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The income-body-size gradient among Chinese urban adults: A semiparametric analysis



Matthieu Clément*

GREThA CNRS, University of Bordeaux, France

A B S T R A C T

The literature has emphasized the existence of a transition in the SES-obesity gradient when a country moves from low-income status to high-income status. As a middle-income country experiencing strong socio-economic changes, China provides a relevant case study. This article forms part of the literature on the impact of SES on body size and aims to clarify and update information about the relationship between income (one specific dimension of SES) and adult body size in urban China. To analyze this potentially complex relationship, we rely on semiparametric methods that enable us to leave the nature of the association between income and body size unspecified in the regression analysis. Empirical investigations conducted as part of this research are based on longitudinal data from the China Health and Nutrition Survey covering the period 1991–2011. Our results show that the income-body size relationship remains complex, gender-specific and very non-linear in urban China. We also provide evidence of the reversal of the income-body-size gradient, a reversal that is observed only for women for the period under study. Finally, we emphasize the specific features of the gradient for the two tails of the income distribution which could indicate that local deviations from the near-universal reversal path are possible.

1. Introduction

In their seminal review of empirical studies published between the 1960s and the mid-1980s, [Sobal and Stunkard \(1989\)](#) identified two main stylized facts about the influence of socioeconomic status (SES) on adult obesity. First, in developed countries, a consistent inverse association is observed between SES and obesity for women, while the association remains unclear for men. Second, a positive association between SES and obesity is largely confirmed in developing countries for men and women. While there is a general consensus on the fact that obesity is mainly a disease of lower SES groups in developed countries, the relationship between SES and body size has been much more widely debated in developing countries. Although positive associations are predominant in low-income countries, the relationship is more ambiguous in middle-income countries ([Dinsa, Goaryakin, Fumagalli, & Suhrcke, 2012](#); [McLaren, 2007](#); [Monteiro, Moura, Conde, & Popkin, 2004](#)). For instance, [Dinsa et al. \(2012\)](#) emphasize the predominance of mixed associations between SES and body size for men in middle-income countries and mainly negative associations for women. This has two main consequences. First, there is a reversal in the SES-obesity gradient when a country moves from low-income status to high-income status. Second, the reversal occurs earlier for women than for men.

As a middle-income country experiencing deep socioeconomic changes, China provides a relevant case study. The consequences of the striking economic development that has occurred in China since the 1980s include extremely rapid changes in eating behaviours,

* GREThA (CNRS), Université de Bordeaux, Avenue Léon Duguit, 33608 Pessac Cedex, France.
E-mail address: matthieu.clement@u-bordeaux.fr.

dietary patterns and physical activity, as predicted by the concept of nutrition transition (Popkin, 2014; Zhai et al., 2009). As a result, China has experienced an increase in the number of overweight and obese individuals. For instance, according to Patterson (2011), the number of obese individuals in China increased from 18 million in 2005 to approximately 100 million in 2011 while 38% of the population was overweight or obese at the same date. The rise in numbers of overweight and obese individuals is concomitant with deep societal changes (particularly significant in Chinese cities) such as rapid urban development (fed by rural-urban migration), increased inequality, expansion of the middle class, globalization of information, etc. Consequently, examining the association between socioeconomic and diet-related changes is of great importance for researchers, practitioners and policymakers interested in nutrition in China.

This article forms part of the literature on the impact of SES on body size. In epidemiological studies examining the association between SES and nutrition, SES is quasi-systematically measured using income, education and occupation. The objective of this article is to provide an in-depth examination of the causal effect of income (one specific dimension of SES) on adult body size in urban China. We refer to this as the income-body size gradient. Empirical investigations conducted as part of this research are based on longitudinal data from 1991 to 2011 from the China Health and Nutrition Survey (CHNS). To analyze this potentially complex relationship, we rely on semiparametric methods that enable us to leave the nature of the relationship between income and body size unspecified in the regression analysis. Such methods are now widely used to identify the impact of body size on labor market outcomes (see Shimokawa (2008) for China). However, to our knowledge, semiparametric methods have not been applied to analyze the influence of income on body size.

The article is structured as follows. Section 2 reviews the empirical studies examining the relationship between income and body size in China. The conceptual framework and the econometric methodology are presented in Section 3. Section 4 describes the data and key variables. Section 5 presents the results while Section 6 discusses the results and concludes.

2. Survey

The empirical literature studying the impact of income and SES on adult body size in China is widespread and its results are ambiguous. Based on CHNS data from 1991 to 1997, Du, Mroz, Zhai, and Popkin (2004) emphasize a positive impact of income on numbers of overweight and obese adults. Numbers of overweight and obese individuals among those with high incomes were twice those of low-income individuals in 1997 and the gap widened between 1991 and 1997. This suggests that the income gradient of obesity in China is close to the gradient observed in low-income countries, with the richest people being the most overweight and obese. Lu and Goldman (2010) and Cao, Hansstein, and Liu (2014) also highlight the positive impact of income on adult body size using CHNS data. However, most empirical studies show that the relationship is much more complex than it first appears.

For instance, in their comparison of the determinants of adult obesity in China and Taiwan based on survey data for 2000 and 2001 respectively, Shimokawa and Chang (2008) show the absence of a significant influence of income on the probability of being obese in China (a middle-income country), for both men and women. Conversely, a negative and significant impact is found for Taiwan (a high-income country). They conclude that when an economy becomes more developed (e.g. Taiwan), the relationship between income and obesity becomes significant and negative. Tafreschi (2015) also points out the role of the development level in understanding the income-body-size gradient. Analyzing CHNS data from 1991 to 2009, he highlights disparities in the income-body-size gradient according to the level of development. More precisely, there is a positive relationship between income and the future growth of the body mass index (a classical indicator of body size) in less developed areas of China, but a negative relationship in more developed areas. Moreover, in line with the literature on developing countries (Dinsa et al., 2012; Monteiro et al., 2004), the reversal of the income-BMI relationship seems to appear at earlier stages of economic development for women. Xiao et al. (2013) confirm this result. Based on a survey for Zhejiang province released in 2010, they observe a significant positive relationship between income and obesity for men, while finding no significant relationship for women.

Relying on 2009 CHNS data for urban areas, Bonnefond and Clément (2014) address the influence of social class on body size. Using a multidimensional definition of social class based on income, education and occupation, they show that the new middle class (i.e. the upper wage earners, and within this group, more particularly women) is the only social group to be relatively well-protected against obesity in urban China. Moreover, no significant difference is observed between rich and poor in relation to being overweight or obese. These results suggest that the income-body-size relationship in urban China is non-linear. This non-linearity is confirmed by Dai, Sriboonchitta, Zi, and Yang (2014) who show, based on CHNS data for 2009, that the probability of being obese increases with income, but only until the fourth income quintile. The idea of a non-linear relationship is more specifically addressed by Lei et al. (2014). Based on a survey conducted in 2011–2012 and focusing on Chinese adults aged 45 and over, they show that there is a markedly nonlinear relationship between per capita expenditure (used instead of income) and being overweight in China. For low levels of per capita expenditure (i.e. lower than the median), a positive relationship is found between expenditure and being overweight. For higher levels of expenditure, the relationship flattens out and becomes negative, both for men and women. However, when focusing on urban areas, no significant association is observed between per capita expenditure and being overweight.

All in all, this short survey highlights the complexity of the income-body-size gradient in China. The results, sometimes contradictory, indicate that the relationship is gender-specific, specific to where people live and has probably changed over time (with the level of economic development). Moreover, taking the potential non-linearity of the relationship into account is the great challenge addressed by this article.

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