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Associations of economic and gender inequality with global obesity prevalence: Understanding the female excess

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ABSTRACT

Obesity is widely assumed to be associated with economic affluence; it has therefore been assumed to become more common with economic development. However, obesity has also been associated with poverty. These contrary findings highlight the need for an examination of the contribution of social and economic factors to the global distribution of obesity. Males and females may be differently exposed to social and economic inequality, however few studies have considered possible gender differences in the association between socio-economic indices and obesity prevalence. We analysed between-country associations between obesity prevalence and three social or economic indices: per capita gross domestic product (GDP), the Gini index of national wealth inequality, and the gender inequality index (GII). We considered the genders separately, the gender average, and also the gender difference (female excess) in obesity prevalence. Across 68 countries listing sample size, there were 3 obese women for every 2 obese men. Within populations, obesity prevalence in males and females was strongly correlated ($r = 0.74$), however, only 17% of the female excess prevalence was accounted for by the gender-average prevalence. In both genders, there was a positive association between obesity prevalence and GDP that attenuated at higher GDP levels, with this association weaker in females than males. Adjusting for GDP, both the Gini index and GII were associated with excess female obesity. These analyses highlight significant gender differences in the global distribution of obesity, and a gender difference in the association of obesity prevalence with socio-economic factors. The magnitude of female excess obesity is not constant across populations, and is greater in countries characterised by gender inequality and lower GDP. These findings indicate that improving women's status may be a key area for addressing the global obesity epidemic over the long term, with potential benefits for the women themselves and for their offspring.

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Introduction

Obesity is widely attributed to positive energy balance, deriving from factors such as high-energy intake (e.g. through large portion sizes, high-energy density) or low levels of energy expenditure on physical activity (Poston & Foreyt, 1999; Prentice & Jebb, 1995). These factors are strongly associated with westernisation and economic affluence, and high and increasing levels of obesity are observed in many industrialised countries (Berghofer et al., 2008; Ogden et al., 2006). Obesity is acknowledged to be a major public health concern, increasing the risk of type 2 diabetes, cardiovascular disease and cancer (World Health Organisation, 2000).

To date, however, public health strategies for the prevention of obesity have demonstrated limited efficacy, best illustrated by the fact that the prevalence of the condition has increased over the last decade in many industrialised and modernising countries (Misra & Khurana, 2008; Mokdad et al., 1999; World Health Organisation, 2000), and that those categorised overweight worldwide now outnumber those categorised underweight (Popkin, 2007). Although individual obesity treatment programmes often have moderate beneficial effects, identifying 'best practice' for generalised application remains challenging due to the population variation in circumstances (Dombrowski, Avenell, & Sniehotta, 2010; Flynn et al., 2006). Identifying effective policies for the long-term prevention of obesity is therefore a global priority, and there is

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a need for more information on the social and economic factors associated with variability in obesity risk.

In industrialised societies, obesity is more common in those of lower socio-economic status (SES) (Giskes et al., 2008), indicative of a less healthy diet and less leisure-time physical activity (Sallis & Glanz, 2009). Increasing prevalence of obesity is also reported in countries undergoing the changes in diet and activity patterns that accompany urbanisation, known as the "nutrition transition" (Mendez, Monteiro, & Popkin, 2005; Popkin, 2007), and in this context is often observed in low-income settings where, paradoxically, under-nutrition is also common (Doak, Adair, Bentley, Monteiro, & Popkin, 2005). Using data collected during the 1990s, an international comparison of obesity rates in women found that in very low-income countries, obesity tended to increase in proportion with gross national product (GNP) and, within populations, to be characteristic of high-SES individuals (Martorell, Kettel Khan, Hughes, & Grummer-Strawn, 2000). A subsequent analysis found, however, that across a wider span of economic development, this association varied, so that when GNP reached around USD 2500, obesity became more common in women of low SES (Monteiro, Conde, Lu, & Popkin, 2004). In wealthy industrialised populations, measures of within-country income inequality (Gini index) have also been associated with obesity prevalence, with less egalitarian countries having higher obesity prevalence (Pickett, Kelly, Brunner, Lobstein, & Wilkinson, 2005). Whether this scenario extends to less wealthy populations remains unknown.

These studies indicate that obesity, like under-nutrition, does not merely reflect energy imbalance at the level of the individual, but also broader social and economic forces acting differentially within populations (Egger & Swinburn, 1997; Nestle, 2003). A recent analysis of countries undergoing economic transition found that in most, obesity remains most common in those of high socio-economic status, but that in some, the fastest rate of increase has occurred in those of lower socio-economic status (Jones-Smith, Gordon-Larsen, Siddiqi, & Popkin, 2011). It is clear therefore that there is no simple association of obesity with economic "affluence", either within or between countries. With increasing understanding of the influence of globalised economics on health (Blouin, Chopra, & van der Hoeven, 2009; Legge, Sanders, & McCoy, 2009) it is important to look beyond the national level, and investigate how global social and economic factors are associated with the worldwide obesity distribution.

One factor particularly meriting attention is the possibility of gender differences in exposure to social economic factors, thereby potentially generating gender differences in obesity risk. Three decades ago, Hoyenga and Hoyenga (1982) suggested that women were both better protected from famine than men, and more prone to excess weight. Whilst this might indicate greater resilience to ecological perturbations in ancestral environments (Stinson, 1985), it suggests that women may be more susceptible to the contemporary obesity epidemic. Female gender is an established risk factor for inequity, and gender, discrimination and poverty contribute interactively to poor health in women (Doyal, 2001; Rogers, 2006). Gender differences in weight gain may emerge not only through sexually-dimorphic physiology but also through different forms of gender discrimination. These factors may operate both via development, and via adult lifestyle.

In India and Bangladesh, for example, infant growth rates are lower in females than males (Borooah, 2004; Ghosh, Kilaru, & Ganapathy, 2002; Moestue, 2009), a scenario relevant to obesity because stunting in early life has been associated with subsequent obesity risk (Florencio, Ferreira, de Franca, Cavalcante, & Sawaya, 2001; Hoffman, Sawaya, Verreschi, Tucker, & Roberts, 2000; Popkin, Richards, & Monteiro, 1996). However, this female growth deficit is not universal, and in some populations males had higher rates of stunting (Bamgboye & Al-Nahedh, 2003). Several studies from western populations have shown stronger associations between parental social status, or early-life living conditions, and adult obesity in females compared to males (Heraclides, Witte, & Brunner, 2008; Khlat, Jusot, & Ville, 2009; Langenberg, Hardy, Kuh, Brunner, & Wadsworth, 2003).

In industrialised populations, adult sex differences in diet are well established (Wardle et al., 2004), while in non-industrialised populations, females may be more likely to be food-insecure or poorly nourished than males (Hadley, Lindstrom, Tessema, & Belachew, 2008). Several studies have indicated that in food-insecure conditions, mothers may reduce their own dietary intake to buffer that of their children (McIntyre et al., 2003; van Liere, Ategbo, Den Hartog, & Hautvast, 1995). Adult women often have less secure and less well-paid employment than men, potentially giving them less control over access to nutritious food.

Thus, there are multiple ways in which factors relevant to obesity risk differ between men and women, under the mediation of socio-economic exposures. These factors are potentially important for understanding gender differences in obesity susceptibility. However, an additional reason why the nutritional status of women merits attention is that maternal physiology represents the developmental niche for the next generation (Wells, 2007), and hence may contribute to future obesity risk of offspring (Armitage, Poston, & Taylor, 2008).

Until recently, however, very few data were available for international comparisons of social and economic factors associated with gender differences in obesity prevalence. An analysis based on data from 11 populations found that obesity prevalence showed complex inter-country associations with indices of wealth and education. Obesity was found to shift towards lower SES with increasing gross national product (GNP), with women more sensitive to this effect (Monteiro, Moura, Conde, & Popkin, 2004).

The International Obesity Task Force has now collated data on the prevalence of obesity by gender in a number of diverse countries. We used these data first to test whether obesity prevalence is equal in males and females, and second to test whether indices of economic affluence, and economic and gender inequality, contribute to between-country variability in gender differences in obesity prevalence.

Methods

Data on obesity prevalence as the outcome, and socio-economic predictors and potential confounding factors, were collated from the literature.

Obesity prevalence

Data on obesity prevalence by gender were collated from the International Obesity Task Force website (http://www.iotf.org/), accessed on 14th April 2011. The prevalence of adult obesity, defined in both genders as body mass index (BMI) > 30 kg/m^2 (Garrow & Webster, 1985) has been assessed in samples from a wide range of countries across a wide range of economic development. Due to ethnic differences in physique, the BMI threshold of 30 kg/m^2 does not index health complications equally across populations. For example, many amongst south and south-east Asian populations experience increased cardiovascular risk associated with overweight, but few are obese according to the cut-off of 30 kg/m^2 (International Obesity Task Force, 2002). Thus, in international comparisons, the ethnic composition of any given population is predicted to influence the proportion of individuals with BMI > 30 kg/m^2, and using ethnic-specific obesity cut-offs does not yet address this problem satisfactorily as such cut-offs have only

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