Original Research Article

Prevalence of Overweight and Obesity in Older Mexican Adults and Its Association with Physical Activity and Related Factors: An Analysis of the Study on Global Ageing and Adult Health

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Objectives: The obesity epidemic in Mexico is increasing and represents a considerable public health challenge. The population aged 50 years and older is also increasing and is not exempt from the obesity rise. We aimed to determine the current prevalence of Body Mass Index (BMI) categories in a sample of Mexicans aged 50 years and older and to test the associations of BMI with physical activity categories and related factors.

Methods: Data from 2,032 individuals aged 50 years and older who participated in SAGE Wave 1 (2009–2010) were analyzed. Representativeness of the sample was obtained by using weighted data. Descriptive statistics, chi square tests, simple regression analysis, and multiple regression analysis were performed in relation to BMI, self-reported physical activity categories, and several variables, including demographic characteristics and selected risk factors for non-communicable diseases.

Results: Among older adults, 0.6% was found to be underweight, 21.4% normal weight, 49.4% overweight, and 28.7% obese. It was also found that practicing vigorous intensity physical activity (−1.32) and being 80 years or older (−2.73) were significantly associated ($P < 0.05$) with a lower mean BMI (28.3). In contrast, being in the lowest income quintile (1.35), and living in urban areas (0.86) were significantly associated with a higher mean BMI.

Conclusions: The study results contribute to the current understanding of obesity etiology in Mexico, and moreover confirm that overweight and obesity are current public health problems that must be addressed in specific subgroups of older adults. Am. J. Hum. Biol. 00:000–000, 2014.

Overweight and obesity are increasing public health concerns that are affecting people of all countries, all ages, and all ethnic groups. Worldwide it has been estimated that there are almost 1.4 billion adults (almost double the number in 1980) who are overweight, and 500 million of them who are obese (WHO, 2006). In Mexico, the National Health and Nutrition Survey (ENSANUT, 2012) reported that more than 70% of older adults (aged 60 years and older) were overweight or obese (Shamah-Levy et al., 2013). Similarly, other countries in Latin America, for example Ecuador, have reported a high prevalence (59%) of overweight and obesity in the same age group (Freire et al., 2010). At the same time, Mexico's older population has one of the fastest population growth rates in Latin America with a 232 percent increase expected by 2040, greater than Brazil, Peru, Guatemala, and United States (Aguila et al., 2011).

Overweight and obesity in older adults is related to important adverse effects, including increased mortality and morbidity related to hypertension, diabetes, cardiovascular disease, osteoarthritis, cancer, and metabolic complications, such as insulin resistance, and dyslipidemia (Villareal et al., 2005). The increase of these conditions among older adults has public health implications; countries' health systems will be under increased pressure to deliver appropriate care for this group. Indeed, a study conducted in the United States found that white older persons who are obese have a greater proportion of nursing home admission compared with those who are not obese (Villareal et al., 2005; Zizza, 2002).

Current recommendations for overweight and obese adults suggest maintenance of a healthy weight through regular physical activity of at least 150 min a week (WHO, 2006, 2009a). Indeed, a Mexican study of adults 20 to 69 years old showed that being overweight or obese was inversely associated with physical activity (Medina et al., 2013). However, no other study has examined the associations of BMI with socio-demographic characteristics, and noncommunicable diseases risk factors among Mexicans 50 years and older. Therefore, to contribute to the current understanding of obesity etiology in Mexico, and to identify specific subgroups at risk of obesity, the present study has two main objectives. First, we aimed to determine the national prevalence of low weight, normal weight, overweight, and obese individuals among specific subgroups of older adults. Second, we aimed to construct a model that explains the changes of BMI among different subgroups of

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older adults, by testing the associations of BMI with selected explanatory variables (physical activity, age, sex, residence area, income quintiles, marital status, fruit and vegetable consumption, use of tobacco and alcohol consumption).

METHODS

Sample and procedure

Data from the World Health Organization's (WHO) Study on global AGEing and adult health (SAGE) were analyzed from Mexico Wave 1 2009–2010. SAGE is a multi-country nationally representative household survey of respondents aged 50 years and older in China, Ghana, India, Mexico, Russia, and South Africa (Kowal et al., 2012).

The sampling procedure for SAGE Wave 1 in Mexico is described in detail elsewhere (Naidoo, 2012; WHO, 2013). Briefly, the sampling in Wave 1 used a stratified multistage cluster sample design, in which a subsample of 211 Basic Geo-Statistical Areas (AGEB) were selected from the original 797 AGEB as part of the baseline Wave 0. This sample design was crafted to ensure representative national estimates by residence area (urban and rural). The response rate for SAGE Wave 1 in Mexico was 59%. The SAGE survey was carried out in Mexico in partnership between the WHO and the National Institute of Public Health (INSP).

Out of a total sample of 2315 individuals aged 50 years and older, the present analyses use data from 2032 (88%) individuals who provided complete valid weight and height data. There were a number of outliers registered and, importantly, these values were not normally distributed. The outliers were removed.

Measures

Body mass index (BMI). It was generated for older adults based on measured weight and height. For its calculation, weight in kilograms was divided by the square height in meters. Respondents were grouped into four categories of BMI: underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9), and obese (>30) (WHO, 1985).

Physical activity categories. This was determined based on responses to questions from the Global Physical Activity Questionnaire (WHO, 2009a,b). These questions are explained elsewhere (WHO, 2009a). In short, three categories of physical activity (low, moderate, and high physical activity) were calculated from responses about moderate or vigorous activities at work; transport activities to and from places; and, recreational/leisure time activities. Each type of activity was classified as low, moderate, or high, depending on the time used for each activity and its total energy requirement in metabolic equivalents (METs).

High physical activity was defined as three or more days a week of vigorous-intensity physical activity plus a total of 1,500 METs or more. Or, as seven or more days of any combination of moderate activity or transport activity, plus a total METs of 3,000 or more (WHO, 2009a).

Moderate physical activity was defined as three or more days of vigorous-intensity physical activity of at least 20 min per day. Or, as five or more days of any combination of moderate physical activity and transport activity of at least 30 min per day. Or, as five or more days of any combination of vigorous, moderate or transport activity, and a total physical activity (METs times minutes per week) of 600 or more (WHO, 2009a).

People in the low physical category were those who do not meet the criteria for either high or moderate level of physical activity; a person in this level of physical activity is considered to be at risk of chronic diseases (WHO, 2009a).

Sociodemographic characteristics. Ten year age groups were generated for analysis: 50–59, 60–69, 70–79, and 80-plus years. Marital status was classified into four groups: *never married; married or cohabiting; separated or divorced; and widowed*. A classification scheme was used to map the highest level of education completed to an international standard (UNESCO, 1997). No formal education was included in the *less than primary level* variable, any primary and completed primary were included in the *primary level*, any secondary and completed secondary were included in the *secondary level/high school level*; finally, any college and higher education were included in the *college/university/postgrad* category. *Urban* areas were classified as having more than 100,000 inhabitants, and included semiurban areas classified as >2,500 to 99,999 inhabitants. *Rural* areas were defined as having <2,500 inhabitants. Household economic status was based on income/wealth quintiles generated using hierarchical ordered profit models based on asset ownership and dwelling characteristics (Ferguson et al., 2003). An index of household wealth was then divided into quintiles within each country with the uppermost quintile indicating the highest economic status.

Fruit and vegetable servings were determined by asking two questions: "How many servings of fruit do you eat on a typical day?" and "How many servings of vegetables do you eat on a typical day?" For each question, the respondents were shown a card with examples of a standard portion of fruits or vegetables, respectively, relevant for typical country diets (WHO, 2009b). To calculate the total servings of fruit and vegetables consumed per day, the fruit and vegetables servings were added together. Then, four categories of consumption were determined: 0–2 servings, 3–4 servings, 5–6 servings and, 7 or more servings. Importantly, the World Health Organization and the Food and Agriculture Organization suggest a minimum intake of 400 g of fruit and vegetables (equivalent to approximately five standard servings) per day, to prevent chronic diseases, and to alleviate micronutrient deficiencies (WHO, 2004b).

Current use of tobacco was assessed by asking two questions: first, "Have you ever smoked tobacco or used smokeless tobacco?"; second, those who answered yes were asked, "Do you currently use (smoke, sniff, or chew) any tobacco products such as cigarettes, cigars, pipes, chewing tobacco, or snuff?" People could answer from three categories: yes, daily; yes, not daily; and no, not currently. From the combinations of these questions, four categories were created: Never, current (daily), current (not-daily), and former (WHO, 2009b).

Alcohol consumption was assessed by asking two questions: "Have you ever consumed a drink that contains alcohol (such as beer, wine, spirits, etc.)?"; and, "In the last 12 months, how frequently (on how many days) on average have you have at least one alcoholic drink?" (WHO, 2009b). After combining these questions, answers

TABLE 1. Body Mass Index (BMI) groupings, by selected demographic characteristics (weighted data) (SAGE Wave 1 2009–2010)

Selected variables	Body mass index group[a]				Total *N*	*P*
	Underweight (%)	Normal weight (%)	Overweight (%)	Obese (%)		
Total population	0.6	21.4	49.4	28.7	2032	–
Sex						
Men	0.5	21.3	56.5	21.7	796	0.08
Women	0.7	21.4	43.2	34.6	1235	
Age group						
50–59	0.4	12.9	54.7	32.0	391	<0.001
60–69	0.5	22.6	46.9	30.1	845	
70–79	0.9	33.3	44.4	21.4	546	
80 plus	1.8	46.1	33.9	18.2	250	
Residence						
Urban	0.5	20.1	48.9	30.6	1465	0.33
Rural	1.1	26.0	51.1	21.8	567	
Socioeconomic status						
1st quintile (lowest)	1.0	29.5	48.3	21.2	437	0.85
2nd quintile	1.2	22.0	48.9	27.9	427	
3rd quintile	0.3	20.6	50.4	28.8	363	
4th quintile	0.5	17.5	47.7	34.3	416	
5th quintile (highest)	0.1	19.0	50.7	30.1	388	
Education level						
Less than primary	0.5	19.0	57.4	23.0	822	0.71
Primary	0.2	20.8	43.6	35.4	430	
Secondary/ high school	1.0	22.6	49.1	27.4	174	
College/ university/ postgrad	0.5	17.2	50.7	31.7	160	
Marital Status						
Single	0.9	33.6	51.1	14.4	174	0.01
Cohabiting/ married	0.3	17.6	51.0	31.0	1221	
Separated/ divorced	3.5	11.9	49.6	34.9	116	
Widowed	0.8	34.6	41.5	23.1	473	

[a]Underweight = < 18.5, normal weight =18.5 to 24.9, overweight =25 to 29.9 and, obese ≥ 30.

were classified into five categories: Never, zero drinks in the last 12 months; less than one drink per month in the last 12 months: one to three drinks per month in the last 12 months; and, 1–7 days a week in the last 12 months. One standard alcoholic drink was defined by using a card in which graphics of different standard drinks were shown to respondents.

Waist circumference has been found to be highly correlated with abdominal tissue which at higher levels is a predictor of an increased risk for cardiovascular disease, diabetes type 2, hypertension, glucose intolerance, reduced insulin sensitivity, and altered lipid profiles (WHO, 2008). Waist circumference in centimeters was "*measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape; the individual should stand with the feet closed together, arms at the side, little clothing, and the measure should be taken at the end of a normal expiration*" (WHO, 2008). The cut offs used to designate higher risk were >94 cm for men, and >80 cm for women (WHO, 2008).

Data analysis

Data were analyzed using SPSS IBM Version 21 and SAS Version 9.3. For the descriptive statistics analysis in SPSS, data were weighted using poststratified individual probability weights based on the selection probability at each stage of selection (Naidoo, 2012). Individual weights were poststratified by sex and age according to the 2009 Mexican population census projections (Naidoo, 2012). Weights sum the total population aged 50 years and older. Associations between categorical variables were tested using a Pearson chi-square analysis in SAS; with the results presented in Tables 1, 2, 3, and 5.

To test the significance of the association between BMI (measured as a continuous variable) and the selected explanatory variable, simple, and multiple linear regression analyses, with unweighted data, were run using an ANOVA test in SAS. As suggested in the literature for surveys' analysis, the rationale for using un-weighted data was to increase precision and to reduce any biases in the estimates (Lumley, 2010). After fitting the base model with simple linear regressions, all variables that were statistically significant with a $P < 0.05$ (physical activity categories, age, gender, residence area, income quintiles, and marital status) were included in the final/explanatory model (multiple linear regression).

RESULTS

Information in Tables 1 and 2 shows the distribution of BMI categories, using weighted data, representative of the Mexican older adults population (≥50 year old). With regard to BMI categories, 0.6% was underweight, 21.4% normal weight, 49.4% overweight, and 28.7%, obese (Table 1).

Notably, those who are 50–59 years old have higher proportions of both overweight (54.7%) and obesity (32.0%) compared with older groups ($P < 0.001$).

Marital status appeared to be significantly related to BMI categories. Those who are separated/ divorced had a higher prevalence of obesity (34.9%) in comparison with other marital status groups; those who are single have the lower rates of obesity (14.4%) ($P = 0.01$).

Sixty-four percent of older men who are overweight and 31.2% who are obese have a waist circumference that put them at higher health risk ($P < 0.001$). Similarly, 47.2% of older women who are overweight and 39.0% who are

TABLE 2. Body Mass Index (BMI) groupings, by selected NCD risk factors among older adults (weighted data) (SAGE Wave 1 2009–2010)

Selected variables	Body mass index group[a]				Total	
	Underweight (%)	Normal weight (%)	Overweight (%)	Obese (%)	*N*	*P*
Fruit and vegetable intake (mean daily servings)						
0 to 2	1.1	27.7	42.4	28.8	760	0.51
3 to 4	0.3	21.2	51.2	27.3	759	
5 to 6	0.2	15.4	55.2	29.3	276	
7 or more	0.6	16.2	45.2	38.1	106	
Physical activity categories						
Low	0.7	23.4	48.4	27.5	384	0.85
Moderate	0.7	23.5	52.0	23.8	427	
High	0.1	20.0	55.9	24.0	647	
Use of tobacco						
Never	0.6	21.5	49.2	28.8	1229	0.70
Current (daily)	0.1	22.4	40.0	37.4	260	
Current (not daily)	1.2	9.9	63.9	25.0	143	
Former	0.8	25.4	49.0	24.8	400	
Drinking pattern (1 drink)						
Never	0.3	19.2	44.8	35.7	512	0.04
Zero drinks in the last 12 months	0.8	26.9	42.1	30.2	629	
Less than 1 drink per month in the last 12 months	0.2	11.3	68.2	20.3	309	
1 to 3 drinks per month in the last 12 months	0.8	19.5	51.5	28.2	110	
1 to 7 drinks a week in the last 12 months	0.0	26.3	67.7	6.0	66	
Waist circumference (men)						
No added risk	1.3	56.9	40.9	0.9	223	<0.0001
At risk (92 cm or more)	0.1	4.7	64.0	31.2	552	
Waist circumference (women)						
No added risk	7.8	87.8	4.1	0.3	119	<0.0001
At risk (80 cm or more)	0.0	13.7	47.2	39.0	1095	

[a]Underweight = < 18.5, normal weight = 18.5 to 24.9, overweight = 25 to 29.9 and, obese ≥ 30.

TABLE 3. Body Mass Index (BMI) groupings, by NCD status among older adults (weighted data) (SAGE Wave 1 2009–2010)

Selected variables	Body mass index group				Total	
	Underweight (%)	Normal weight (%)	Overweight (%)	Obese (%)	*N*	*P*
Angina						
Yes	0.0	44.7	33.3	22.0	87	0.32
No	1.0	25.6	45.2	28.1	878	
Depression						
Yes	1.8	22.9	45.6	29.7	119	0.81
No	0.9	27.8	44.0	27.4	899	
Diabetes						
Yes	2.1	21.3	49.4	27.2	166	0.54
No	0.8	28.2	43.4	27.6	853	
Hypertension						
Yes	0.3	18.1	44.0	37.7	753	0.10
No	0.7	22.4	51.9	25.0	1231	
Stroke						
Yes	0.0	8.1	64.7	27.2	95	0.14
No	0.6	21.7	48.9	28.9	1889	

obese are also at higher health risk based on waist circumference results ($P < 0.001$).

Examining selected noncommunicable diseases risk factors and BMI, those who have <1 drink per month had the higher prevalence of overweight (68.2%) in comparison with other groups; those who never drink had the higher prevalence of obesity (35.7%; $P = 0.04$; Table 2).

Analyzing BMI in relation to self-reported non-communicable diseases it stands that those who have diabetes, hypertension, stroke, and depression have high rates of overweight and obesity (Table 3); however, these findings were not statistically significant. Moreover, there are also high proportions of overweight and obesity among individuals who do not have a noncommunicable disease.

Univariate regression with unweighted data reveals that among older adults, BMI appeared to have a significant independent relationship ($P < 0.05$) with physical activity, age, sex, income quintiles, and marital status (Table 4). In multivariate regression, the final explanatory model suggest that, after adjusting for age-groups, sex, residence area, quintile, and marital status, there is strong evidence for a difference in the mean BMI among the three physical activity groups ($P = 0.0001$; $AR^2 = 0.10$; Table 4). In comparison with the mean BMI (28.3) of the low physical activity group, the moderate physical activity group had a mean BMI (27.6) that is 0.7 points lower (CI = −1.4 to −0.1); the high physical activity group had a mean BMI (27) that is 1.3 points lower (CI= −2.0 to

TABLE 4. Simple and multiple linear regression analyses (unweighted data).

	Simple regression			Multiple regressión		
Explanatory variables	Change in mean BMI (Unadjusted)	CI (95%) (lower; upper)	*P*	Change in mean BMI (Adjusted)	CI (95%) (lower; upper)	*P*
Physical activity						
Low (ref)	29		0.0001	28.30		0.0001
Moderate	−0.8	−1.50; −0.11		−0.72	−1.40; −0.10	
High	−1.32	−2.00; 0.72		−1.32	−2.00; −1.00	
Age groups						
50–59 (ref)	28.85		<0.0001	28.30		<0.0001
60–69	0.06	−0.57; −0.69		0.02	−0.62; 0.66	
70–79	−0.9	−1.55; −0.18		−0.88	−1.61; −0.15	
80+	−2.82	−3.66; −1.99		−2.73	−3.80; −1.66	
Sex						
Women (ref)	29		<0.0001	28.30		<0.0001
Men	−1.81	−2.30; −1.34		−1.95	−2.47; −1.42	
Residence area						
Rural (ref)	27.31		<0.0001	28.3		0.003
Urban	1.4	0.85; 2.00		0.86	0.30; 1.42	
Quintile group						
Quintile 1 (ref) (lowest)	27.2		<0.0001	28.3		0.01
Quintile 2	0.88	0.20; 2.00		0.63	−0.12; 1.38	
Quintile 3	1.24	0.50; 2.00		1.01	0.21; 1.81	
Quintile 4	1.6	1.00; 2.31		1.10	0.32; 1.88	
Quintile 5 (highest)	1.9	1.15; 3.00		1.35	0.57; 2.14	
Marital Status						
Single (ref)	27.04		0.003	28.3		0.002
Married/ cohabitating	1.5	0.64; 2.33		1.65	0.75; 2.54	
Divorced/separated	2.02	0.80; 3.30		1.45	0.11; 2.78	
Widowed	1.2	0.30; 2.11		1.04	−0.05; 2.04	
Fruit and vegetables servings						
0 to 2 (ref)	28.15		0.1			
3 to 4 servings	0.52	−0.02; 1.10				
5 to 6 servings	−0.01	−0.74; 0.73				
7 ≥ servings	0.9	−0.21; 2.00				
Use of tobacco						
Never	28.2		0.1			
Current (daily)	1	0.14; 1.60				
Current (not daily)	0.5	−0.50; 1.40				
Former	−0.23	−1.00; 0.40				
Drinking pattern						
Never	28.1		0.1			
Zero drinks in the last 12 months	0.52	−0.10; 1.14				
Less than 1 drink per month in the last 12 months	0.37	−0.38; 1.11				
1 to 3 drinks per month in the last 12 months	−0.1	−1.20; 0.99				
1 to 7 drinks a week in the last 12 months	−0.96	−2.33; 0.39				

−1.0). In addition, we found that age was associated with lower BMI, with those in the 80+ group had a BMI of 2.8 kg/m^2 lower than those in the 50–59 years group (CI: −3.8 to 1.7); income was associated with higher BMI, with those in the fifth income quintile had a BMI of 1.3 kg/m^2 higher than those in lowest quintile (CI: 0.5 to 2.1), and finally, urban living was associated with higher BMI, with those in urban living had a BMI 0.9 kg/m^2 greater than those in rural living (CI = 0.3 to 1.04). Importantly, following the guides for regression analysis, we ratify that there were not real differences with these results and the results that would be drawn from an analysis with weighted data, yet the present analysis has assured the models' precision (Lumley, 2010).

Furthermore, the final model examined a variety of independent potential interactions with physical activity categories: age, gender, residence area, income quintile, and marital status. None of these interactions were found to be significant.

Finally, Table 5 includes the descriptive and statistical analysis of selected demographic characteristics in relation to physical activity categories. Those who were 50–59 years old (64%), those who were married (59.5%), those who ate 5 to 6 fruit and vegetable servings (69.7%) and men (62.2%) were more likely to engage in high physical activity than other groups ($P < 0.05$). No other percentages were found to be significant.

DISCUSSION

This study found a high prevalence of overweight and obesity among Mexican older adults aged 50 years and older (49.4% overweight and 28.7% obese). It was also found that practicing vigorous intensity physical activity and being 80 years or older were significantly associated ($P < 0.05$) with a lower mean BMI; in contrast, being in the lowest income quintile and living in urban areas were significantly associated with a higher mean BMI.

Among Mexican older adults (50 years and older) 78% were overweight or obese. This is higher than the prevalence of overweight or obesity found in this same age group (67%) in 2006 (Olaiz-Fernández G et al., 2006). Moreover, this study confirms the findings of the ENSANUT 2012 study, which found that 70% of older adults aged 60 years and older were overweight or obese; though

TABLE 5. Physical activity groupings, by selected demographic characteristics (weighted data) (SAGE Wave 1 2009–2010)

Selected variables	Physical activity category			Total	
	Low	Moderate	High	*N*	*P*
Sex					
Men	13.4	24.4	62.2	657	0.03
Women	22.9	34.4	42.6	915	
Age group					
50–59	11.4	24.7	64.0	334	<0.001
60–69	19.6	35.2	45.1	700	
70–79	32.1	33.4	34.5	415	
80-plus	35.0	37.8	27.2	126	
Residence					
Urban	18.3	27.9	54.0	1129	0.93
Rural	18.2	30.0	51.7	446	
Socioeconomic status					
1st quintile (lowest)	24.3	30.1	45.5	336	0.64
2nd quintile	18.0	37.0	45.0	341	
3rd quintile	12.8	25.5	61.7	276	
4th quintile	22.2	22.5	55.4	315	
5th quintile (highest)	16.6	28.9	54.4	303	
Education level					
Less than primary	16.3	30.8	52.9	638	0.89
Primary	15.6	23.7	60.6	355	
Secondary/ high school	16.4	30.3	53.3	149	
College/ university/ postgrad	22.7	33.8	43.4	133	
Marital Status					
Single	34.5	37.7	27.8	136	<0.01
Cohabiting/married	14.4	26.1	59.5	1012	
Separated/divorced	20.1	43.1	36.7	89	
Widowed	29.9	40.1	30.0	338	
Fruit and vegetable intake (mean daily servings)					
0 to 2	28.4	32.7	38.9	255	0.02
3 to 4	15.6	32.4	52.0	260	
5 to 6	9.8	20.6	69.7	116	
7 or more	24.8	45.3	28.9	36	

the ENSANUT study did not include those 50–59 years old.

In addition, this study found that among those age 50–59 years, 87% were overweight or obese, compared with the 2006 study, where 80% were overweight or obese (Barquera et al., 2006; Olaiz-Fernández et al., 2006). It was also found that the prevalence of overweight or obesity decreased with each increase in age group; those aged 80 or older have an overweight/obesity prevalence of 52% compared with those in the 50–59 years old category (87%).

Overweight and obesity have different consequences for older adults. They have been found to be significantly associated with reduced quality of life related to mental and physical aspects of everyday life (Hollander et al., 2013). As well, obesity in older populations increases the risk of disability mainly due to an increased sedentary life, morbidity, and difficulty in movements (Gerst et al., 2012). Similarly, a study in older Mexicans aged 65–74 in rural areas showed that obesity was an important predictor of disability in basic activities of daily life (Manrique-Espinoza et al., 2014). In contrast, overweight has been associated with a lower risk of all-cause mortality in the 65 years and older, whereas obesity (especially with a BMI $\geq$35) is associated with a 10% increased risk of mortality (Flegal et al., 2013). Even though overweight appears to have less risk of mortality, considering quality of life in these older adults, with regard to mental and physical function, is the most important thing when interpreting results.

The 50–59 year old age group appeared to have more individuals with overweight/obesity; three main reasons may explain this. First, various studies with large populations from the United States and Sweden have shown that BMI has its peak values at this same age period; as well after 60 years old BMI tends to go down (Villareal et al., 2005). Second, a Chinese study suggested that people in this same age group, may have sedentary jobs than older groups who are already retired, implying that they are more likely to be overweight/obese (Du et al., 2013). Finally, survival bias may have affected these studies; in fact, premature mortality of middle aged overweight/obese adults decreases BMI and mean body weight in those older adults who survive (Villareal et al., 2005).

In this study, obesity was more prevalent in urban areas and among the richest quintiles. These findings are consistent with the nutrition transition that is occurring in most developing countries, which is characterized by increasing westernization, urbanization, and sedentary lifestyles (Swinburn et al., 2004; WHO, 2006). Besides this, in some developing countries like Nigeria and Brazil being overweight among the lowest quintiles is considered a sign of health, wealth, and beauty, especially among women (Brown and Konner, 1987; Stunkard, 2000). As a consequence of these complex interactions, when urban living and income rise, traditional food is replaced with diets high in processed foods, saturated fat, soft drinks, sugar, and sodium; which in turn are important determinants for obesity development (Swinburn et al., 2004; WHO, 2006).

In relation to selected risk factors, though not significant, obesity was greater in those who consume more servings of fruit and vegetables and in those who practice more physical activity. From the present cross section it is

impossible to know if these risk factors came before obesity or vice versa. In the first case, because they are obese, there is the possibility that they started to eat more fruit and vegetables as a possible nutritional treatment. Or, as they are obese they tend to eat more of every food group, including fruit and vegetables. However, the ENSANUT 2006 (National Health and Nutrition Survey) in Mexico showed that an adequate consumption of fruit and vegetables (400 g) among adults 19–59 years old increases with income quintiles (Olaiz-Fernández G, 2006). This was also tested in this study; however, the distribution of fruit and vegetable consumption among income quintiles was not significant (>0.05) among categories and therefore not included in the results section.

A considerable proportion of Mexican older adults were found to be overweight or obese, and have a waist circumference, which puts them at risk of cardiovascular disease (Men: 79.2% and women: 78.6%; $P < 0.001$). Because waist circumference is correlated with high levels of visceral fat, this measurement is used to predict cardiovascular disease, and in combination with other risk factors, the absence/presence of the metabolic syndrome (WHO, 2008). This finding adds support to other studies that found that BMI is highly correlated with visceral fat (Flegal et al., 2009). Although it is necessary to document the proportion of older adults at risk, further international agreement is needed for determining the applicability of the waist circumference cut-off values for specific populations such as older adults, and especially, non-European ethnic groups (WHO, 2008).

The multivariate regression showed a lower BMI for those who have moderate/high physical activity levels. This association has been found in other cohort studies, where physical activity was associated with a 0.15 points lower BMI (Du et al., 2013). Although the reduction is small, the results found in the present study suggest that promoting physical activity among older adults could be a good strategy to reduce morbidity and disabilities due to overweight/ obesity. Importantly, physical activity among older adults has been found to be protective against loss of functioning (related to bathing, toileting, transferring into/out of bed, walking, and eating) in both the United States and Mexico (Gerst et al., 2011; Manrique-Espinoza et al., 2014). However, this protection appeared to be weaker in Mexico. Taking into account this characteristic in Mexico, future research could explore the different options toward physical activity in this group.

Importantly, current WHO recommendations about physical activity suggest maintenance of a healthy life through regular physical activity of at least 30 min five days a week. Nevertheless, these recommendations are applied only to the general population and not to older adults specifically (WHO, 2006). Therefore, a better approach to tackle the unhealthy excess body fat in older adults could be to improve physical function by increasing fat free mass and bone density (Villareal et al., 2005). In addition, taking into account the special characteristics that older adults may have (augmented morbidity, cognitive dysfunction, dependency on others, widowhood, loneliness, among others), physical activity goals in this group should include components that increase flexibility, endurance, and strength (Villareal et al., 2005). Besides improving the quality of life and achieving a healthier weight, this approach can also minimize muscle and bone loss among older adults.

LIMITATIONS

There is considerable scientific debate about the use of BMI in older adults; in fact, some institutions suggest the adjustment of BMI classifications in adults 65 years and older (Queensland Government, 2011). In order to facilitate comparisons between reports and to follow current WHO recommendations, this study used the usual BMI categories (with no further grading of obesity).

As well, this work did not take into account the ethnic differences existing in the Mexico populations because relevant data were not collected. The WHO, however, maintains that the current BMI cut-offs are not significantly different among ethnic groups, and, if required, countries must follow specific guidelines to determine specific risks (WHO, 2004a). Therefore, adding this variable in the analysis may not change the results substantially.

Additionally, the use of self-reported physical activity is likely to include some degree of recall bias (Webb et al, 2011). Individuals who are overweight or obese might be inclined to overestimate the time and type of activities they undertake because of the stigma associated with excess body fat. However, the approach used to assess physical activity in SAGE Mexico has shown high levels of accuracy in other studies, including physical activity determination, fruit, and vegetable consumption, among others (Meenakshi et al., 2012).

Finally, 12% of older adults participating in this study did not have height and weight data, consequently they did not have their BMI computed. Not having this information may have affected the distribution of BMI categories among the different subgroups of older adults. Indeed, those with missing data could be the unhealthiest, leading to lower overweight/obesity prevalence estimates. Nevertheless, the present study confirms what other studies have noted about overweight and obesity prevalence estimates in Mexican older adults (Shamah-Levy et al., 2013).

CONCLUSIONS

Mexican authorities are increasingly aware of the significant burden and increased rates of overweight and obesity among the general population. It has been estimated that the monetary cost of obesity in the country in 1998 was 3.6 million USD, which represented 30% of the public health expenditure and 10% of the national health expenditures (Barquera et al., 2006). In addition, the Mexican National Agreement for Healthy Nutrition proposed by the federal government and key stakeholders "have proposed among its aims for 2012: a reversal in the prevalence of overweight and obesity for children aged 2–5 years, to stop the increasing prevalence in this condition for school children and adolescents, and to slow down the increasing prevalence of overweight and obesity in adults" (Barquera et al., 2006).

There is no doubt that these efforts will contribute to the overall improvement of the overweight/obesity epidemic in Mexico. These are complex conditions that have to be prevented and controlled from a life cycle perspective, and, more importantly, in the first 1000 days after conception (including the mother and the baby) and in vulnerable groups, such as older adults (Black et al., 2013). Indeed, this study contributes to the current understanding of obesity etiology in Mexico, and confirms that

overweight and obesity are current public health problems that must be addressed in nonactive older adults, in older adults living in urban areas, and in older adults from the highest income quintiles.

Moreover, this study also provides substantial evidence that secondary and tertiary attention should be given to older adults. One type of intervention that has already proved successful in a rural Mexican community created a group of more than 30 older adults trained to help disseminate information about healthy aging, sexuality, chronic diseases, and physical activity to more than 600 older adults in their community (Martínez-Maldonado et al., 2007). Participants reported increased feelings of empowerment, creativity and self-esteem; all important components of a better quality of life. Interventions like this one could be implemented at a national level and among the most vulnerable groups.

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