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The effect of obesity on incidence of disability and mortality in Mexicans aged 50 years and older

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Abstract

Objective. To examine the effect of obesity on incidence of disability and mortality among non-disabled older Mexicans at baseline. **Materials and methods.** The sample included 8 415 Mexicans aged ≥ 50 years from the Mexican Health and Aging Study (2001-2012), who reported no limitations in activities of daily living (ADLs) at baseline and have complete data on all covariates. Sociodemographics, smoking status, comorbidities, ADL activities, and body mass index (BMI) were collected. **Results.** The lowest hazard ratio (HR) for disability was at BMI of 25 to < 30 (HR = 0.97; 95% confidence interval [CI], 0.85-1.12). The lowest HR for mortality were seen among participants with BMIs 25 to < 30 (HR = 0.85; 95%CI, 075-0.97), 30 to < 35 (HR = 0.86; 95 %CI, 0.72-1.02), and ≥ 35 (HR = 0.92; 95 %CI, 0.70-1.22). **Conclusion.** Mexican older adults with a BMI of 25 to < 30 were at less risk for both disability and mortality.

Key words: adults; obesity; BMI; disability; mortality

Kumar A, Karmarkar AM, Tan A, Graham JE, Arcari CM, Ottenbacher KJ, Snih SA. El efecto de la obesidad sobre la incidencia de discapacidad y mortalidad en adultos mexicanos mayores de 50 años. Salud Publica Mex 2015;57 supl 1:S31-S38.

Resumen

Objetivo. Examinar el efecto de la obesidad sobre la incidencia de discapacidad y mortalidad en adultos mayores mexicanos sin discapacidad al inicio del estudio. **Material y métodos.** La muestra incluyó 8 415 Mexicanos ≥ 50 años de edad del Estudio Nacional de Salud y Envejecimiento en México (2001-2012), quienes no reportaron discapacidad en las actividades de la vida diaria en la encuesta basal y tenían información completa de todas las covariables. **Resultados.** La razón de riesgo más baja (HR) para discapacidad se observó con un IMC de 25 a < 30 (HR=0.97; 95%CI, 0.85-1.12). La razón de riesgo más baja para mortalidad se observó con IMC de 25 a < 30 (HR = 0.85; 95%CI, 075-0.97), de 30 a < 35 (HR = 0.86; 95%CI, 0.72-1.02), y ≥ 35 (HR = 0.92; 95%CI, 0.70-1.22). **Conclusión.** Los adultos mayores mexicanos con un IMC de 25 a < 30 tuvieron menor riesgo de discapacidad y mortalidad.

Palabras clave: adultos; obesidad; índice de masa corporal; discapacidad; mortalidad

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The number of older adults is increasing substantially, especially in developing countries, including Mexico.[1] Over the last few years, Mexico has undergone an unprecedented demographic change, with a rapidly aging population, due to a declining birthrate and improved life expectancy. According to the Mexican National Population Council, the number of older persons aged 65 years and over is expected to be 25.9 million by the year 2050.[2] Obesity (usually assessed by body mass index [BMI], calculated as weight in kilograms divided by height in meters squared[3]) is a concern for public health officials and policy makers. Numerous studies have documented an increase in the prevalence of obesity worldwide, a trend described as an "epidemic". The prevalence of obesity in Mexico surpassed other countries.[4] The National Health Survey 2000 of Mexico reported that 39% of older adults were overweight and 26% were obese.[5] The growing prevalence of obesity will lead to an increase of obesity-related chronic diseases.[5,6]

The effect of obesity on disability and mortality in older adults has been studied extensively in western countries, including the United States and Europe.[7-12] Studies have shown an obesity-associated increased risk of mortality[13,14] although others reported a decreased risk of mortality with increasing levels of BMI.[10,15,16] For example, Calle and colleagues examined the effect of BMI on mortality in the US adult population and found lower risk of all-cause mortality with BMI between 23.5 to 24.9 in men and 22.0 to 23.4 in women. However, the risk associated with a higher BMI diminished after age 75.[17] Examining the effect of obesity on both disability and mortality, Al Snih and colleagues found a decreased risk of mortality with BMIs between 25 and < 35 and higher risk of disability with BMIs < 18.5 or ≥ 30 in American older adults.[12] Findings from the Rotterdam cohort study showed that BMI was associated with higher incidence of disability and diminished effect on mortality for BMIs ranging 25-35.[18] Findings from the Health and Retirement Study (HRS) showed that the risk of falls and disability was higher in older adults with BMIs of 30.0-39.9.[19]

Few studies have examined the relationship between obesity, disability, and mortality in Mexican older adults.[20-22] Findings from the Health, Well-Being and Aging in Latin America and the Caribbean Study (SABE) found greater disability among older adults with BMIs of 25-34.9.[22] However, Monteverde and colleagues compared the risk of mortality associated with obesity in both US and Mexican older adults and found higher mortality risk among Mexicans with BMIs > 27.3.[21] The effects of BMI on disability and mortality have been examined in the US population and other countries but little is known regarding Mexican older adults.[12,16,17] The objective of this study was to examine the effect of obesity on disability and mortality over 11 years of follow-up among Mexicans aged 50 years and older non-disabled at baseline.

Materials and methods

Sample

Participants were from the Mexican Health and Aging Study (MHAS), which started in 2001. The MHAS is a national representative sample of Mexicans aged 50 years and older (born prior to 1951). The goal of this study is to examine the aging processes, and its impact on disease and disability burden in a large representative sample of older Mexicans. Respondents were randomly selected from households with at least one individual aged 50 or older and their spouse/partner regardless of their age. The MHAS sample is representative of both rural and urban areas, and states with high migration to the US were oversampled.[23] In 2001, self or proxy interviews were conducted with 15 146 selected persons and spouse/partner, for a response rate of 93%. Of these, a random sub-sample of 2 573 completed anthropometric measures (height, weight, waist circumference, hip circumference, knee height, and calf circumference). Two follow-ups were conducted in 2003 and 2012.[24] A direct interview was conducted when possible, and proxy interviews were obtained when participants were in poor health or temporarily absent. Information on sociodemographics, health service utilization, comorbidities, functional limitations, cognitive function, depressive symptoms, anthropometric measures, work history, and family background were collected at each interview. The MHAS study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, the Instituto Nacional de Estadistica y Geografía (INEGI) and the Instituto Nacional de Salud Pública (INSP) in Mexico. The present study includes participants who reported no limitations in activities of daily living (ADL) at baseline (2001), were interviewed in person, and had complete data on BMI and other covariates. Of the 14 142 participants interviewed in person, 1 459 reported one or more ADL limitations, 2 640 had missing information on BMI, and 1 628 had missing information on covariates. The final sample is 8 415. At end of follow-up (2012), 4 854 participants were re-interviewed in person, 2 325 were lost to follow-up, and 1 236 were confirmed dead through relatives reports. Excluded participants (n=5 727) were significantly more likely than included participants to be older, female, married, have a lower level of education, never smoked, have low BMI, and report more arthritis, hypertension, heart attack, stroke, diabetes, falls, and fractures.

Measurement

Sociodemographic variables included age, gender, years of formal education, and marital status (married vs. unmarried). Smoking status was determined by asking participants if they were current smokers, former smokers, or never smokers. Comorbidities were recorded by asking participants if they have ever been diagnosed by a physician for the following medical conditions: hypertension, diabetes, heart attack, stroke, arthritis, falls, fracture, and cancer. Self-reported height and weight measures were used to calculate the BMI. When self-reported height and weight were missing, actual height and weight measurements from the subsample were used (n = 591). The correlation between self-reported and actual measurements of BMI for the MHAS sample and subsample was 0.79. BMI was grouped according to the National Heart Lung and Blood Institute obesity standards into underweight (< 18.5 kg/m^2), normal weight (18.5 to < 25 kg/m^2), overweight (25 < 30 kg/m^2), obesity type I (30 to < 35), and obesity type II or morbid obesity (≥ 35).[3] Disability was measured using the Katz index of independence in ADLs. Participants were asked about any difficulty or assistance needed in performing the following: walking across a small room, bathing, dressing, eating, getting in and out of bed, and using the toilet. Disability was dichotomized as having difficulty or no difficulty in performing one or more of the six ADLs.

Statistical analysis

Chi-square and Anova tests were used to examine the distribution of covariates for participants by status at the end of the 11-year follow-up period. Cox proportional hazard regression analysis was used to estimate the hazard ratio (HR) of incidence of ADL disability and the HR of mortality as a function of BMI category at baseline, controlling for all covariates. Participants who died or were lost to follow-up were censored at the date of last follow-up (last interview data for the 11-years of follow-up). BMI was also analyzed as a continuous variable in terms of disability and mortality using Martingale residuals from Cox proportional hazard models adjusted for all covariates. A J-shaped or U-shaped association between BMI and disability or mortality was found when we applied weighted scatterplot smooth method to the Martingale residuals.[25] The location knot (inflection point) on the curves was estimated by non-linear least squares regression analysis and used to fit piecewise Cox proportional hazards models to estimate the HR from BMIs of 15 to 40. Three models assessed the effect of BMI on disability and mortality. Model 1 was adjusted for sociodemographic characteristics and baseline comorbidities, Model 2 was not adjusted for baseline comorbidities, and Model 3 excluded current smokers and those who died during the first five years of follow-up and was adjusted for baseline comorbidities. All analyses were performed using SAS 9.3 (SAS Institute, Cary, NC).

Results

Table I shows the baseline characteristics of the sample by status at the end of the 11-year follow-up. Of 8 415 total participants, 3 043 (36.2%) remained non-disabled during follow-up, 1 305 (15.5%) became ADL disabled (including those who became disabled before they died), 1 067 (12.7%) died, and 3 000 (35.6%) were lost to follow-up. Participants who became ADL disabled and died during the follow-up were significantly more likely to be older, have lower levels of education, be underweight and report more comorbid conditions than those without disability or who were lost to follow-up. Also, participants who became disabled were significantly more likely than other groups to be female and have a BMI ≥ 30.

Table II presents the results of Cox proportional hazard models for disability and mortality as a function of baseline BMI category, controlling for age, gender, marital status, level of formal education, smoking status, and comorbidities. Compared to normal weight, the HR of becoming ADL disabled were higher for those with BMI < 18.5 or ≥ 30. Compared to normal weight, those with BMI < 18.5 had the highest HR for mortality and those with BMI 25 < 30 had the lowest.

Figures 1 and 2 show the HR for disability and mortality using BMI as a continuous variable. For each outcome, three models are presented. Model 1 was adjusted for sociodemographic characteristics and baseline comorbidity, Model 2 was not adjusted for baseline comorbidity, and Model 3 excluded current smokers and those who died during the first five years of follow-up, and was adjusted for baseline comorbidity. The BMIs associated with the lowest HR of becoming ADL disabled was 26.0 (95% CI: 24.2, 27.7) in Model 1, 25.8 (95% CI: 24.2, 27.4) in Model 2, and 26.9 (95% CI: 24.9, 29.0) in Model 3, with a fairly steep increase in the hazard for disability with lower and higher BMIs. The BMIs associated with the lowest HR of mortality was 25.4 (95% CI: 23.1, 27.7) in Model 1; 25.3 (95% CI: 23.1, 27.6) in Model 2; and 24.9 (95% CI: 22.2, 27.6) in Model 3, with a fairly steep increase in the hazard for mortality

Table I

Baseline characteristics by status at the end of the 11-year follow-up period (N=8 415)

Variable	Nondisabled N (%)	Disabled N (%)	Dead N (%)	Lost to follow-up N (%)	P value
Total	3 043(36.2)	1 305(15.5)	1 067(12.7)	3 000(35.6)	
Age, mean (SD)	56.3(8.3)	61.5(9.8)	66.0(10.2)	58.2(10.4)	< 0.0001
Female	1 698(55.8)	791(60.6)	447(41.8)	1 609(53.6)	< 0.0001
Education (years)	5.8(4.6)	3.9(4.6)	4.2(4.2)	6.2(6.1)	< 0.0001
Married	2 149(70.6)	851(65.2)	624(58.4)	1 962(65.4)	< 0.0001
Smoking status					
Never	1 727(56.7)	753(57.7)	489(45.8)	1 659(55.2)	
Former	768(25.2)	366(28.0)	352(32.9)	730(24.3)	< 0.0001
Current	548(18.0)	186(14.2)	226(21.1)	614(20.4)	
Body mass index (BMI) category					
Underweight (<18. 5)	45(1.48)	41(3.1)	47(4.4)	58(1.9)	
Normal (18.5 to <25)	929(30.5)	356(27.2)	392(36.7)	975(32.5)	
Overweight (25 to <30)	1 344(44.1)	478(36.6)	424(39.7)	1 307(43.5)	< 0.0001
Obese type I (30 to <35)	559(18.3)	287(21.9)	152(14.2)	500(16.6)	
Obesity type II or morbid obese (≥35)	166(5.4)	143(10.9)	52(4.8)	160(5.3)	
BMI (kg/m^2) mean (SD)	27.2(4.9)	28.0(5.9)	26.3(5.3)	26.9(4.9)	< 0.0001
Comorbidities					
Arthritis	417(13.7)	359(27.5)	203(19.0)	442(14.7)	< 0.0001
Diabetes	282(9.2)	257(19.6)	278(26.0)	375(12.5)	< 0.0001
Hypertension	917(30.1)	578(44.2)	435(40.7)	941(31.3)	< 0.0001
Stroke	26(0.8)	35(2.6)	32(3.0)	47(1.5)	< 0.0001
Heart attack	57(1.8)	43(3.3)	59(5.5)	74(2.4)	< 0.0001
Cancer	35(1.1)	33(2.5)	25(2.3)	53(1.7)	0.004
Fracture	286(9.4)	173(13.2)	141(13.2)	270(9.0)	< 0.0001
Falls	907(29.8)	509(39.0)	385(36.0)	914(30.4)	< 0.0001

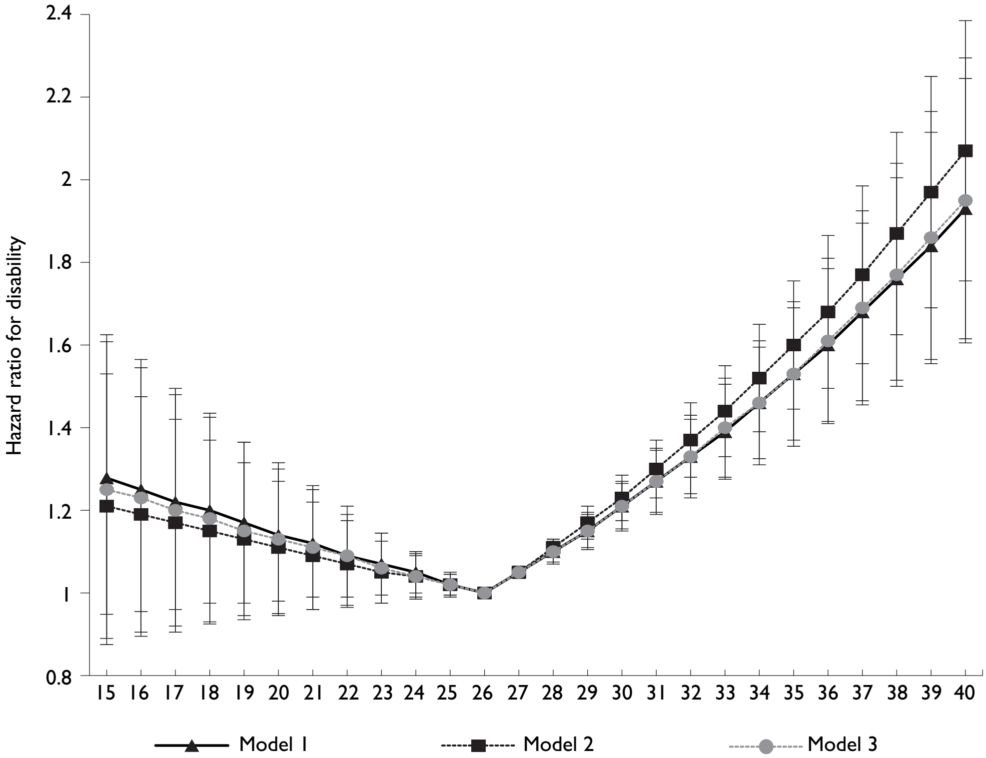
Data was collected in Mexico in year 2001, 2003, and 2012
SD=Standard Deviation
BMI=body mass index

Table II

Cox proportional hazards models predicting the hazard ratios (HRs) of ADL disability and mortality as a function of BMI among non-disabled Mexican older adults at baseline during the 11 year follow-up period

BMI category	ADL disability			Mortality	
	No. of subjects (N=8 415)	No. (%) of subjects (N=1 305)	HR (95% Confidence Interval [CI])	No. (%) of subject (N=1 236)	HR (95%CI)
Underweight (<18.5)	191	41(3.14)	1.58(1.14-2.18)	59(4.77)	1.31(1.00-1.72)
Normal (18.5 to <25)	2 652	356(27.28)	1.00 (reference)	455(4.77)	1.00 (reference)
Overweight (25 to <30)	3 553	478(36.63)	0.97(0.85-1.12)	483(39.08)	0.85(0.75-0.97)
Obese type I (30 to <35)	1 498	287(21.99)	1.31(1.12-1.54)	178(14.40)	0.86(0.72-1.02)
Type II or morbid obese (≥35)	521	143(10.9)	1.87(1.56-2.29)	61(4.94)	0.92(0.70-1.22)

Data was collected in Mexico in year 2001, 2003, and 2012
ADL=Activities of daily living
BMI=body mass index



Data was collected in Mexico in year 2001, 2003, and 2012
ADL=Activities of daily living
BMI=body mass index

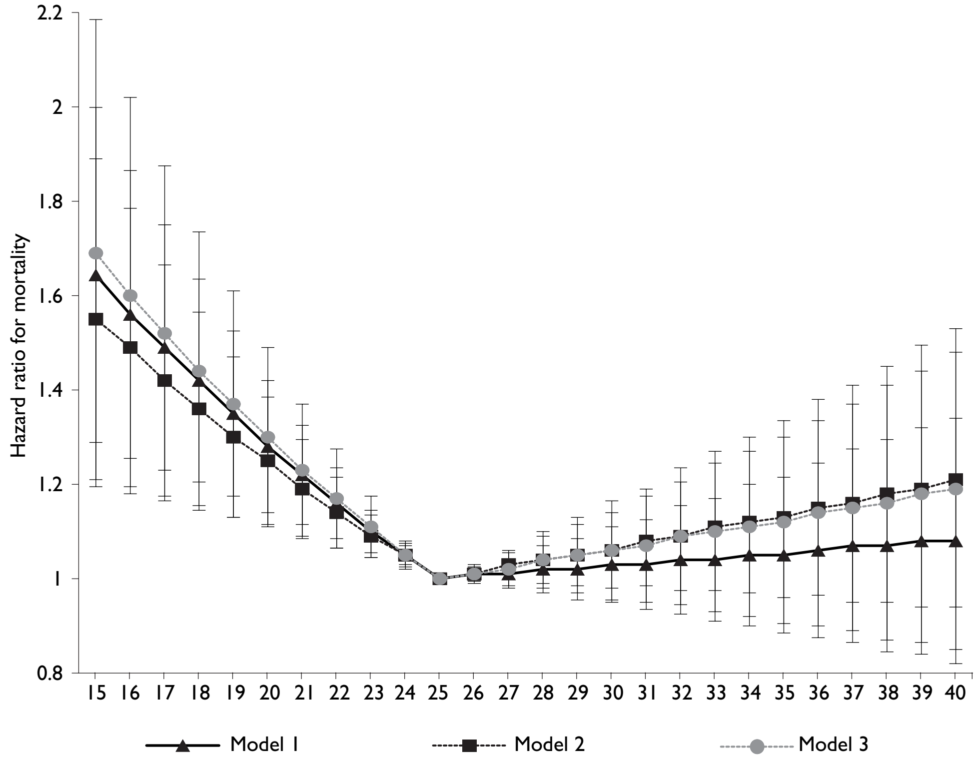
Figure 1. Hazard ratios predicting ADL disability during 11-year of follow-up as a function of BMI among non-disabled Mexicans older adults at baseline. Model 1 was adjusted for socio-demographic characteristics and baseline comorbidities. Model 2 was not adjusted for baseline comorbidities. Model 3 excluded current smokers and those who died during the first 5 years of follow-up, and was adjusted for baseline comorbidities. Values are hazard ratios (95% confidence interval)

with lower BMIs and a more gradual increase in the hazard with higher BMIs. The inflection estimate points were not statistically different across the three models for either disability or mortality.

Discussion

This study examined the effect of obesity on disability and mortality among Mexican older adults who were non-disabled at the baseline. The relationship between BMI and ADL disability was mostly U-shaped. The higher HR of becoming ADL disabled was seen in the underweight, obese, and morbid obese categories compared with normal weight, while those in the overweight category had the lowest HR of becoming ADL disabled. The relationship between BMI and mortality was mostly an inverted J-shape. Participants in the overweight category showed a lower HR of mortality compared with normal weight. Those with BMIs ≥ 30 had an increased HR of mortality, but the increase was not statistically significant.

Our results are consistent with the previous studies demonstrating a protective effect of being overweight on disability and mortality.[12,14] The association between obesity (type I and type II) and disability can be explained by the following assumptions: a) obesity is a risk factor for chronic conditions such as cardiovascular diseases, stroke, diabetes, arthritis, and other degenerative diseases, which in due course increases the risk of disability;[19,26,27] and b) the decrease in lean mass and increase in fat mass associated with aging, a phenomenon called “sarcopenic-obesity” has been associated



Data was collected in Mexico in year 2001, 2003, and 2012
BMI=body mass index

Figure 2. Hazard ratios predicting mortality during 11-year of follow-up as a function of BMI among non-disabled Mexicans older adults at baseline. Model 1 was adjusted for socio-demographic characteristics and baseline comorbidities. Model 2 was not adjusted for baseline comorbidities. Model 3 excluded current smokers and those who died during the first 5 years of follow-up, and was adjusted for baseline comorbidities. Values are hazard ratios (95% confidence interval)

with diminished functional performance which leads to disability.[28,29]

Perhaps the most interesting finding was the weak association between obesity (type I and type II) and mortality, particularly in the morbid obesity group. There are three plausible explanations for this observation. First is survival bias, wherein only healthy obese individuals were alive and able to participate in the study. However, we partially addressed this concern by adjusting for comorbidity, excluding current smokers, and participants who died during the first five years of follow-up (figure 2). Second, while 11 years is a reasonable follow-up period for a longitudinal study, it may not be sufficient to evaluate mortality risk in our relatively young sample (mean age, 59 years at baseline). Lastly, participants with higher BMI are more likely to have chronic diseases and receive more medical attention which helps them survive longer.

This study has some limitations. First, we used self-reported heights and weights to compute BMI, which may underestimate the effect on disability and mortality. However, studies have shown good validity of self-reported height and weight in the Mexican population.[30] We used self-reported comorbidities in all the analytical models. However, there has been good agreement reported between self-reported comorbidities and medical chart reviews.[31] Third, we did not include physical activity in our analysis. Studies have found physical activity levels associated with disability and mortality.[32,33] Fourth, we did not analyze the waist circumference measurement, since this information was collected only in the subsample. Conflicting evidence exists in the literature regarding the most appropriate and sensitive measure of body mass and obesity in older adults.[22] Some studies have suggested that using waist circumference may be a better measure of obesity in older adults for predicting disability and mortality.[8,9,22] We selected BMI to assess obesity because it was the most commonly used measure in prior studies examining older adults.[12,14,17] Future research is needed to investigate the most appropriate anthropometric measure to use in this population.

This study also has several strengths, including its large, well-defined representative sample of Mexican older adults, the prospective design, and the 11-year follow-up period. To our knowledge, this is the first study to explore the long-term effect of obesity on disability and mortality in a large sample of non-disabled Mexican older adults.

Prevalence of obesity is increasing in Latin America, including Mexico. The current increasing rate of obesity in Mexico will produce more obesity-related comorbidities associated with an increased risk of disability. Disability not only affects the independence of older adults, but also increases the burden on family members, caregivers, and society. Traditionally, normal weight is recommended in younger populations. However, our study results –consistent with previous studies– suggest that being overweight was not detrimental in Mexican older adults. BMIs between 25 and 26 were associated with minimal hazard of disability and mortality in Mexican older adults. The Mexican government launched the universal health care *Seguro Popular* program during the study period (2004) providing health care to 50 million previously-uninsured Mexicans.[34] Our study suggests emphasis on obesity prevention programs for the Mexican population. BMI cut-off values in older adults should be applied cautiously in clinical settings. The findings from our study have considerable public health importance in the development of obesity management programs for the older Mexican population.

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Declaration of conflict of interests. The authors declare that they have no conflict of interests.

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