Social determinants for overweight and obesity in a highly marginalized population from Comitán, Chiapas, Mexico

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Abstract

Objective. We assessed the prevalence of overweight and obesity and its association with some social determinants in a highly marginalized population in Mexico. **Materials and methods.** Cross-sectional study conducted in Comitán, Chiapas, from 2010 to 2012, comprising 1 858 subjects aged ≥20 years. We evaluated proximal, intermediate, and structural social determinants. **Results.** The prevalence of overweight and obesity was 37.9 and 16.5%, respectively. The probability of overweight and obesity was higher in participants with ≥primary school, self-reported non-indigenous origin, and medium level of marginalization compared with those with <primary school, self-reported indigenous origin, and high/very high level of marginalization. **Conclusion.** The probability of overweight and obesity was higher in population with more favorable social conditions, which may be partially explained by changes in the traditional lifestyle with greater access to high energy foods and physical inactivity.

Keywords: prevalence; overweight; obesity; social determinants

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Resumen

Objetivo. Estimar la prevalencia de sobrepeso y obesidad y su asociación con determinantes sociales en población con alto grado de marginación. **Material y métodos.** Estudio transversal realizado en Comitán, Chiapas, de 2010 a 2012, que incluyó 1 858 sujetos ≥20 años de edad. Se evaluaron determinantes sociales proximales, intermedios y estructurales. **Resultados.** La prevalencia de sobrepeso y obesidad fue de 37.9 y 16.5%, respectivamente. La probabilidad de sobrepeso y obesidad fue mayor en sujetos con escolaridad ≥primaria, en sujetos que se autodefinieron como no indígenas y en sujetos con un grado de marginación medio comparado con individuos con escolaridad <primaria, con autodefinirse como indígena y tener un grado de marginación alto/muy alto. **Conclusión.** La probabilidad de sobrepeso y obesidad fue mayor en población con condiciones sociales más favorables, parcialmente explicada por cambios en el estilo de vida con mayor acceso a alimentos con alta energía e inactividad física.

Palabras clave: prevalencia; sobrepeso; obesidad; determinantes sociales

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According to estimations of the World Health Organization (WHO), in 2016 there were worldwide more than 1 900 million adults aged over 18 years with overweight and obesity (O/O), 650 million corresponding to obesity. It is estimated that by the year 2030, 40% of the world population will be overweight and 20%, obese.[1] Globally, Mexico is ranked as the second country with the largest number of people with O/O, behind the United States of America. Mexico's 2012 National Survey of Health and Nutrition (Ensanut 2012) found that 71.2% of the adult population had O/O; the prevalence was higher in upper (73.5%) compared with lower socioeconomic strata (65.7%) and in urban (72.9%) than in rural areas (65.6%).[2]

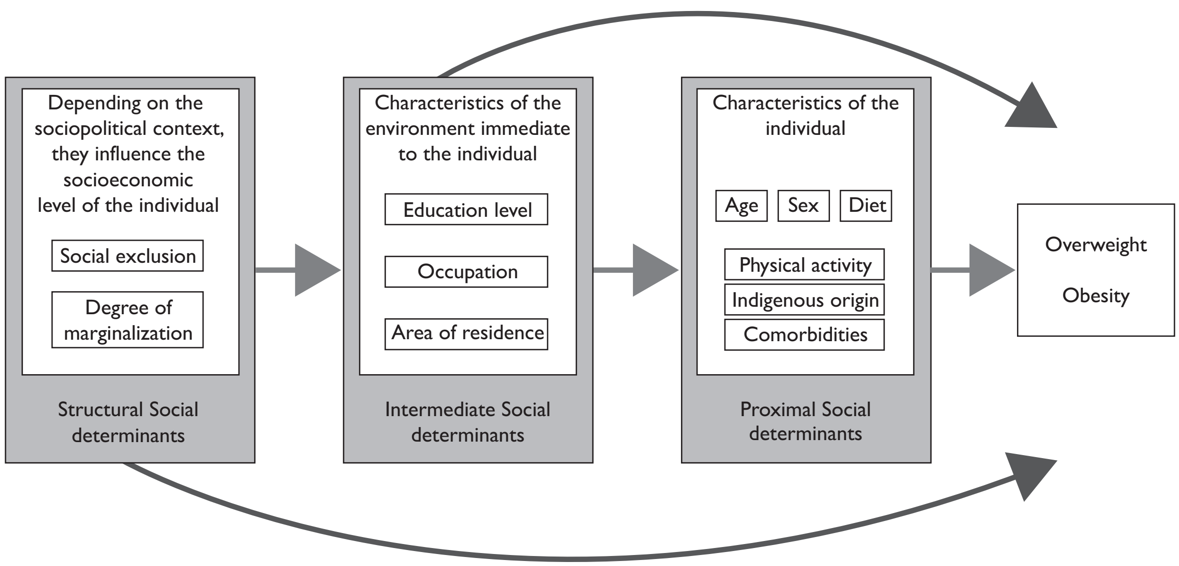
The higher prevalence of O/O is the result of environmental and social transformations related to poor supportive policies in public sectors such as health, agriculture, transport, and education, as well as of factors such as food access,[3,4] inequalities of gender and of social, educational, and economic support networks, employment, and access to health services.[5,6] Marmot defines social determinants as the conditions in which the population develops, those conditions being the product of the political and economic context of each region (figure 1).[7] Through these determinants it is possible to examine the unfair distribution of social goods and how avoidable inequalities manifest themselves in the health status.[5]

The State of Chiapas is among the four poorest states in Mexico and is the second state with the highest proportion of indigenous population. Although the prevalence of O/O in Chiapas is lower than that in wealthier states, the prevalence of overweight increased from 39.8% in 2006 to 41% in 2012 in urban areas, whereas it increased from 37.4 to 39.5% in rural areas.[8] Changes on obesity prevalence were less evident, but it seems that this population has a similar trend than populations with better social conditions, so we need specific strategies for them. This study aimed to assess the prevalence of O/O and its association with proximal, intermediate, and structural social determinants in population from the Municipality of Comitán de Domínguez, in the State of Chiapas, Mexico. We hypothesized that more favorable social conditions predispose to higher probability of overweight and obesity.

Materials and methods

Study design and subjects

A population-based, cross-sectional study was conducted in the municipality of Comitán de Domínguez, Chiapas, from June 2010 to June 2012. A census track of three urban (Jerusalem, El Cedro and Cerrito de Concepción) and five rural areas (Santa Rosalía, Zaragoza de la Montaña, San



Source: reference 7

Figure 1. Scheme of social determinants for overweight and obesity

José, La Floresta and Yalumá) chosen by random and convenience sampling, respectively, was performed. All eligible indigenous (IND) persons from the rural areas were invited to participate, whereas non-indigenous (NIND) persons were chosen randomly (N=2 500). People were considered of IND origin either by self-report or the speaking of an IND language. Of 1 940 potential participants (response rate 77.6%), 1 858 individuals aged >20 years (885 from IND origin, mainly from the Tzeltal and Tojolabal ethnic groups, and 973 from NIND origin) had complete anthropometric measurements. All eligible individuals were visited at their homes and invited to participate in the study. Those who accepted were examined at the health care center (persons from rural areas) or at the Comitán General Hospital (persons from urban areas). This study was carried out in accordance with the STROBE guidelines (Strengthening the Reporting of Observational studies in Epidemiology) for cross-sectional studies and with the Declaration of Helsinki (2000). The committees of Research, Ethics, and Biosecurity of the National Institute of Public Health (*Instituto Nacional de Salud Pública*, INSP) approved the study protocol. All participants who agreed to participate signed an informed consent form.

Anthropometric measurements

Anthropometry was performed by trained and standardized personnel (intra- and interclass correlation ≥85). Measurements were made by triplicate with the participants using light clothing and no shoes. Weight, height, waist circumference (WC), mid-upper arm circumference (MUAC), and four skinfolds (bicipital, tricipital, subscapular, and suprailiac) were measured. Body mass index (BMI) was calculated as weight (kg) /height^2 (m) and classified according to the WHO into lightweight (<18.9), normal (18.9 to 24.9), overweight (25.0-29.9), and obesity (≥30).[9] Abdominal obesity was defined according to the criteria of the International Diabetes Federation for Latin American countries as WC≥94 cm in men and ≥88 cm in women.[10] Body composition was defined as the percentage of fat through the sum of the four skinfolds using the Durnin and Womersley body density equation and by using the Siri's formula.[11,12] The percentage of fat-free mass and fat mass was obtained. The percentage of fat mass was classified by sex (men and women) into normal (12 to 20% and 20 to 30%, respectively), high (21 to 25% and 31 to 33%, respectively), and very high (>25 and >33%, respectively).

Social determinants of health

Marmot classifies the social determinants into proximal, intermediate and structural.[7] As proximal determinants, we included age, sex, and self-report of indigenous origin. Also diet information was obtained through a semiquantitative questionnaire on food consumption frequency (FFQ) designed with the methodology of Walter Willett.[13] Both calorie intake (kcal) and percentage of carbohydrates, proteins and lipids included in the diet were calculated. Physical activity was measured using the International Questionnaire for Physical Activity (IPAQ, short version) that measures the frequency (days a week) and intensity (hours and minutes) of the activities carried out by a person; then the metabolic equivalents (METs) were calculated. The level of physical activity (by METs) was classified into inactive, mild, moderate, and vigorous.[14] The comorbidities included were diabetes (fasting glucose ≥126 or 2-hr post-load glucose ≥200 mg/dL or previous medical diagnosis) and hypertension (systolic blood pressure >140 mm/Hg or diastolic blood pressure >90 mm/Hg or prior medical diagnosis). As for intermediate determinants, education level was categorized into <primary and ≥primary school. Occupation was classified into housewife, farmer, trader, and other. The place of residence was classified into urban (≥2 500 inhabitants) and rural (<2 500 inhabitants) areas.[15] For structural determinants, residence areas were classified as having low, medium, high, and very high degree of marginalization according to criteria of Mexico's National Council of Population (*Consejo Nacional de Población*, Conapo), which take into account education level, type of housing, type of residence area, overcrowding, and economic wealth.[15] Social exclusion was classified as low, medium, high, and very high in accordance with the criteria of the National Council for the Evaluation of Social Development Policy (*Consejo Nacional de Evaluación de la Política de Desarrollo Social*, Coneval), which consider education level, type of housing, household goods, and affiliation to social security.[16]

Statistical analysis

Comparisons of some proximal, intermediate, and structural determinants were done by age groups (20-29, 30-39 and ≥40 years) and sex. Also, comparisons of the distribution and composition of body fat by age, sex, IND origin, area of residence, and marginalization degree were carried out. For categorical variables χ^2 was used; for continuous variables *t*-student test, analysis of variance (Anova) or Kruskal-Wallis test were used when appropriate. The age- and sex-adjusted prevalence and 95% confidence intervals (95%CI) of overweight and obesity according to some social determinants were estimated through multiple logistic regression. The association between overweight and obesity and determinants such as age (continuous), sex (women/men), self-reported IND origin (no/yes), education level (≥primary and <primary school), and degree of marginalization (low/medium and high/very high) among other covariables were evaluated using multinomial logistic regression. Finally, models were made stratifying by self-reported IND origin and adjusting for the variables mentioned above. The fit of the models was evaluated through χ^2 goodness of fit test (Hosmer-Lemeshow test) and by evaluating the influence statistics and outliers. All analyses were performed with Stata/MP 15.1 (Stata Corporation, College Station, TX, USA).

Results

Description of the study population

A total of 1 858 individuals participated in the study (644 men and 1 214 women, with a mean age of 42.2 years [±15. 2 years]). By sex, the mean age in men was 43.8 (±0. 6) years and in women, 41.4 (±0. 4) years. 47% of participants self-reported IND origin (46.7% spoke their native language, Tojolabal, in addition to Spanish), 49.7% lived in rural areas, 58.8% lived in localities with a high/very high degree of marginalization and 33.9% in localities with high/very high social exclusion. Differences were found between the percentage of men and women who self-reported IND origin (55.8 and 43.3%, respectively), lived in rural areas (57.8 and 45.9%, respectively), and resided in localities with high/very high marginalization (66.0 and 54.9%, respectively) or high/very high social exclusion (44.1 and 28.5%, respectively).

As for the comparison of proximal determinants by age and sex, although calorie intake was significantly lower in women than in men, the mean percentage of fat intake was higher in women (27.5%) than in men (26.8%) and in both cases it was above the recommended percentage (25%). On the other hand, a higher proportion of women (49.9%) had a lower level of physical activity compared with men (46.6%). Also, significant differences were observed between men and women by level of education, area of residence, and degree of marginalization and social exclusion. In comparisons by age, the percentage of ≥primary school was higher in the groups of age 20-29 years (87.6%) and 30-39 years (82.9%), whereas in the age group ≥40 years 55.5% had ≥primary and 44.5% <primary school (table I).

Regarding distribution and composition of body fat, BMI was significantly higher in women than in men and increased with age. It was also higher in those who self-reported NIND origin and those who resided in urban areas and in localities with medium degree of marginalization. The results were similar for WC, MUAC, and waist-to-height ratio. For the percentage of body fat, the mean was 21.4% in men and 33.6% in women, which was higher than the recommended value (<20 and <30%, respectively). In both men and women, the percentage of fat mass increased with age. In men aged ≥40 years the mean percentage was 23.6% higher than the recommended level (< 30%). As for women, the mean percentage was 29.5% in the 20-29 years-old group, 32.3% in the 30-39 years-old group, and 36.2% in individuals aged ≥40 years. The percentages were greater than the recommended for all age groups (<24, <27, and <30%, respectively) (table II).

Prevalence of overweight and obesity and social determinants

The age- and sex-adjusted prevalence of O/O was 37.9% (95%CI 35.5-40.3) and 16.5% (95%CI 14.5-18.5), respectively. The prevalence was higher in localities with medium degree of marginalization (45.9% [95%CI 42.1-49.7] and 25.5% [95%CI 22.1-28.9], respectively) than in localities with high/very high marginalization (32.7% [95%CI 29.8-35.5] and 10.6% [95%CI 8.8-12.5], respectively). The results were similar for self-reported IND origin, area of residence, and degree of social exclusion (table III).

In a multinomial regression model, after adjustment for age, physical activity, and lipid intake, the probability of overweight and obesity was higher in women, in persons with ≥primary school and in those of NIND origin. After stratification by self-report of IND origin, the probability of overweight in the NIND participants was 1.42 (95%CI 1.01-1.99) times higher in women than in men and 2.06 (95%CI 1.36-3.13) times higher in individuals with ≥primary school that in those with <primary. The persons of localities with medium degree of marginalization were also more likely to be overweight (OR=2.25, 95%CI 1.61-3.14) compared with those of localities with high/very high marginalization. In the IND population only the medium degree of marginalization (OR=2.79, 95%CI 1.87-4.16) was associated with the probability of overweight.

As for obesity, the probability of being obese was greater in women, in individuals with ≥primary school and in those of NIND origin. Low physical activity and greater intake of lipids were also associated with obesity. In both IND and NIND participants the probability of obesity was higher in women than in men (OR=2.79, 95%CI 1.84-4.23 and OR=2.64, 95%CI 1.56-4.47, respectively). It was also higher in dwellers of localities with medium degree of marginalization than in those of localities with high/very high marginalization in both IND and NIND population persons (OR=2.83, 95%CI 1.94-4.14 and OR=5.79, 95%CI 3.42-9.78, respectively) (table IV).

Table I

Description of the study population according to proximal, intermediate, and structural determinants by age and sex. The Comitán Study, Chiapas, Mexico, 2010-2012

	Sex		*Age group*		
	Men *n =644*	*Women* *n =1 214*	*20-29 yrs* *n =426*	*30-39 yrs* *n =475*	*≥40 yrs* *n =957*
Proximal determinants					
Self-report of indigenous origin*					
Yes	359 (55.8)	526 (43.3)	207 (48.6)	223 (46.9)	455 (47.5)
No	285 (44.2)	688 (56.7)#	219 (51.4)	252 (53.1)	502 (52.5)
Speaking of any indigenous language*					
Yes	177 (49.3)	237 (45.1)	44 (21.3)	88 (39.5)	282 (62.0)#
No	182 (50.7)	289 (54.9)	163 (78.7)	135 (60.5)	173 (38.0)
Calorie intake (kcal)‡	1 777.4 (1 511.3-2 083.8)	1 723 (1 461.5-2 074.9)#	1 771.0 (1 492.1-2 080.0)	1 739.2 (1 479.1-2 080.9)	1 726.4 (1 471.6-2 043.7)
Macronutrient intake§#					
Carbohydrates %	56.7 (0.2)	56.4 (0.2)	56.5 (6.3)	56.2 (6.4)	56.7 (6.2)
Proteins %	17.0 (0.1)	17.0 (0.1)	16.9 (2.2)	17.0 (2.0)	17.1 (2.1)
Lipids %	26.8 (0.2)	27.5 (0.1)#	27.4 (5.1)	27.6 (5.0)	27.0 (4.9)
METs‡	1 638 (819-2 274)	996 (699-1 794)#	1 257 (769-2 019)	1 158 (786-2 076)	1 116 (720-2 034)
Level of physical activity*					
Inactive/mild	280 (46.6)	588 (49.9)#	177 (43.6)	224 (48.9)	467 (51.0)#
Moderate	69 (11.5)	196 (16.6)	75 (18.5)	58 (12.7)	132 (14.4)
Vigorous	252 (41.9)	394 (33.4)	154 (37.9)	176 (38.4)	316 (34.5)
Comorbidities*					
Diabetes	47 (7.3)	112 (9.2)	10 (2.3)	18 (3.8)	131 (13.7)#
Hypertension	124 (19.2)	238 (19.6)	37 (8.7)	54 (11.4)	271 (28.3)#
Intermediate determinants					
Occupation*					
Housewife	16 (2.5)	1002 (82.5)#	244 (57.3)	264 (55.6)	510 (53.3)#
Farmer	374 (58.1)	21 (1.7)	62 (14.5)	97 (20.4)	236 (24.7)
Trader	50 (7.8)	80 (6.6)	27 (6.3)	31 (6.5)	72 (7.5)
Other	204 (31.7)	111 (9.1)	93 (21.8)	83 (17.5)	139 (14.5)
Education level*					
< Primary	129 (20.0)	431 (35.5)#	53 (12.4)	81 (17.0)	426 (44.5)#
≥ Primary	515 (80.0)	783 (64.5)	373 (87.6)	394 (82.9)	531 (55.5)
Area of residence*					
Urban	272 (42.2)	663 (54.6)#	191 (44.8)	232 (48.8)	512 (53.5)#
Rural	372 (57.8)	551 (45.4)	235 (55.1)	243 (51.2)	445 (46.5)
Structural determinants					
Degree of marginalization*					
Medium	219 (34.0)	547 (45.1)#	164 (38.5)	190 (40.0)	412 (43.0)
High/very high	425 (66.0)	667 (54.9)	262 (61.5)	285 (60.0)	545 (56.9)
Degree of social exclusion*					
Medium	360 (55.9)	868 (71.5)#	265 (62.2)	314 (66.1)	649 (67.8)
High/very high	284 (44.1)	346 (28.5)	161 (37.8)	161 (33.9)	308 (32.2)

* Number of subjects (%),
‡ Median and percentiles 25-75
§ Mean and standard deviation. X^2 was used for comparison of proportions. For comparison of mean between two groups *t*-Student test was used and one-way ANOVA for more than two groups. For continuous variables with non-normal Kruskal Wallis was used.
# Significant differences between groups (p<.05).

Table II

Distribution and composition of body fat according to proximal, intermediate, and structural determinants. The Comitán Study, Chiapas, Mexico, 2010-2012

	Sex		Age group			Self-report of indigenous origin		Area of residence		Marginalization degree	
	Men n =644	Women n =1214	20-29 yrs n =426	30-39 yrs n =475	>40 yrs n =957	No n =973	Yes n =885	Urban n =935	Rural n =923	Low/medium n =766	High/very high n =1 092
BMI*	25.4 (4.0)	27.0 (4.7)§	24.8 (3.9)	26.9 (4.5)	26.9 (4.6)§	27.3 (4.8)	25.4 (4.0)§	28.1 (4.6)	24.7 (3.7)§	28.1 (4.6)	25.2 (4.0)§
Normal‡	332 (51.5)	471 (38.8)§	266 (62.4)	188 (39.6)	349 (36.5)§	350 (36.0)	453 (51.2)§	251 (26.8)	552 (59.8)§	203 (26.5)	600 (54.9)§
Overweight‡	242 (37.6)	449 (37.0)	120 (28.2)	175 (36.8)	396 (41.4)	370 (38.0)	321 (36.3)	405 (43.3)	286 (31.0)	335 (43.7)	356 (32.6)
Obesity‡	70 (10.9)	294 (24.2)	40 (9.4)	112 (23.6)	212 (22.1)	253 (26.0)	111 (12.5)	279 (29.8)	85 (9.2)	228 (29.8)	136 (12.4)
MUAC* (cm)	29.6 (3.3)	29.9 (3.6)§	–	–	–	–	–	–	–	–	–
Men	–	–	29.5 (2.9)	30.2 (3.2)	29.4 (3.5)§	30.4 (3.5)	29.0 (3.0)§	30.9 (3.6)	28.6 (2.8)§	31.2 (3.6)	28.8 (2.9)§
Women	–	–	28.7 (3.0)	30.6 (3.6)	30.2 (3.8)§	30.6 (3.7)	29.1 (3.4)§	31.1 (3.6)	28.6 (3.3)§	30.9 (3.6)	29.1 (3.5)§
WC (cm)*	89.2 (37.2)	89.9 (10.9)	–	–	–	–	–	–	–	–	–
Men	–	–	83.2 (10.3)	87.2 (9.3)	92.6 (49.8)§	90.0 (10.6)	88.6 (48.9)	95.2 (55.9)	84.8 (8.0)	96.5 (62.2)	85.5 (8.2)
Women	–	–	83.5 (8.9)	89.9 (10.3)	93.0 (10.7)§	91.0 (11.2)	88.5 (10.3)§	91.8 (11.0)	87.7 (10.3)§	90.8 (11.0)	89.2 (10.7)§
Waist-to-height ratio*	0.55 (0.05)	0.61 (0.00)§	–	–	–	–	–	–	–	–	–
Men	–	–	0.52 (0.06)	0.55 (0.05)	0.57 (0.05)§	0.56 (0.00)	0.54 (0.00)§	0.57 (0.06)	0.53 (0.05)§	0.58 (0.06)	0.54 (0.05)§
Women	–	–	0.56 (0.06)	0.61 (0.07)	0.64 (0.07)§	0.62 (0.07)	0.60 (0.07)§	0.62 (0.7)	0.60 (0.07)§	0.62 (0.07)	0.61 (0.07)
Percentage of fat mass*	21.4 (0.3)	33.6 (0.2)§	–	–	–	–	–	–	–	–	–
Men	–	–	16.6 (4.7)	20.6 (4.0)	23.6 (7.3)§	22.5 (6.3)	20.5 (6.8)§	23.7 (7.7)	19.6 (5.2)§	24.2 (8.1)	19.9 (5.2)§
Women	–	–	29.5 (6.5)	32.3 (4.7)	36.2 (5.6)§	34.5 (5.9)	32.5 (6.6)§	35.2 (5.5)	31.6 (6.6)§	35.3 (5.6)	32.2 (6.4)§
Percentage of fat-free mass*	78.6 (0.3)	66.4 (0.2)§	–	–	–	–	–	–	–	–	–
Men	–	–	83.3 (4.7)	79.4 (4.0)	76.3 (7.3)§	77.5 (6.3)	79.5 (6.9)§	76.3 (7.7)	80.3 (5.2)§	75.7 (8.2)	80.1 (5.2)§
Women	–	–	70.5 (6.5)	67.7 (4.7)	63.8 (5.6)§	65.5 (5.9)	67.5 (6.6)§	64.8 (5.5)	68.3 (6.7)§	64.7 (5.6)	67.8 (6.4)§

* Mean and standard deviation.
‡ Number of subjects (%).
§ Significant differences between groups ($p<.05$).
MUAC: Mid-upper arm circumference
X^2 was used for comparison of proportions. For comparison of medians between two groups t-Student test was used for independent samples and ANOVA for more than two groups.

Table III

Age- and sex-adjusted prevalence of overweight and obesity according to some intermediate and structural determinants in adult population. Comitán Study, Chiapas, Mexico, 2010-2012

	Overweight			Obesity		
	Prevalence	*Prevalence ratio (95%CI)*	*p value*	*Prevalence*	*Prevalence ratio (95%CI)*	*p value*
Intermediate determinants						
Self-report of indigenous origin						
Yes	36.30 (33.06-39.53)	1 (Reference)		10.85 (8.78-12. 92)	1 (Reference)	
No	39.47 (36.18-42.76)	1.09 (0.97-1.23)	<.001	22.07 (19.18-24.96)	2.03 (1.67-2.56)	<.001
Level of education						
<primary	29.10 (24.89-33.32)	1 (Reference)		13.38 (10.40-16.36)	1 (Reference)	
>primary	41.27 (38.42-44.13)	1.42 (1.19-1.65)	<.001	17.67 (15.38-19.95)	1.32 (0.99-1.64)	.016
Area of residence						
Rural	31.03 (27.99-34.06)	1 (Reference)		7.93 (6.19-9.66)	1 (Reference)	
Urban	45.30 (41.84-48.75)	1.46 (1.30-1.67)	<.001	25.69 (22.54-28.83)	3.24 (2.63-4.17)	<.001
Structural determinants						
Degree of marginalization						
High/very high	32.70 (29.85-35.55)	1 (Reference)		10.65 (8.77-12.52)	1 (Reference)	
Medium	45.91 (42.13-49.70)	1.40 (1.26-1.59)	<.001	25.51 (22.13-28.90)	2.39 (2.0-3.03)	<.001
Degree of social exclusion						
High/very high	29.98 (26.37-33.59)	1 (Reference)		6.22 (4.37-8.06)	1 (Reference)	
Medium	42.41 (39.40-45.42)	1.41 (1.25-1.64)	<.001	22.35 (19.68-25.02)	3.59 (2.78-5.26)	<.001
Age-and sex-adjusted prevalence	37.90 (35.54-40.27)	-	-	16.50 (14.55-18.44)	-	-

Discussion

Overweight and obesity is a complex condition influenced by the interaction of genetics and environmental risk factors. However, genetic factors only account for 40% of variations in body mass index, so the social environment plays an important role in overweight and obesity. The prevalence of O/O found in this study was 39.5 and 22.1%, respectively, in NIND participants and 36.3 and 10.8%, respectively, in IND participants. When comparing with other studies carried out in Mexico in IND population, we observed a lower prevalence of O/O than that reported in Nahua of Ixtaczoquitlán, Veracruz (41 and 36.5%, respectively),[17] Nahua of the Sierra of Puebla (44.1 and 19.2%, respectively),[18] Maya of Yucatán (11 and 80.3%, respectively),[19] and Triquis of San Juan Copala, Oaxaca (85.5% combined).[20] In a wider scope, in our study, the prevalence of obesity in IND population was lower than that in aboriginal Australian (38.4%) and Canadian population (36.4%), whereas the prevalence of obesity in NIND population was similar to that in non-aboriginal Australian (22.3%) and Canadian population (22.6%).[21,22]

Women are a vulnerable group due to inequalities in education, recreational activities, and food access in comparison with men.[7] In our study, the prevalence of overweight was similar in both sexes, but obesity was twice as high in women as in men. Both prevalence rates were lower than those reported in other populations with high degree of marginalization.[18,20] Women also had a high-fat diet and low physical activity compared with men, with implications for O/O risk. In a study including Mayan Chontal IND population, a higher prevalence of O/O was found in women than in men. In this population physical exercising is prohibited for women. After maternity women assume that having O/O is normal; obesity is considered as an inevitable legacy of parents, not a disease. Thus, weight loss in women is not desirable at any stage of life.[23]

Regarding area of residence, the probability of overweight was similar in both IND and NIND individuals living in localities with medium degree of marginalization compared with those of localities with high/very high marginalization. On the other hand, for localities with medium degree of marginalization, the risk of O/O was higher in IND than in NIND persons

Table IV

Proximal, intermediate, and structural determinants associated with overweight and obesity in adult population. The Comitán Study, Chiapas, Mexico, 2010-2012

	Whole sample		*Indigenous origin*			
	N=1 858 OR (95%CI)	*p value*	*Non-indigenous, n= 973*		*Indigenous, n= 885*	
			OR (95%CI)	*p value*	*OR (95%CI)*	*p value*
Overweight						
Age (years)	1.02 (1.01-1.03)	<.001	1.03 (1.01-1.04)	<.001	1.01 (1.00-1.03)	.003
Sex (women)	1.40 (1.12-1.76)	.003	1.42 (1.01-1.99)	.04	1.23 (0.89-1.70)	.20
Non-indigenous origin	1.25 (1.00-1.56)	.05	–	–	–	–
Schooling >primary	1.81 (1.39-2.35)	<.001	2.06 (1.36-3.13)	.001	1.20 (0.84-1.72)	.31
Level of physical activity						
Inactive/mild	1 (Reference)	–	1 (Reference)	–	1(Reference)	–
Moderate	1.03 (0.76-1.39)	.85	0.94 (0.62-1.44)	.79	1.36 (0.86-2.16)	.18
Vigorous	0.73 (0.53-1.01)	.06	0.59 (0.37-0.95)	.03	1.06 (0.66-1.70)	.81
Intake of lipids >25%	1.22 (0.97-1.53)	.08	1.09 (0.76-1.58)	.62	0.84 (0.61-1.17)	.31
Medium degree of marginalization	–	–	2.25 (1.61-3.14)	<.001	2.79 (1.87-4.16)	<.001
Obesity						
Age (years)	1.02 (1.01-1.03)	<.001	1.03 (1.01-1.04)	.001	1.01 (0.99-1.03)	.16
Sex (women)	2.91 (2.12-3.99)	<.001	2.79 (1.84-4.23)	<.001	2.64 (1.56-4.47)	<.001
Non-indigenous origin	2.27 (1.69-3.03)	<.001	–	–	–	–
Schooling >primary	1.41 (1.03-1.94)	.03	1.28 (0.82-1.99)	.28	0.95 (0.57-1.60)	.86
Level of physical activity						
Inactive/mild	1 (Reference)	-	1 (Reference)	-	1 (Reference)	-
Moderate	0.81 (0.57-1.15)	.24	0.68 (0.43-1.06)	.09	1.67 (0.84-3.29)	.14
Vigorous	0.68 (0.46-1.01)	.05	0.50 (0.30-0.84)	.01	1.61 (0.79-3.28)	.19
Intake of lipids >25%	1.61 (1.20-2.16)	.001	1.34 (0.88-2.05)	.17	0.87 (0.53-1.42)	.59
Medium degree of marginalization	–	–	2.83 (1.94-4.14)	<.001	5.79 (3.42-9.78)	<.001

Note: A multiple multinomial regression model was done. Biologically relevant variables with $p< .20$ by simple regression were added to the model.

(OR=2.8 and OR=5.8, respectively). In the present study, nearly 50% of the participants self-reported IND origin. Most of this population are farmers and breed the animals that are part of their diet. Mexico has the largest number of people of IND origin in Latin America, totaling 11 million, of which 2.7 million have limited access to public services, education, and health care.[24] In Chiapas, the percentage of IND population (27.9%) is four times greater than the national average (6.7%).[25] A higher percentage of the IND population lives in rural areas where they have few social, economic, and political opportunities to develop. This coupled with the abandonment of public investment and little subsidy for rural activities has forced the IND population to migrate to big cities. For example, during the decade of 1970s agricultural production accounted for 12% of Mexico's GDP, while by 2014 it had decreased to 3.3%.[26]

In our study, the prevalence of O/O was higher in urban than in rural areas. O/O is spreading rapidly in the urban zones of developing countries. Popkin and colleagues compared the prevalence of O/O in 42 countries of Asia, Middle East, Africa, and Latin America and found a higher prevalence in urban (37.2%) than in rural localities (19%).[27] According to the Ensanut 2000 and the 2016 Ensanut-MC national surveys, O/O prevalence in rural areas increased 7.2 and 7.1%, respectively, whereas in urban locations it decreased 2.6% for overweight and increased 8.1% for obesity.[2]

The high risk of O/O for IND people living in urban areas is linked to changes in lifestyle (food and diet) typical of cities.[28] A study comparing the eating patterns of Pima Indians from Phoenix, Arizona, in the United States of America (urban area residents) and the Pima from Maycoba, Sonora, in Mexico (rural dwellers), found that the diet in the second group was higher in fiber and lower in fat,[29] whereas the first group had a diet higher in saturated fat and lower in fiber. Thus, the prevalence of obesity was five times higher in the Pima from Arizona (69%) than in the Pima from Sonora (13%).[30]

Populations with lower degree of marginalization are at more risk of O/O compared with those with higher marginalization.[31] In Mexico several studies show that globalization has led to a nutritional transition that has conditioned in part the increase in O/O. In past decades meals consisted of little processed foods and most foods were grown by people for their own consumption.[5] More recently, worldwide advances in communication, infrastructure, and technology have given way to access to a great variety of processed foods with high-calorie content and low nutritional contribution.[27] The analysis of the Food Balance Sheets of the Food and Agriculture Organization (FAO) shows that in Mexico, from 1961 to 2013, the kcal/day consumption per person rose from 2 401 to 3 049 kcal.[32]

Eating patterns are also related to socioeconomic status and area of residence; this however does not guarantee an adequate food choice of the most favored people.[28,29] Unfortunately, in poor rural areas soft-drinks and ultra-processed foods are increasingly consumed because accessibility is growing.[33] Another key factor is physical activity, which has decreased in less marginalized areas as a result of less walking and more use of car or public transport. Insecurity in large cities has also played a role in the decrease of outdoor activities. Likewise, technological tools have replaced physical labor resulting in a greater number of jobs that favor O/O.[33]

Among the strengths of our study was the number of individuals enrolled, which helped us to analyze some social determinants and lifestyle risk factors. Although the nonresponse rate was moderate because of similar reasons in both people with medium marginalization and those with high/very high marginalization, no differences in social determinants between respondents and nonrespondents were found, which reduces the probability of selection bias. Due to the smaller proportion of IND individuals compared with NIND ones, an oversampling of IND persons was done, which could affect the external validity. However, after comparison of people who accepted to participate in the study vs. those who did not accept, no significant differences were observed. On the other hand, because of the definition of IND origin we used, the probability of misclassification bias exists. Yet, self-reported IND origin is more related to social and cultural factors than to biological or genetic aspects, the former being of more interest for the purpose of this study. Also, the cross-sectional design of the study made it difficult to determine the impact of changes on food intake and physical activity as well as on social determinants related to the prevalence of O/O.

In summary, we consider that public policies aimed to reduce O/O should first be tailored to the particular social environment, ethnicity, socioeconomic status, availability of food, and social and food culture of targeted populations in order to break access barriers and facilitate healthy food choices.

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