweight among the Taiwanese population; this was most likely due to a significant decrease in the number of underweight Taiwanese men during 1993-6 and 2003-5.

The change and annual increase rates of weight status in Taiwan and China

Table 3 shows the prevalence (%) of weight status (underweight, normal weight, overweight, and obesity) among Taiwanese and Chinese adults, age 18-50, by gender in the first and last survey years.

According to CHNS database, the annual increase of the prevalence of obesity among Chinese males was more rapid than among females during the first and last survey years. The prevalence of obesity has increased 391.81% among Chinese men and 183.06% among Chinese women during 1989-2009. On the other hand, Taiwanese databases also show that the prevalence of obesity has only increased about 1.33 times or 33.08% among Taiwanese men and about 1.04 times or 3.58% among Taiwanese women.

The prevalence of normal weight has decreased dramatically between first and last survey years except among Taiwanese females, which increased 1.09 times or 9.03%, instead. The slower speed of increasing rates of obesity among women in table 3 suggests that Taiwanese and Chinese females may have increased consciousness of controlling body weight.

The disparities in obesity and underweight by educational attainment in China and Taiwan

Tables 4 and 5 show the CHNS results from the longitudinal, random-effects logistic regression models. The researcher estimates the odds of being underweight/obese by gender while controlling for the confounders. Table 4 shows that the association between education and odds of underweight was complex among Chinese females. There was an inverse association

between education and the odds of underweight among females of junior high school education and below, and there was a direct association between education and the odds of underweight among female of senior high school education and above. After controlling self-rated health status (model 3), the OR of underweight for the highest versus lowest education groups was still significant. Table 4 suggests that there is an inverse association between education and the odds of obesity. The higher education attainment, the lower the odds of obesity compared to women of no education; it remains significant after controlling self-rated health status (model 3). Model 4 demonstrates that the obesity disparities by education have decreased over the years among Chinese women.

Table 5 suggests that being older is associated with lower odds of being underweight among the male population. The OR for underweight for elementary school, senior high school, or college education versus no education groups is significant in model 2. The odds of underweight among Chinese men have decreased for those with elementary or senior high school education versus no education after controlling self-rated health status.

Table 5 shows that being older is associated with higher odds of obesity, and the evidence also shows that the odds of obesity among Chinese men have increased during CHNS survey years. There is a direct association between education and odds of obesity. The higher educational attainment, the higher odds of being obese compared to men of no education, and it remains significant after controlling self-rated health status (model 3). The obesity disparities by education did not change by years among Chinese males, but the obesity disparities have increased between urban and rural by years in model 5. In general, men with higher education, living in the urban areas, and residing in the province of Shandong have higher risk of obesity between 1989-2009.

The prevalence of underweight did not change among Taiwanese females during the two survey years in Table 6. Table 6 examines the odds of underweight in Taiwanese females, and it shows that the higher education group experienced significantly higher odds of underweight. Model 5 shows that the odds of being underweight between women of college education and women of primary school education are significantly different. There is a strong inverse association between education and the odds of obesity among Taiwanese females. For women with a college degree, the odds of obesity decreases when compared to women of primary school education.

The results in Table 6, examining the odds of underweight in Taiwanese males, shows that there is no association between education attainment and the odds of underweight. Table 6 suggests that the odds of obesity for Taiwanese men are largely similar to Taiwanese women except there is no significant difference between men of junior high school education and men of primary school education. The more educated men have the lowest odds of obesity.

CONCULSIONS

In the past, the low prevalence of obesity and high prevalence of underweight in China and Taiwan was due to lack of food; but in recent decades, a greater prevalence of obesity and lower prevalence of underweight are attributed to more widely available resources allowing the population to obtain adequate food supplies and nutrition. However, Taiwanese and Chinese databases show that male subjects had the greatest contributions in increasing the prevalence of obesity during survey years in both databases. There was only a relatively smaller rise in the prevalence of obesity among Chinese females; there was no significant increase among Taiwanese females during the survey period. Instead, there was the highest prevalence of

underweight among Taiwanese females when compared to Chinese males, Chinese females, and Taiwanese males in the last survey years of both databases.

Although an obesity epidemic has spread to people globally, empirical knowledge about nutrition transition on Asian obesity and underweight remains scant, particularly in examining the gendered patterns in the transition of the SES-underweight relationship. The "fundamental social causes" theory believes that social inequalities in health are expected to emerge under health transitions. The theory predicts that, as health-related situations change, resources are transmitted from one situation to another, 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).

The results show that a gender-specific pattern of obesity and underweight disparities has emerged in China and Taiwan. The effects of SES on obesity shift from positive to negative, when comparing China to Taiwan, as the level of development of a society progresses from low to high, and social gradients in obesity appear first among women. However, the "fundamental social causes" theory does not properly address the changing body ideal/body image pressures as a country develops. Our research evidence has shown that the higher the SES, the greater the prevalence of underweight among women in Taiwan and China. This means that this segment of the population does not have as high a risk for obesity as the general population. The evidence indicates that an internalized social norm where being underweight or skinny represents attractiveness among women has impacted Chinese societies.

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TABLE1

BMI among adults (age 18-50) in China, by gender 1989‑2009

	Total				Male				Female			
wave	N	Mean	min	max	N	mean	min	max	N	mean	min	max
1989	4961	21.49	14.78	36.44	2393	21.25	14.78	33.53	2569	21.71	15.15	36.44
1991	6102	21.56	13.95	40.34	2905	21.33	14.74	32.39	3197	21.76	13.95	40.34
1993	5686	21.74*	14.72	38.91	2724	21.59*	14.89	33.91	2962	21.87	14.72	38.91
1997	5678	22.19***	14.81	39.63	2782	22.07***	14.81	33.45	2896	22.30***	15.02	39.63
2000	5994	22.67***	14.94	39.34	2869	22.63***	15.19	35.25	3125	22.70***	14.94	39.34
2004	4975	22.87*	14.25	41.32	2388	22.94*	14.25	36.39	2587	22.80	15.08	41.32
2006	4629	23.02	13.97	38.73	2192	23.22**	13.97	38.73	2437	22.83	15.16	37.69
2009	4560	23.15	14.52	42.59	2187	23.43	14.52	37.20	2373	22.88†	14.52	42.59

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

BMI among adults (age 18-50) in Taiwan, by gender 1993-6 &2005-8

	Total				Male				Female			
wave	N	Mean	min	max	N	mean	min	max	N	mean	min	max
1993-6	1620	23.42	12.92	47.71	729	23.51	12.92	35.46	891	23.36	14.29	47.71
2005-8	1108	23.98***	14.76	53.13	516	24.55***	16.51	45.16	592	23.48	14.76	53.13

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

TABLE 2

Trends in the prevalence (%) of obesity (BMI ≥ 25)/ underweight (BMI<18.5) among adults (Age 18-50) in China, by gender, 1989-2009

	Total			Male			Female		
Year	n	Underweight (%)	Obesity (%)	n	Underweight (%)	Obesity (%)	n	Underweight (%)	Obesity (%)
1989	4961	8.59	8.39	2392	8.69	6.15	2569	8.49	10.47
1991	6102	8.44	10.16	2905	8.43	7.81	3197	8.45	12.29
1993	5686	7.77	11.45	2724	7.31	9.47	2962	8.20	13.27
1997	5678	6.53*	15.80***	2782	6.87	14.56**	2896	6.22*	16.99***
2000	5994	5.91	20.97***	2869	5.47	20.74**	3125	6.30	21.18***
2004	4975	5.37	23.30*	2388	5.03	23.53	2587	5.68	23.08
2006	4629	5.64	25.02	2192	5.06	26.92*	2437	6.16	23.31
2009	4560	6.75	27.00*	2187	5.85	30.22*	2373	7.59	24.02

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

Trends in the prevalence (%) of obesity (BMI ≥ 25)/ underweight (BMI<18.5) among adults (Age 18-50) in Taiwan, by gender, 1993-6 & 2005-8

	Total			Male			Female		
Year	n	Underweight (%)	Obesity (%)	n	Underweight (%)	Obesity (%)	n	Underweight (%)	Obesity (%)
1993-6	1620	7.65	30.06	1401	5.35	30.73	1445	9.54	29.52
2005-8	1115	5.83†	35.43***	1063	2.71*	40.89***	1083	8.61	30.58

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

TABLE 3

The prevalence (%), change (%) and Annual increase rates of weight status among adults (Age 18-50) in Taiwan and China, by gender and the first/ last survey year

		Men						Women					
		First Survey[3]		Last Survey[4]		Change	Annual increase	First Survey		Last Survey		Change (%)	Annual increase
		n	%	n	%	%	%	n	%	n	%	%	%
Obesity	**China**[1]	147	6.15	661	30.22	391.81	1.20	218	8.49	570	24.02	183.06	0.78
	Taiwan[2]	224	30.73	211	40.89	33.08	0.85	263	29.52	181	30.57	3.58	0.09
Overweight	**China**	304	12.71	473	21.63	70.18	0.45	409	15.92	447	18.84	18.32	0.15
	Taiwan	174	23.87	131	25.39	6.37	0.13	162	18.18	84	14.19	-21.96	-0.33
Normal Weight	**China**	1733	72.45	925	42.30	-41.62	-1.51	1673	65.12	1176	49.56	-23.90	-0.78
	Taiwan	292	40.05	160	31.01	-22.59	-0.75	381	42.76	276	46.62	9.03	0.32
Underweight	**China**	208	8.70	128	5.85	-32.69	-0.14	218	8.49	180	7.59	-10.61	-0.05
	Taiwan	39	5.35	14	2.71	-49.28	-0.22	85	9.54	51	8.61	-9.70	-0.08

[1] China Health and Nutrition Survey (CHNS)

[2] Nutrition and Health Survey in Taiwan (NAHSIT)

[3] The first survey year is 1989 and the last survey year is 2009 in CHNS

[4] The first survey year was 1994-6 and the last survey year in was 2004-8 in NAHSIT

TABLE 4
Obesity (BMI ≥25)/ underweight (BMI<18.5) among adults (Age 18-50) in China, Female, 1989-2009 (odd-ratio)

	Female									
	Underweight					Obese				
Variable	Model1	Model2	Model3	Model4	Model5	Model1	Model2	Model3	Model4	Model5
Age-18 (18=0)	0.91***	0.91***	0.89***	0.91***	0.91***	1.18***	1.17***	1.17***	1.17***	1.17***
Year (1989=0)	1.00	1.00	0.99	1.01	1.02†	1.06***	1.07***	1.05**	1.12***	1.04***
Liaoning (ref.)										
Heilongjiang	0.61†	0.64	0.54	0.64	0.64	0.79	0.79	0.63	0.81	0.80
Jiangsu	1.06	1.06	0.86	1.04	1.05	0.40***	0.40***	0.44*	0.43***	0.41***
Shandong	0.44**	0.44**	0.37*	0.43***	0.44**	1.80*	1.82*	1.68	1.90**	1.84*
Henan	0.58*	0.58*	0.54	0.58*	0.58*	0.66†	0.64†	0.53†	0.67	0.65
Hubei	1.35	1.40	1.46	1.39	1.40	0.27***	0.27***	0.19***	0.27***	0.27***
Hunan	1.81*	1.81*	2.20*	1.79*	1.79*	0.22***	0.22***	0.13***	0.23***	0.22***
Guangxi	3.90***	4.32***	3.27***	4.26***	4.32***	0.08***	0.07***	0.05***	0.08***	0.07***
Guizhou	1.68†	1.73*	2.36*	1.71*	1.71*	0.14***	0.14***	0.10***	0.14***	0.14***
Urban										
Rural	0.80†	0.95	1.07	0.95	1.27	0.72*	0.56***	0.53***	0.58***	0.34***
No education(ref.)										
Elementary		0.65*	0.61†	0.75	0.66*		1.51**	1.82**	1.71*	1.50**
Junior High		0.72†	0.70	0.8	0.74†		1.22	1.35	2.19***	1.19
Senior High		1.13	1.13	1.47	1.16		0.77	0.67	1.56	0.77
Occupational/College		1.73*	1.93*	0.98	1.72*		0.26***	0.22***	1.46	0.26***
Self rate health (poor)										
average			0.74					0.99		
good			0.40***					1.17		
excellent			0.40*					1.25		
No education*year (ref.)										
Elementary*year				0.98					0.98	
Junior High*year				0.98					0.94***	
Senior High*year				0.97					0.93**	
Occupational/College*year				1.04					0.87***	
Urban *year (ref.)										
Rural* year					0.97*					1.05***
_cons	0.03***	0.04***	0.06***	0.03***	0.03***	0.00***	0.00***	0.00***	0.00***	0.00***
lnsig2u_cons	7.86***	7.82***	8.86***	7.88***	7.76***	15.61***	15.14***	16.02***	14.99***	15.13***

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

TABLE 5

Obesity (BMI ≥25)/ underweight (BMI<18.5) among adults (Age 18-50) in China, Male, 1989-2009 (odd-ratio)

	Male									
	Underweight					Obese				
Variable	Model1	Model2	Model3	Model3	Model5	Model1	Model2	Model3	Model4	Model5
Age-18 (18=0)	0.91***	0.91***	0.89***	0.91***	0.91***	1.09***	1.10***	1.12***	1.10***	1.10***
year (1989=0)	0.98*	0.98†	0.99	0.97	0.98	1.19***	1.17***	1.14***	1.14***	1.15***
Liaoning (ref.)										
Heilongjiang	0.72	0.74	0.56	0.73	0.74	0.95	1.03	0.83	1.04	1.04
Jiangsu	1.74†	1.68†	0.7	1.65†	1.68†	0.65†	0.69	0.51*	0.70	0.69
Shandong	0.27***	0.27***	0.12***	0.26***	0.27***	2.62***	2.69***	2.07*	2.75***	2.71***
Henan	0.61	0.59†	0.19***	0.59+	0.59	0.99	1.09	1.01	1.10	1.10
Hubei	2.74***	2.72***	1.83	2.69***	2.73***	0.30***	0.32***	0.22***	0.32***	0.32***
Hunan	1.96*	1.91*	1.19	1.89*	1.92*	0.20***	0.21***	0.14***	0.21***	0.21***
Guangxi	3.64***	3.63***	1.48	3.57***	3.63***	0.06***	0.07***	0.05***	0.07***	0.07***
Guizhou	3.67***	3.30***	2.37*	3.27***	3.31***	0.08***	0.10***	0.06***	0.10***	0.10***
Urban(ref.)										
Rural	1.07	1.05	1.04	1.04	1.00	0.52***	0.65***	0.64***	0.65***	0.46***
No education										
Elementary		0.56***	0.52†	0.52*	0.56***		1.70*	2.05*	1.25	1.72*
Junior High		0.74	0.58	0.67	0.73		2.56***	4.01***	1.60	2.55***
Senior High		0.56*	0.41*	0.6	0.56*		3.76***	7.33***	3.04**	3.75***
Occupational/College		0.62†	0.52	0.44†	0.62†		5.85***	13.21***	7.29***	5.88***
Self rate health (poor)										
Average			0.48†					1.81		
Good			0.27***					2.43*		
excellent			0.20***					2.29*		
No education*year(ref.)										
Elementary*year				1.01					1.03	
Junior High*year				1.02					1.04	
Senior High*year				1.00					1.02	
Occupational/College*year				1.03					0.99	
Urban *year (ref.)										
Rural* year					1.01					1.03*
_cons	0.01***	0.02***	0.21*	0.02***	0.02***	0.00***	0.00***	0.00***	0.00***	0.00***
lnsig2u_cons	9.05***	9.13***	8.52***	9.12***	9.14***	13.23***	12.73***	17.30***	12.75***	12.68***

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***

TABLE 6
Obesity (BMI ≥25)/ underweight (BMI<18.5) among adults (Age 18-50) in Taiwan, by gender, 1993-6 & 2005-8 (odd-ratio)

	Obese						Underweight					
	Male			Female			Male			Female		
Variable	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**
Survey year (1993-6=0)	1.03***	1.04***	1.04	1.00	1.03**	1.01	0.96*	0.96†	0.44	1.0	0.99	0.97
Age_18 (age 18=0)	1.04***	1.03***	1.03***	1.06***	1.03***	1.03***	0.93***	0.93***	0.93***	0.9***	0.91***	0.91***
Primary (ref.)												
Junior		1.00	1.22		0.63**	0.70†		0.99	0.73		1.7	1.98
Senior		0.66*	0.62*		0.37***	0.31***		0.85	0.79		2.96**	2.83***
College+		0.49**	0.46**		0.12***	0.08***		0.82	0.93		2.80*	2.24†
primary*year (ref.)												
Junior *year			0.97			0.99			2.28			0.95
Senior *year			1.01			1.03			2.16			1.02
College*year			1.01			1.05			2.06			1.05
_cons	0.21***	0.32***	0.31***	0.15***	0.39***	0.40***	0.15***	0.18**	0.20**	0.46***	0.18***	0.18***

p<.1†, *p*<.05*, *p*<.01**, *p*<.001***