Fit in the City? Weight Gain among Urban Individuals in Low and Middle Income Countries

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Abstract

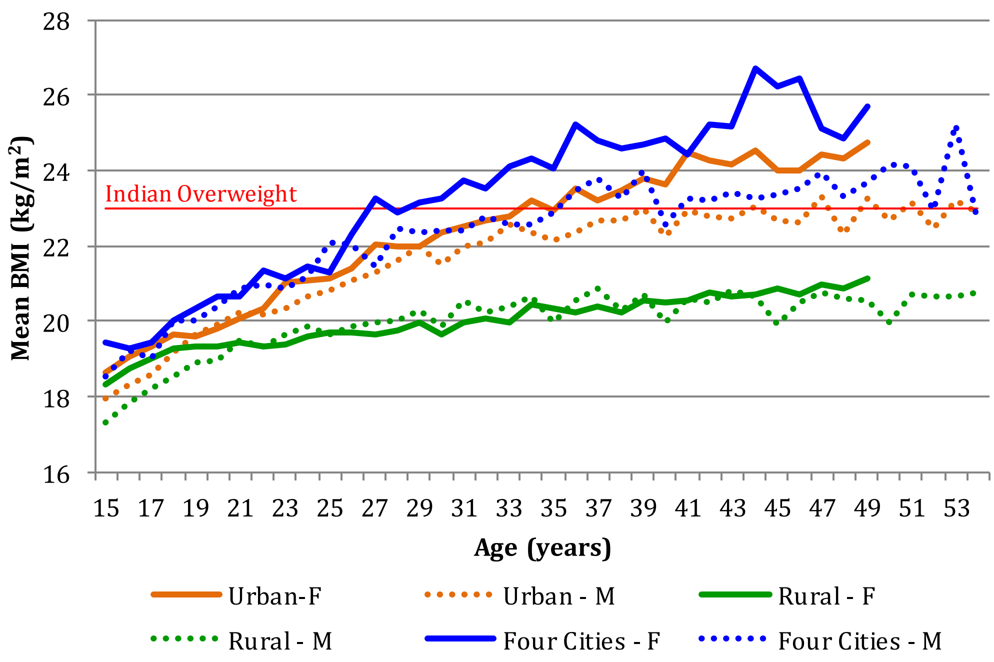
The globalization of food and lifestyles combined with economic changes could result in different risks for overweight and obesity among urban and rural residents but also among women and men. City size may also predict an urban gradient of future prevalence of obesity and chronic diseases. We examine DHS data on women (ages 15-49) and men (ages 15-54), focusing on an independent effect of urbanization on gains in BMI in over 50 countries over the past two decades. We also restrict analysis to countries with georeferenced clusters to examine city size and other spatial characteristics more closely. We construct multilevel hierarchical models that assess the role of individual and community level characteristics in the likelihood of weight gain. We use separate multilevel models for each characteristic of the urban environment with individual characteristics. Findings have implications for urban public health planning in established and emerging metropolitan areas.

Introduction

While malnutrition remains an important public health concern in poor countries, particularly in rural areas and among the urban and rural poor, overweight and obesity are emerging as increasingly important public health concerns for urban individuals (WHO, 2013). Changes in lifestyle and dietary intake in adulthood as a result of economic growth and urbanization, can lead to a "double burden" of disease in cities, i.e. the co-existence of diseases related to under- and over-nutrition (Tanumihardjo et al., 2007; WHO, 2006). In an analysis of demographic health survey (DHS) data from India, we found that women living in cities are more likely to be overweight as they age than women in rural areas, and women in larger cities even more so (Dev & Balk, 2013). Past studies of overweight and obesity in developing countries have shown a strong positive association between socioeconomic status (SES) and body mass index (BMI) as well as SES and overweight (Subramanian, Perkins, Özaltin, & Smith, 2011).

Our study in India suggested an independent effect of urbanization on overweight and obesity among women, after controlling for SES. The proposed study aims to further investigate this finding in additional low and middle income countries. Where available, BMI data on men will also be analyzed in order to explore the gender dimensions of weight gain and urban residence, which at least for India suggests different risks for urban women and men as they age; women in cities and especially in the largest cities gain wait at a much faster rate than men after age 26 years (Figure 1). We examine DHS data on women (ages 15-49) and men (ages 15-54), focusing on the role of urbanization on gains in BMI in over 50 countries over the past two decades. In countries that are primarily urban, such as Colombia (75% urban) and the Dominican Republic (69% urban), older surveys will be included to determine the timing of urban BMI increases.

Figure 1: Mean BMI by Age among Indian Women and Men: NFHS-3 (2005-06)



Background

Urbanization has been hypothesized to affect weight gain. By 2030, the combined effect of a wider availability of fast food products, higher caloric intake from refined and processed foods, and sedentary work and life conditions associated with urban living, could contribute to a 75% increase in the prevalence of overweight and obesity among adults ages 20 years and older worldwide (Kelly & Melnyk, 2008). In hub cities, such as Accra, Ghana, urban residents have become more vulnerable to unhealthy weight gain due to macro level economic trends that promote consumption of energy-dense processed foods, late working hours, and greater alcohol consumption (Agyei-Mensah & Aikins, 2010). Rising trends in overweight and obesity have also been observed in India during the massive economic reforms and urban growth of the 1990s. The prevalence of overweight and obesity has been documented to be 28% in urban Delhi, and was higher among females than males (Gopinath, Chadha, Jain, Shekhawat, & Tandon, 1994). A socioeconomic gradient among higher income adults in Indian urban areas also been observed while others have found positive associations of pre-overweight,

overweight, and obese categories with a socioeconomic gradient across higher standard-of-living index quintiles (Subramanian, Kawachi, & Smith, 2007).

While the highest wealth and education groups have higher prevalence of overweight and obesity in low and middle income countries, longitudinal data also suggest a trend toward faster overweight prevalence growth rates for the lowest wealth and education groups in urban areas as well (Jones-Smith, Gordon-Larsen, Siddiqi, & Popkin, 2012). A study of rural to urban migrants in India found that urban male and female migrants reported an increase in fat intake and reduced physical activity compared to their rural siblings, with corresponding higher levels of obesity and diabetes (Ebrahim et al., 2010). A study from urban Brazil found that slum residents had higher rates of physical activity than non-slum dwellers, but also higher intake of low-cost, high saturated fat foods (Alves, Figueiroa, & Alves, 2011). Combined with food consumption patterns, slum dwellers could be vulnerable to unhealthy weight gain as they age, although their vulnerability to under-nutrition remains a priority for public health action.

Data

DHS is a nationally representative cross sectional survey of women aged 15-49 years and men ages 15-54 years which takes place in low and middle income countries with varying frequency and intervals. The data set includes the most recent DHS rounds from over 50 countries in the past two decades. The exact number of countries will be determined during analysis but we will focus primarily on surveys conducted since 2000 to capture varying levels of urban change across countries. We restrict our sample to women who were not pregnant at the time of the survey and who were not missing data for the BMI outcome. Where BMI data is available, we also include men's surveys for the same analysis. Some DHS data sets, such as the last survey in India, have identified slum residents in their questionnaire. If it is possible to distinguish slum residents from other poor and non-poor urban residents in any survey, we will do so.

The main exposure of interest is place of residence as we were interested in the association between the urban environment and BMI. A dichotomous variable for urban or rural residence as well as another for city size, as determined by some administrative criteria, are the key independent variables. In the next phase, we will further restrict analysis to countries with georeferenced clusters to examine city size and other spatial characteristics more closely. Other covariates include: age, education, parity, breastfeeding, smoking, occupation, standard of living, standard of living or wealth score, and slum residence (where available). Variables to determine women's status with regard to mobility and decision-making will also be included when available, for a closer look at gender related factors. Age, education, wealth, and parity will be included as continuous variables while breastfeeding, smoking, occupation, standard of living, and slum residence will be categorical.

Occupation will also included as a categorical variable to capture potential physical strain in the following areas: agriculture, manual labor, and clerical/professional. Standard of living will be included when available as will the more refined measure of socioeconomic status, the wealth score. Both measures are based on a weighted combination of household living conditions and assets. Standard of living is measured as being low, medium, or high, while wealth is included as a raw score and divided into two sets of quintiles by urban or rural residence. Slum dwellers will be included if they are designated as such by any administrative or survey criteria.

Beyond the individual and household level data, we will also include higher level determinants, such as level of urbanization, income growth, subnational food prices, and others that might impact variation in BMI.

Dependent variable

The main dependent variable is BMI, calculated as weight in kilograms divided by height in meters squared (kg/m^2). Both weight and height are measured by the interviewer. While BMI is used as a continuous variable for analysis, the following cut-offs are used for comparison with WHO standards: <16 (severely thin), 16–18.49 (moderately to mildly thin), 18.5–24.9 (normal), 25-29.9 (global overweight), and $\geq$ 30 (obese).

Analysis Plan

Utilizing DHS data, we plan to extend the investigation of weight gain among men and women to more comprehensively include the urban environment through multiple indicators at community and individual levels. The analysis will include develop multilevel models for the simultaneous quantitative analysis of variables measured at the individual, household, sampling cluster, city, subnational levels, and country levels, especially in light of more recent GPS data availability (Diez-Roux, 2000; Jones & Duncan, 1995). Due to the potential clustering of obesity-related risk factors in the environment, especially the urban setting, multilevel modeling will allow for nested models with individual level data as the first level, nested within hierarchical groups such as sampling clusters, cities, and other subnational areas where higher level variables will vary. This analysis will allow for the inclusion of risk factors that health exposures that may be occurring at the group level and that may work differently with individual level factors in different settings.

We will first examine if there is an urban gradient in the share of overweight and obese women by urban/rural residence and city size. Because our analysis of Indian data suggests that increases in BMI for women are substantially higher in the largest cities, we will critically examine urban classification and use the DHS cluster locations to construct city-size categories by combining the DHS data with the geospatial data on cities (such as Global Rural Urban Mapping Project data and other sources) (Dorélien, Balk, & Todd, 2013). In addition to determining city size, geospatial data will be useful in introducing variables that capture higher level determinants of weight gain, including the food and built environments. Some examples of variables to be included are given in the data section above.

We will further stratify on place of residence for BMI outcome by age to determine if there is an interaction between BMI and urban residence in urban areas, as found in our study from India. Similar analysis will be performed on the men's datasets where BMI data is available. We will estimate weighted, multivariate, linear regression models to assess the independent effect of place of residence on BMI and how the magnitude of this effect changes after controlling for the covariates, including an effect for the interaction between urban residence and age as well as urban residence and wealth. We will also estimate multivariate, logistic regression models for overweight or obese (BMI$\geq$25) and underweight (BMI<18.5) outcomes as well as multinomial logistic regression models to compare the effect of residence and urban-age interaction on BMI for overweight or obese and underweight compared to normal weight.

We will apply multilevel models to estimate the fixed effects of community- and individual-level factors on BMI. We construct multilevel hierarchical models that assess the relation between each characteristic of the city environment and the likelihood of weight gain. We use separate multilevel models for each characteristic of the urban environment with individual characteristics, controlling for one another. All models will account for clustering at the PSU level. All analyses were weighted to adjust for the probability of selection for interview and for the oversample.

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