Household motor vehicle use and weight status among Colombian adults: Are we driving our way towards obesity?

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Objective. To determine the associations between household motor vehicle ownership and weight status among Colombian adults.

Methods. Secondary analysis of data from the 2005 Demographic and Health Survey of Colombia. Height, weight and waist circumference were objectively measured in 49,079 adults, ages 18 to 64 that resided in urban settings. Abdominal obesity was defined as a waist circumference > 80 cm in women and > 90 cm in men.

Results. Prevalence was 19.9% for motor vehicle ownership in household, 33.1% for BMI between 25 and 29.9 kg/m², 14.4% for BMI > 30 kg/m², and 46% for abdominal obesity. Males reporting any household motor vehicle ownership were more likely to be overweight or obese, and to have abdominal obesity (p for gender*exposure variables interaction = 0.001).

Conclusions. Household motor vehicle ownership is associated with overweight, obesity, and abdominal obesity among Colombian men but not women.

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Introduction

Obesity has reached epidemic proportions worldwide and is a condition no longer confined to high-income countries and populations (Lobelo et al., 2006; Raymond et al., 2006). Excess adiposity, and in particular, abdominal obesity have been consistently associated with certain cancers and an array of metabolic, cardiovascular, respiratory and musculo-skeletal diseases (Pan et al., 2004; Vgontzas et al., 2005; Klein et al., 2004; NTFPTO, 2000; Mertens and Van Gaal, 2002; Sahyoun et al., 1999). Epidemiological, nutritional and demographic transitions, coupled with rapid urbanization and globalization processes have been linked to the obesity epidemic in low-middle income countries (Uauy et al., 2001). In this context, overweight and obesity have emerged as public health threats, creating social and economic burdens (Lobelo et al., 2006; Campbell and Campbell, 2007). In Colombia, according to the 2005 National Nutrition Survey, 32.3% of Colombians (including people living in rural areas) were overweight, and an additional 13.8% were obese. These rates were significantly higher among women, people ages 28 years and older, middle-low socioeconomic status populations, and residents of urban areas (DANE, 2005). Physical inactivity and sedentary lifestyles appear to exert independent effects on the development of obesity (Delmas et al., 2007; Pate et al., 2008). Time devoted to sedentary activities such as television (TV) viewing or private motor vehicle use have been positively associated with obesity in high-income countries, as well as some low-middle income countries (Gomez et al., 2007; Bell et al., 2002; Frank et al., 2004; Wen et al., 2006). In Latin-American countries such as Colombia, physical inactivity and sedentary behaviors are increasingly prevalent and have also shown to be related to adverse health outcomes, such as obesity and excess mortality (Lobelo et al., 2006). For example, in 2005, only 42.6% of the Colombian adult population engaged in regular physical activity (PA) (ICBF, 2005). Moreover, although the rates of private motor vehicle ownership in Latin-American cities remain low compared to rates in the United States, car sales have recently been on the rise (WHO, 2009).
The World Bank estimates a four-fold increase in motor vehicles worldwide by 2050 (Roberts et al., 2006). In fact, from 2004 to 2005, the percentage of car sales in Colombia increased by almost 50% (ICBF, 2005). Motorcycles sales have also increased, and they are often a preferred mode of transportation in Colombia due to their low cost, speed, and maneuverability for negotiating traffic, as compared to automobiles (DANE, 2005).

Given that mobilization patterns in Latin-American cities are rapidly shifting towards the use of private motorized transportation, (Vasconcellos, 1999) the relationship between motor vehicle use and obesity warrants exploration. This study offers a unique opportunity to explore the topic in a cross sectional manner in a low-middle income country. The objective of this study is to determine the associations between household motor vehicle ownership and excess adiposity in a representative sample of Colombian adults residing in urban areas.

Methods

Study design and population

Cross-sectional data were analyzed from the Fourth National Demographic and Health Survey of Colombia (NDHS-Colombia 2005; in Spanish: Encuesta Nacional de Demografía y Salud, ENDS 2005). This survey is a periodic, multistage, national probabilistic survey of non-institutionalized residents from urban and rural areas, it provides information on various demographic, maternal-child health issues, and includes objective anthropometric measures. The technical details of the study can be found elsewhere (ICBF, 2005). Response rates were 74.3% for BMI measures and 72% for waist circumference measures. For this study, we restricted the analysis to 49,079 adults, ages 18 to 64 that resided in urban settings.

Outcome variables

Weight, height and waist circumference were measured directly by trained staff, using standardized measuring equipment and protocols. Weight was measured to the nearest 1.0 kg with participants wearing light clothing and without shoes; using a digital weighing scale (SECA model 770; Brooklyn, NY). Height was measured to the nearest 1.0 cm using a portable stadiometer (Shorr Productions, Onley, MD). Body mass index (BMI) was calculated as weight in kilograms divided by height squared in meters. Overweight was defined as a BMI equal to or greater than 25 kg/m² and less or equal to 29.9 kg/m² and obesity was defined as a BMI equal to or greater than 30 kg/m², in accordance to international standards (NTFPTO, 2000). Waist circumference (WC) was measured after a relaxed expiration, using a measuring tape parallel to the ground, at the center point between the iliac crest and the last rib, and keeping direct contact with the skin. Abdominal obesity was defined as a WC equal to or greater than 80 cm in women, and equal to or greater than 90 cm in men (Alberti et al., 2005).

Independent variables

Motor vehicle ownership was assessed at the household level through self-reports, separately for automobile and motorcycle. Covariates included: age groups (18–29, 30–49, and 50–64 years), gender, urbanization level, socioeconomic position (SEP), and family structure. Based on population density, three urbanization levels were created. Level I areas included urban settlements with 30,000 inhabitants or less; level II areas with 30,001 to 99,999 inhabitants; level III areas with 1,000,000 or more inhabitants. The SEP of the family was determined using an adapted score of the SISBEN index, which considers living conditions (construction type and materials), and access to public utilities (sewer, electricity, potable water, and garbage collection) (ICBE, 2005). Based on this information, six levels are defined, with (1) being the most disadvantaged and (6) the most advantaged SES group. The NDHS-Colombia disaggregated information from SES 1–3, but not from SES 4–6, due to their minimal proportion at the national level (less than 3%). For the current analysis, three levels of SEP were defined: low (SEP 1), low-middle (SEP 2), and middle (SEP 3 or higher). Family structure was determined as the number of family members residing in the home: 1 to 4, 5 to 6, and 7 or more.

Statistical analysis

Since the purpose of this study was to examine the potential associations between motor vehicle ownership and BMI categories (overweight and obesity), as compared to normal weight, a polytomous logistic regression was carried out. In addition, a binary logistic regression model was conducted in order to determine the association between motor vehicle ownership and abdominal obesity. The analyses were conducted among all participants and stratified by gender, while adjusting for age groups, SEP, urbanization level, and family structure. The variance inflation factor test was used to examine collinearity between variables (Kleinbaum et al., 1998). The statistical analysis took into account an unequal selection of probabilities in STATA 9.

Results

Study population characteristics by weight status

The mean age for the total population sample was 36.5 years (SD = 12.7). The population was predominantly female (62.5%); the majority of respondents were in the 30–49 years category (44.5%); and 72.6% of the sample population resided in urban settlements with less than 30,000 inhabitants (level 1). Household motor vehicle ownership was reported by 19.9% of the participants.

Prevalence of overweight, obesity and abdominal obesity

In the overall sample, 47.5% of the respondents were classified as being overweight with a significantly higher prevalence among females (49.7%) as compared to men, those in the age group 50–64 years old (66.4%) also had a higher prevalence of overweight as compared to all other age groups. These results along with the prevalence for obesity and abdominal obesity can be found in Table 1.

Overweight and obesity by motor vehicle ownership and gender

Males reporting household automobile ownership were more likely to be overweight (prevalence odds ratio) (POR: 1.6, CI: 1.4–1.8, \( p < 0.001 \)) or obese (POR: 1.8, CI: 1.5–2.2 \( p < 0.001 \)) than those with normal weight. The results for household motorcycle ownership showed a significant association with both overweight and obesity among males (POR: 1.5, CI: 1.4–1.8, \( p < 0.001 \)) and POR: 1.4, CI: 1.2–1.7, \( p < 0.001 \), respectively). The results for any household motor vehicle ownership (automobile or motorcycle) among males also showed significant associations with overweight and obesity (POR: 1.6, CI: 1.4–1.8, \( p < 0.001 \) and POR: 1.7, CI: 1.4–1.9 \( p < 0.001 \), respectively).

None of the associations were significant among women (Table 2).

Abdominal obesity by motor vehicle ownership

Household automobile ownership was found to be associated with abdominal obesity among males (POR: 1.7, CI: 1.5–2.0, \( p < 0.001 \)), but not among females (POR: 1.0, CI: 0.8–1.1, \( p = 0.722 \)). Likewise, household motorcycle ownership was found to be associated with abdominal obesity among males only (POR: 1.3, CI: 1.2–1.5, \( p < 0.001 \)). There was a significant association between any household motor vehicle ownership (automobile or motorcycle) and abdominal obesity among males (POR: 1.5, CI: 1.4–1.7, \( p < 0.001 \)), but not among women (POR: 1.0, CI: 0.9–1.1, \( p = 0.466 \) (Table 3).

The p-value of the interaction term between gender and the three different exposure variables (obesity, overweight and abdominal obesity) was less than 0.001 in all the models.

Discussion

This study indicates that, after adjusting for potential confounders, there is a positive association between motor vehicle (automobile and/or motorcycle) ownership and overweight, obesity, and...
abdominal obesity among Colombian men. Our findings are similar to those of other studies, conducted in both developed (Wen et al., 2006; Pendola and Gen, 2007; Bell et al., 2002; Frank et al., 2004) and rapidly developing nations, (Bell et al., 2002) who have found a direct link between private motorized transportation and obesity. To our knowledge, this study is the first of its kind that addresses this association in a developing country from Latin America. The relationship between obesity and motor vehicle ownership was significant in men; however, the effect sizes were of a relatively small magnitude. Nevertheless, while the effects are small, if this association is determined to be causal with longitudinal studies, it could have large public health implications at the population level due to the large proportion of people affected and the current trends in motor vehicle sales in the country.

Motorized transportation may be linked to overweight or weight gain by prolonged periods of sitting while driving and by replacing PA that would otherwise be attained by walking and/or bicycling as means of transportation. It has also been suggested that the long commute times often associated with private vehicle use result in less discretionary time for PA, and are linked to excessive car snacking (Frank et al., 2004). Studies have reported positive associations between time devoted to sedentary

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activities, either continuously measured or classified as categorical activities (such as TV viewing or sitting time), and cardio-metabolic risk, even after adjusting for potential confounders, including PA levels (Healy et al., 2008).

The lack of an association between motor vehicle use and excess adiposity women requires further exploration. This finding could potentially be explained, however, by the low degree of specificity in the exposure variable, which implies household motor vehicle (automobile and motorcycle) ownership, rather than individual use. Moreover, according to transportation reports and rates of motor vehicle accidents and deaths in Colombia, motor vehicle use appears to be higher for men than for women, which could explain in part the lack of statistical significance among women (ICBF, 2005). Possibly, there are other particular cultural and social characteristics (such as stereotypes) that link owning a car with reflecting success and status, which might make motor vehicle use more prevalent among men. The explanations listed above are only hypothesis, and will require further exploration. We also stratified the analysis by SEP (low-middle, low versus middle) and positive associations with all three outcomes for were present among both strata, with a smaller magnitude among people from middle SEP. We can hypothesize that populations from middle and high SEP have additional resources to counteract the effects of inactivity while driving by engaging in more leisure time physical activity or having better nutrition habits. We did not find significant interaction terms between SEP and excess adiposity.

Some limitations of this study are noted here. The lack of specificity of the exposure variable, which was based on a single question inquiring about household motor vehicle ownership rather than individual use, reduces the precision of the outcome variable. Despite this limitation, it is important to emphasize that on average, the majority of Colombian families own only one car per household. For example, in Bogotá, the capital city of Colombia, the rate of automobile ownership is slightly more than 20% of all households (ICBF, 2005). The cross sectional design of the study does not allow us to establish causal relationships between excess adiposity and motor vehicle ownership. In the future longitudinal studies need to be conducted in order to help understating this dynamic. In addition, information on overall PA habits in different domains, including leisure time, utilitarian, and transportation, as well as objective indicators of the built environment (which could act as mediators or effect modifiers of the relationship between motor vehicle ownership and weight status), were not available during this study and therefore it wasn’t possible to control the results for them. Future research in the region of Latin America that assess the temporal and causal relationships between private motor vehicle use (including its trends) and health-related outcomes, taking PA habits and the built environment into account, will constitute an important next step in this area of research.

Some strengths of this study should also be highlighted, particularly the use of objective measurement of weight, height and waist circumference which reduces the degree of misclassification in the outcome variables. To date most epidemiologic studies in this field have relied on self-reported data. The use of a large population-based sample allowed us to establish prevalence estimates of overweight, obesity and abdominal obesity at the national level. The results from this study could potentially be extrapolated to similar urban settlements in the region Latin-American, keeping contextual differences in mind.

In conclusion, the results of the present study indicate that among Colombian men, there is a cross sectional association between motor vehicle ownership and overweight, obesity, and abdominal obesity. If this association is proven to be causal, interventions and policies aimed at facilitating active transportation and reducing unnecessary and/or excessive use of private motor transportation could assist in controlling and preventing the ongoing obesity epidemic in Latin America. These include but are not limited to maintaining policies that promote active vs. motorized transportation. The low prevalence of motor vehicle ownership combined with the high population densities and land-use mix that are commonly found in most Latin-American cities, makes these interventions feasible. A number of programs are currently in place in some Colombian cities, such as daily restrictions in regard to the use of private motor vehicles (pico y placa), improvement of public transportation systems, creation of a city-wide network of bike lanes (ciclорuta), and the “ciclovía”, a policy that enforces the closing of selected roads within the city for recreational activities during Sundays and holidays (Parra et al., 2007). Studies determining the effects of these types of programs on health-related outcomes, such as the prevalence of overweight and obesity, will provide further support for their inclusion in prevention policies, both locally and in the Latin America region.

**Conflict of interest statement**
The authors declare that there are no conflicts of interest.

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**References**


Bell, A.C., Ge, K., Popkin, B.M., 2002. The road to obesity or the path to prevention: motorized transportation and obesity in China. Obes. Res. 10, 277–283.


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