nutrición clínica y Dietética Hospitalaria

Artículo Original

Nutr Clín Diet Hosp. 2025; 45(2):194-203
DOI: 10.12873/452chaquila

Prevalence and factors associated with Relative Fat Mass in Peru: a cross-sectional analysis of the 2017–2018 national survey

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Recibido: 13/marzo/2025. Aceptado: 2/mayo/2025.

ABSTRACT

Introduction: Obesity is a global health issue affecting both high- and middle-income countries, with Peru being among the affected nations. Relative Fat Mass (RFM) is a novel anthropometric indicator that estimates body fat percentage and has demonstrated superior diagnostic accuracy for obesity compared to other anthropometric estimators. Therefore, this study aimed to determine the prevalence of obesity according to RFM and its associated factors in Peru.

Material and methods: An observational study with cross-sectional design was conducted. Data were analyzed from a nationally representative survey in Peru: The Food and Nutritional Surveillance by Life Stages 2017–2018 (VIANEV, by its Spanish acronym). Obesity was defined as RFM ≥ 40% in women and ≥ 30% in men. Descriptive, bivariate, and multivariate analyses were conducted, accounting for the survey's complex design. To identify associated factors, a generalized linear model of the Poisson family was used, adjusting for potential confounders related to household characteristics and adult biochemical markers.

Results: During 2017–2018, 59.38% of Peruvian adults were classified as obese according to RFM, being more than twice the prevalence of obesity according to Body Mass Index (26.22%). In the multivariate model, obese individuals had a 45% and 25% higher prevalence of metabolic syndrome and low HDL levels, respectively. Lifestyle habits were not significantly associated with obesity.

Conclusion: The prevalence of obesity according to the RFM in Peru is high, affecting 6 out of 10 adults, with women being the most susceptible. These findings show an unfavorable nutritional situation in Peru when using an alternative anthropometric indicator.

KEY WORDS

Relative fat mass, body mass index, obesity, body fat percentage, adults.

INTRODUCTION

Globally, obesity has become a major public health concern, closely linked to the rise of non-communicable diseases such as diabetes, hypertension, and cardiovascular diseases[1]. In Peru, the prevalence of excess weight and obesity has increased significantly in recent years, leading to a higher burden of metabolic diseases among the adult population[2]. This trend has also been observed in other Latin American countries, where obesity levels and related comorbidities continue to rise[3].

Although body mass index (BMI) is the most commonly used tool for detecting obesity[4], it has important clinical limitations, such as not accounting for sex differences or the distribution of body fat to distinguish between fat mass and lean mass, reducing its ability to estimate risks associated with comorbidities[5-8]. These limitations have led to misclassifications of obesity in individuals who do not have a high body fat percentage. Nevertheless, BMI continues to be widely used due to its practical and simple application. Recently, the World Health Organization (WHO) recommended the inclusion of additional anthropometric markers to enable a more accurate diagnosis of obesity, proposing two categories: preclinical and clinical obesity[9]. This proposal underscores the need to seek alternative approaches that incorporate a broader set of criteria for obesity classification.

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Given the need for methods that balance practicality and effectiveness—especially in light of the limitations associated with skinfold measurements or bioimpedance analysis—predictive models have been proposed to estimate body fat percentage in adults using easily obtainable anthropometric measurements. Among these, the Relative Fat Mass (RFM) equation, developed by Woolcott and Bergman in 2018, provides a more accurate assessment of body composition, as it evaluates not only total fat but also its distribution in the body[10]. RFM has demonstrated higher diagnostic accuracy in detecting obesity in both sexes (AUC ≥ 0.93) compared to BMI, highlighting its clinical potential[11]. However, despite the importance of RFM as a health indicator, few studies in Peru and Latin America have examined its prevalence and the factors contributing to its variability. Additionally, as a secondary objective, we compared the prevalence estimates based on RFM and BMI.

The implementation of RFM could provide a different perspective on a country's nutritional status, helping assess whether public health interventions aimed at reducing overnutrition are effective. Therefore, given the limited evidence on RFM in Peru and Latin America, this study aimed to determine the prevalence of RFM and its associated factors in a nationally representative sample of Peruvian adults from 2017–2018.

MATERIALS AND METHODS

Study design and population

A cross-sectional analytical study was conducted using data from the Peruvian Food and Nutritional Surveillance by Life Stages survey (VIANEV, by its Spanish acronym), carried out by the National Center for Food and Nutrition, National Institute of Health (Peru). The VIANEV participants included in this study were selected from a subsample of adults aged 18 to 59 years who participated in the 2018 National Household Survey (ENAHO) and had available information on anthropometric measurements, biochemical markers, and other assessments.

The survey ensures national inference through three domains: Metropolitan Lima (the capital), urban areas, and rural areas of Peru. This process involved a two-stage random sampling: first, a random selection of clusters, followed by a second-stage random sampling of households. The survey included information from 1,806 adults. For more technical details, the official survey report should be consulted[12] In the present study, pregnant women and adults with at least one missing data on the covariates of interest were excluded. (Figure 1) The final analyzed sample consisted of 895 participants (Figure 1).

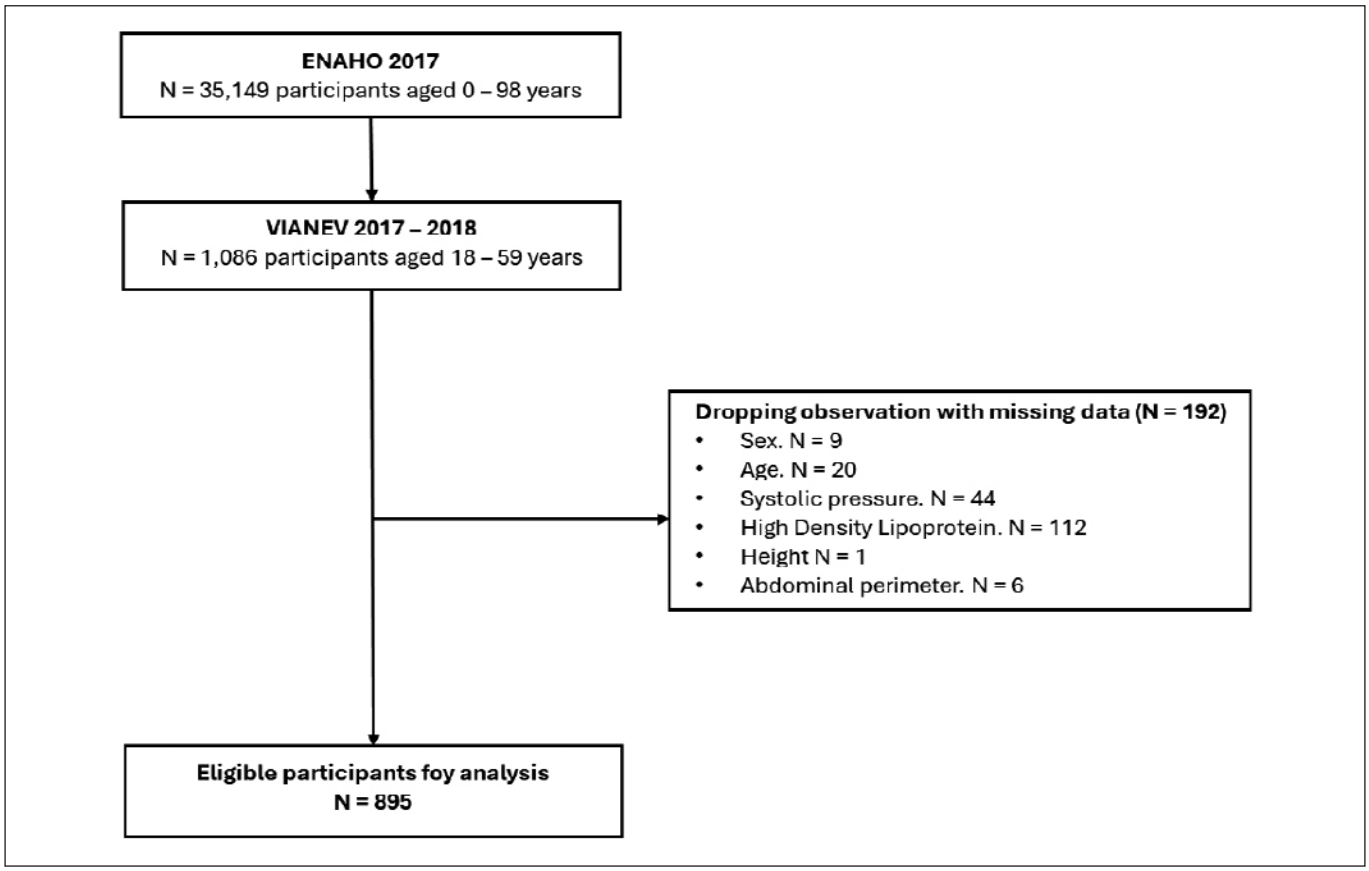

Figure 1. Flowchart of participant selection

Variables

Outcome variable: Relative Fat Mass (RFM)

RFM is a linear equation that incorporates height (cm), waist circumference (cm), and sex to estimate body fat percentage. This indicator has been previously validated in European, American, and Mexican populations[10], and has also been applied in both representative and non-representative national populations, including the Peruvian population[13,14]. RFM has a diagnostic accuracy of 91% in identifying obesity compared to DXA in both men and women. Additionally, unlike BMI, RFM results in a lower misclassification rate of obesity as determined by DXA. The formula for calculating RFM is: 64 - (20 - (height(cm) / waist circumference (cm)) + (12 x sex), where sex is assigned a value of 1 for women and 0 for men. Obesity was classified as RFM ≥ 40% in women and RFM ≥ 30% in men[15].

Additionally, for the classification of obesity according to BMI (kg/m²), the equation proposed by the WHO was used: weight (kg)/height (m)². Obesity was defined as a BMI greater than or equal to 30.

Explanatory variables

The explanatory variables were selected based on established literature and included sociodemographic and lifestyle factors. These variables comprised sex, age, educational level, altitude of residence, region, type of residence (urban or rural), daily smoking, alcohol consumption in the last 30 days, and daily intake of at least five servings of fruits and/or vegetables[14,16-19]. Additionally, metabolic status-related variables were assessed following the definitions of the Adult Treatment Panel III for metabolic syndrome classification. Metabolic syndrome was defined as the presence of at least three of the following components: diabetes (fasting glucose > 110 mg/dL or a prior diagnosis of hyperglycemia), hypercholesterolemia (total cholesterol > 200 mg/dL), hypertriglyceridemia (triglycerides > 150 mg/dL), hypertension (systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg, or a prior diagnosis of hypertension), low HDL cholesterol (< 40 mg/dL in men and < 50 mg/dL in women), and elevated LDL cholesterol (≥ 100 mg/dL) [20].

Statistical analysis

The database was exported to STATA v16, where all statistical analyses were performed. The analyses accounted for the survey's complex sampling design. Bivariate analyses were conducted using Pearson's chi-square test, the Kolmogorov–Smirnov test, and the Kruskal–Wallis test, considering statistical significance at a p-value < 0.05. Multivariate analysis was performed using a generalized linear model from the Poisson family with a log link function and robust variance, establishing crude (cPR) and adjusted prevalence ratios (aPR). The selection of explanatory variables for the adjusted model was based on both statistical and epidemiological criteria. Variables with a p-value < 0.2 in the bivariate analysis (via Pearson's Chi-square test) were included in the adjusted model. Additionally, the variable representing the daily consumption of five servings of fruits and vegetables was included despite not meeting the statistical criterion due to its epidemiological significance. All association measures were reported with confidence intervals (CI 95%).

To represent the national prevalence of obesity based on RFM, a choropleth map of Peru was created using QGIS Desktop 3.34.14. To visualize the severity of obesity at the national level, quintiles were generated by ranking prevalence from lowest to highest, where the highest quintile represented the greatest severity.

Ethical considerations

The VIANEV survey is publicly accessible and available through the Peruvian National Open Data Platform at the following link: https://datosabiertos.gob.pe/dataset/cenan-ins-vigilancia-del-estado-nutricional-de-adolescentes-y-adultos-mayores-per%C3%BA-2017-2018. The dataset does not contain any sensitive information that could identify or contact participants, ensuring confidentiality. Given that the study does not involve the handling of sensitive participant data, ethical committee approval was not required for this research.

RESULTS

Demographic, lifestyle, and biochemical characteristics of the participants are presented in Table 1. A higher proportion of the sample consisted of women, adults under 30 years old, and individuals with higher education. Three out of ten adults smoked daily, and slightly more than half consumed alcohol in the past month. About 30% consumed more than five servings of fruits and vegetables per day, and 40% engaged in moderate to intense physical activity. Regarding socioeconomic status and geographic distribution, 14.79% were in poverty, 15.36% lived below 500 meters above sea level (m.a.s.l.), 51.03% resided in Metropolitan Lima, and 18.95% lived in rural areas. Additionally, 33.26% of the sample had metabolic syndrome (Table 1).

The anthropometric characteristics of the sample, stratified by sex and age, are presented in Table 2. The median RFM and BMI were 37.82 and 26.66, respectively. Unlike waist circumference, the other measurements differed significantly by sex. The median waist circumference was similar between men and women. Regarding age, both RFM and BMI increased from ages 18 to 49 and then declined in individuals aged 50 and older, with statistically significant differences observed across age groups. (Table 2) Additionally, six out of ten Peruvian adults were classified as obese based on RFM (59.38%) (Figure 2). The national prevalence of obesity based on RFM was more than twice that reported using BMI (26.22%). Among men, however, obesity was more frequently identified according to BMI criteria. Regarding age, no

Table 1. Characteristics of the sample. N = 895

	N	%*	CI 95%*
Sex			
Male	385	42.98	0.39 - 0.46
Female	510	57.01	0.53 - 0.60
Age (years)			
Under 30	251	29.4	26.05 - 32.98
30 a 39	230	25.12	21.92 - 28.62
40 a 49	218	24.15	20.97 - 27.64
50 a 59	196	21.31	18.39 - 24.55
Maximum level of education attained			
No education	20	1.54	0.94 - 2.52
Primary	190	16.35	13.9 - 19.14
Secondary	332	35.4	31.45 - 39.56
Higher	353	46.69	42.37 - 51.06
Daily smoking			
No	873	97.02	95.19 - 98.17
Yes	22	2.97	1.82 - 4.8
Drinking alcohol during the last month			
No	451	46.19	42.3 - 50.12
Yes	444	53.8	49.87 - 57.69
Consumption of 5 servings of fruits or vegetables per day			
No	627	67.66	63.58 - 71.49
Yes	268	32.33	28.5 - 36.41
Physical activity			
Mild	512	60.34	56.37 - 64.17
Moderate/Severe	383	39.65	35.82 - 43.62
Poverty			
Poor	150	14.79	12 - 18.11
Not poor	745	85.2	81.88 - 87.99
Altitude			
≤ 500	626	73.68	69.52 - 77.45
500 - 2499	124	10.95	8.31 - 14.3
≥ 2500	145	15.36	12.18 - 19.18

	N	%*	CI 95%*
Region			
Metropolitan Lima	395	51.03	47.82 - 54.23
Coast	177	17.81	14.65 - 21.47
Highlands	191	20.26	16.72 - 24.33
Jungle	132	10.88	8.5 - 13.84
Residence			
Metropolitan Lima	395	51.03	47.82 - 54.23
Urban	207	30.01	27.20 - 32.98
Rural	293	18.95	17.06 - 20.99
Elevated waist circumference			
Low	536	58.71	55.01 - 62.31
High	359	41.28	37.68 - 44.98
Hypertension			
No	796	90.13	87.6 - 92.2
Yes	99	9.86	7.79 - 12.39
Diabetes			
No	580	65.66	61.34 - 69.71
Yes	315	34.34	30.28 - 38.65
Hypercholesterolemia			
No	615	70.58	66.87 - 74.03
Yes	280	29.41	25.96 - 33.12
Low HDL			
No	207	22.25	19.01 - 25.87
Yes	688	77.74	74.12 - 80.98
Elevated LDL			
No	339	39.39	35.44 - 43.49
Yes	556	60.6	56.5 - 64.55
Metabolic syndrome			
No	596	66.73	63.18 - 70.09
Yes	299	33.26	29.9 - 36.81

* Weighted percentages according to survey complex sampling. CI: Confidence Interval.
RFM: relative fat mass, HDL: high-density lipoprotein, LDL: low-density lipoprotein.

Table 2. Anthropometric measurements of the participants and prevalence of obesity according to RFM and BMI

	Sex				Age				
	Global (n = 895)	**Male (n = 385)**	**Female (n = 510)**		**Under 30 (n = 251)**	**30 – 39 (n = 230)**	**40 – 49 (n = 218)**	**50 – 59 (n = 196)**	
	Median (IQ)			**P value[a]**	**Median (IQ)**				**P value[b]**
Weight	65.7 (58.4 – 75.0)	69.7 (61.4 – 79.2)	63.4 (56.2 – 71.8)	<0.001	61.7 (54.6 – 70.2)	67.4 (59.3 – 76.3)	68.1 (59.8 – 77.4)	67.7 (59.9 – 76.2)	<0.001
Height	157.2 (151.2 – 164.2)	164.5 (160.3 – 169.5)	152.1 (148.4 – 156.4)	<0.001	158.9 (153.4 – 166.9)	157.6 (151.0 – 164.2)	156.4 (150.6 – 163.3)	155.65 (150.0 – 162.1)	<0.001
Waist circumference	90.6 (82.8 – 98.9)	90.5 (83.1 – 99)	90.8 (82.6 – 98.9)	0.979	82.3 (76.7 – 89.6)	90.9 (84.7 – 99.0)	94.8 (86.9 – 101.3)	96.5 (89.4 – 102.2)	<0.001
RFM	37.82 (29.62 – 44.17)	28.92 (25.07 – 31.65)	43.55 (40.09 – 46.27)	<0.001	32.52 (25.3 – 39.92)	38.51 (29.76 – 44.24)	41.34 (31.31 – 45.66)	39.61 (31.66 – 45.37)	<0.001
BMI	26.66 (23.65 – 30.04)	26.02 (22.99 – 28.58)	27.49 (24.26 – 30.76)	<0.001	24.22 (21.72 – 26.93)	27.06 (24.59 – 30.4)	28.21 (24.66 – 31.01)	27.59 (25.21 – 30.86)	<0.001
	RFM obesity (n = 533)				**BMI obesity (n = 583)**				
	% (CI95%)				**% (CI95%)**				**P valor**
Global	59.38 (55.56 – 63.09)				26.22 (22.87 – 29.86)				< 0.001
Sex									
Male	29.15 (24.96 – 33.74)				34.34 (27.7 – 41.63)				< 0.001
Female	70.85 (66.25 – 75.03)				65.66 (58.36 – 72.29)				
Age									
Under 30	13.93 (10.92 – 17.62)				12.54 (8.45 – 18.18)				0.069
30 - 39	26.85 (22.66 – 31.49)				25.62 (19.52 – 32.85)				0.452
40 – 49	31.35 (26.68 – 36.39)				33.18 (26.24 – 40.92)				0.457
50 - 59	27.87 (23.64 – 32.54)				28.66 (22.43 – 35.83)				0.132

Weighted percentages according to survey complex sampling. [a]: p-value obtained from the Kolmogorov–Smirnov test. [b]: p-value obtained from the Kruskal–Wallis test. Relative fat mass. BMI: Body Mass Index. CI: confidence interval.

significant differences were found in obesity prevalence when comparing the two anthropometric measures. (Table 2)

Table 3 presents the bivariate analysis between obesity based on RFM and explanatory variables. The proportion of women with obesity was higher (73.8%) compared to men (40.28%). Obesity prevalence ranged from 63% to 77% across different age groups (p<0.001). A lower prevalence of obesity was observed among individuals with higher educational attainment (p<0.001). Except for diabetes, which showed no significant difference between obesity groups, chronic diseases were present in more than 65% of individuals with obesity (p<0.001).

In the multivariate analysis, women had a 70% higher prevalence of RFM obesity compared to men. Regarding age groups, older adults had a progressively higher prevalence of RFM obesity, with those aged 50–59 years having more than double the prevalence compared to younger adults. Educational level, smoking, alcohol consumption, fruit and vegetable intake, and physical activity were not significantly associated with RFM. Among metabolic outcomes, hypertension, diabetes, and hypercholesterolemia were not significantly associated with RFM obesity in the adjusted model. However, low HDL levels and metabolic syndrome remained significantly associated with RFM obesity (Table 4).

Table 3. Bivariate analysis between RFM-defined obesity and other adult characteristics

	Without obesity N = 362	Obesity N = 533	p valor
	% (CI 95%)	% (CI 95%)	
Sex			
Male	63.21 (57.37 - 68.69)	29.15 (24.96 - 33.74)	<0.001
Female	36.78 (31.3 - 42.62)	70.84 (66.25 - 75.03)	
Age (years)			
Under 30	52.01 (45.9 - 58.07)	13.93 (10.92 - 17.61)	<0.001
30 a 39	22.6 (18.28 - 27.6)	26.85 (22.66 - 31.49)	
40 a 49	13.64 (10.35 - 17.77)	31.33 (26.67 - 36.4)	
50 a 59	11.72 (8.16 - 16.56)	27.87 (26.63 - 32.54)	
Maximum level of education attained			
No education	0.6 (0.1 - 1.87)	2.19 (1.25 - 3.8)	<0.001
Primary	12.31 (9.13 - 16.39)	19.12 (15.8 - 22.94)	
Secondary	32.6 (27.24 - 38.45)	37.32 (32.5 - 42.39)	
Higher	54.48 (48.49 - 60.34)	41.36 (36.31 - 46.6)	
Daily smoking			
No	95.89 (92.2 - 97.87)	97.8 (95.6 - 98.91)	0.187
Yes	4.1 (2.12 - 7.79)	2.19 (1.08 - 4.39)	
Drinking alcohol during the last month			
No	39.05 (33.76 - 44.62)	51.06 (46.11 - 56)	0.001
Yes	60.94 (55.37 - 66.23)	48.93 (43.99 - 53.88)	
Consumption of 5 servings of fruits or vegetables per day			
No	65.12 (58.7 - 71.02)	69.4 (64.48 - 73.92)	0.251
Yes	34.87 (28.97 - 41.29)	30.59 (26.07 - 35.51)	
Physical activity			
Mild	54.08 (48.18 - 59.87)	64.61 (59.75 - 69.19)	0.003
Moderate/Severe	45.91 (40.12 - 51.81)	35.38 (30.8 - 40.24)	
Poverty			
Poor	13.94 (10.31 - 18.59)	15.38 (12.12 - 19.31)	0.559
Not poor	86.06 (81.4 - 89.68)	84.61 (80.68 - 87.87)	
Altitude			
≤ 500	73.03 (67.39 - 78.01)	74.12 (69.09 - 78.59)	0.751
500 - 2499	10.42 (7.39 - 14.48)	11.32 (8.04 - 15.71)	
≥ 2500	16.54 (12.09 - 22.22)	14.55 (11 - 19)	
Region			
Metropolitan Lima	52.72 (48.95 - 56.47)	49.87 (46 - 53.74)	0.244
Coast	15.89 (12.22 - 20.42)	19.11 (15.39 - 23.48)	
Highlands	21.68 (16.92 - 27.35)	19.29 (15.14 - 24.26)	
Jungle	9.68 (7.1 - 13.06)	11.71 (8.76 - 15.48)	
Residence			
Metropolitan Lima	52.72 (48.95 - 56.47)	49.87 (46 - 53.74)	0.457
Urban	26.74 (23.45 - 30.29)	32.25 (28.88 - 35.86)	
Rural	20.53 (18.2 - 23.07)	17.87 (15.84 - 20.09)	
Hypertension			
No	94.68 (91.41 - 96.75)	87.02 (83.54 - 89.85)	<0.001
Yes	5.31 (3.24 - 8.58)	12.97 (10.14 - 16.45)	
Diabetes			
No	63.51 (57.09 - 69.47)	67.11 (61.79 - 72.03)	0.346
Yes	36.48 (30.52 - 42.9)	32.88 (27.96 - 38.2)	
Hypercholesterolemia			
No	78.81 (73.94 - 82.98)	64.95 (59.84 - 69.74)	<0.001
Yes	21.18 (17.01 - 26.05)	35.04 (30.25 - 40.15)	
Low HDL			
No	34.7 (29.03 - 40.84)	13.74 (10.27 - 18.13)	<0.001
Yes	65.29 (59.15 - 70.96)	86.25 (81.86 - 89.72)	
Elevated LDL			
No	49.23 (42.83 - 55.66)	32.66 (28.12 - 37.56)	<0.001
Yes	50.76 (44.33 - 57.16)	67.33 (62.43 - 71.87)	
Metabolic syndrome			
No	90.15 (85.89 - 93.22)	50.71 (45.83 - 55.58)	<0.001
Yes	9.84 (6.77 - 14.1)	49.28 (44.41 - 54.16)	

* Weighted percentages according to survey complex sampling. CI: Confidence Interval.
RFM: relative fat mass. HDL: high-density lipoprotein. LDL: low-density lipoprotein.

Table 4. Multivariate analysis between obesity as defined by RFM and other adult characteristics

	cPR	CI95%	aPR*	CI95%
Sex				
Male	Ref		Ref	
Female	1.92	1.68 - 2.20	**1.7**	1.5 - 1.93
Age (years)				
Under 30	Ref		Ref	
30 a 39	2.03	1.64 - 2.52	**1.75**	1.44 - 2.13
40 a 49	2.4	1.96 - 2.95	**1.87**	1.54 - 2.27
50 a 59	2.62	2.15 - 3.21	**2.1**	1.72 - 2.56
Maximum level of education attained				
No education	Ref		Ref	
Primary	0.82	0.66 - 1.01	1.02	0.8 - 1.29
Secondary	0.7	0.57 - 0.86	1.05	0.82 - 1.35
Higher	0.6	0.49 - 0.75	0.95	0.74 - 2.56
Daily smoking				
No	Ref		Ref	
Yes	0.91	0.62 - 1.34	1.02	0.76 - 1.36
Drinking alcohol during the last month				
No	Ref		Ref	
Yes	**0.83**	0.74 - 0.92	0.97	0.88 - 1.08
Consumption of 5 servings of fruits or vegetables per day				
No	Ref		Ref	
Yes	0.94	0.83 - 1.06	1.01	0.91 - 1.11
Physical activity				
Mild	Ref		Ref	
Moderate/Severe	**0.85**	0.76 - 0.95	0.94	0.86 - 1.04
Poverty				
Poor	Ref		-	
Not poor	0.97	0.84 - 1.12		
Altitude				
≤ 500	Ref		-	
500 - 2499	0.95	0.81 - 1.12		
≥ 2500	0.93	0.79 - 1.09		
Region				
Metropolitan Lima	Ref		-	
Coast	1.1	0.96 - 1.26		
Highlands	0.93	0.8 - 1.09		
Jungle	1.04	0.89 - 1.22		
Residence				
Metropolitan Lima	Ref		-	
Urban	1.1	0.96 - 1.25		
Rural	0.97	0.85 - 1.10		
Hypertension				
No	Ref		Ref	
Yes	**1.41**	1.26 - 1.59	1.03	0.92 - 1.15
Diabetes				
No	Ref		-	
Yes	0.98	0.88 - 1.10		
Hypercholesterolemia				
No	Ref		Ref	
Yes	**1.29**	1.16 - 1.44	1.01	0.91 - 1.12
Low HDL				
No	Ref		Ref	
Yes	**1.8**	1.5 - 2.18	**1.25**	1.05 - 1.49
Elevated LDL				
No	Ref		Ref	
Yes	**1.34**	1.19 - 1.52	1.11	0.99 - 1.26
Metabolic syndrome				
No	Ref		Ref	
Yes	1.98	1.8 - 2.18	**1.45**	1.31 - 1.61

* The estimates shown were adjusted for the variables that showed a p value <0.2 in the bivariate analysis (Pearson's chi-square). The variable "consumption of 5 portions of fruit or vegetables per day" was also adjusted for its epidemiological relevance despite not meeting the statistical criterion. RFM: relative fat mass, HDL: high-density lipoprotein, LDL: low-density lipoprotein, cPR: crude prevalence ratio, aPR: adjusted prevalence ratio. CI: Confidence interval, Ref: Referential.

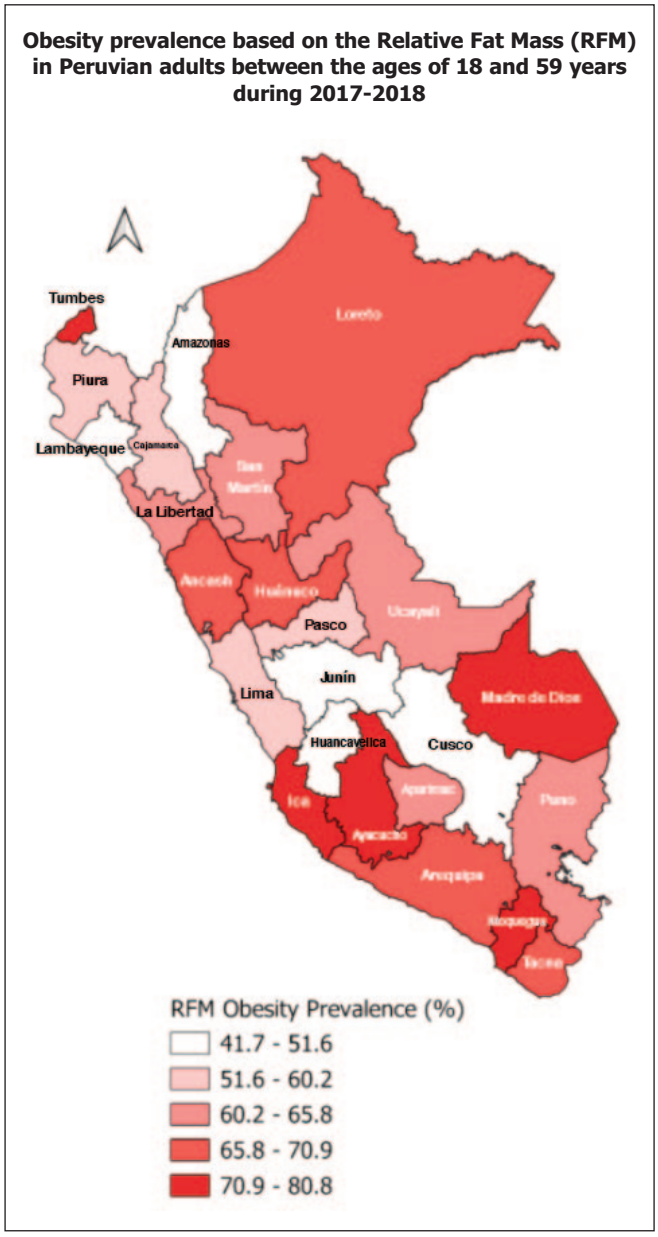

Figure 2. Prevalence of obesity defined by RFM in Peru during 2017–2018

DISCUSSION

In this study, we assessed the prevalence of obesity based on RFM in Peruvian adults and its associated factors, using a nationally representative sample. We found that six out of ten adults were classified as obese according to RFM, which is twice the prevalence observed when using BMI criteria. These substantial differences in obesity prevalence depending on the diagnostic criteria reveal an alarming scenario in Peru, suggesting a potential underestimation of obesity when using BMI.

This difference in obesity prevalence has also been observed in the United States, where BMI-based obesity prevalence was 42.2% in 2017–2020, whereas RFM-based prevalence reached 64.7%, particularly affecting women and older adults[11] Additionally, our findings confirm that obesity prevalence increases with age, doubling among those aged 50–59 years compared to adults under 30 year, with a higher prevalence observed among women.

RFM incorporates height, waist circumference, and sex into its equation, making it a strong predictor of body fat percentage. These characteristics position RFM as a potential tool for cardiovascular risk assessment[21]. Regarding dyslipidemias, we found that low HDL levels were significantly associated with obesity, consistent with the inverse relationship between body fat percentage and this lipid marker[22]. However, no association was found with hypercholesterolemia or elevated LDL levels. These results could be due to genetic and ethnic variations in our sample of Latino adults, who appear to be less susceptible to hypercholesterolemia[23,24]. Regarding metabolic syndrome, several studies have evaluated RFM's predictive ability for this condition yielding results consistent with our findings[25,26], including studies conducted in Peruvian adults[13].

Contrary to expectations, obesity was not associated with socioeconomic determinants such as education level, poverty, or place of residence[3]. This might be explained by the specific characteristics of our surveyed population, where no significant differences were observed among subgroups. In the context of epidemiological and nutritional transitions, Peru has improved health equity indicators, narrowing the gap in healthcare access across different groups[27]. Similarly, lifestyle factors such as smoking, alcohol consumption, and fruit and vegetable intake were not associated with obesity. Fruits and vegetables provide essential nutrients for a healthy diet and are key in obesity prevention. However, our results align with findings from other Peruvian population-based surveys, where fruit and vegetable consumption was not associated with obesity based on BMI[28] or with high waist circumference[29]. While some evidence suggests that fruit and vegetable intake has no direct effect on obesity[30], these findings could be influenced by the data collection method used in the survey—24-hour dietary recall.

This study has some limitations that should be considered. First, the cross-sectional design only allows for associations to be established, not causal pathways, and reverse causality cannot be ruled out. Second, due to our sample's characteristics, findings may not be generalizable to other Latin American ethnic groups. Third, we did not account for additional potential confounders that could influence the associations, as the survey did not collect such information. Nevertheless, a key strength of our study is its national representativeness, enabled by the survey's sampling technique. This allows for population-level inference in Peru, making our findings relevant for public health decision-making.

CONSLUSIONS

Six out of ten Peruvian adults were classified as obese according to RFM during 2017–2018. Women had an obesity prevalence more than 30 percentage points higher than men. Additionally, obesity prevalence increased with age, nearly doubling among adults aged 50–59 years compared to younger adults. By using an alternative diagnostic criterion for obesity, our findings reveal a concerning epidemiological scenario, suggesting that the true burden of obesity in Peru may be underestimated.

ACKNOWLEDGMENTS

We extend our gratitude to the National Institute of Health of Peru and the National Center for Food, Nutrition, and Healthy Living for their efforts in developing the VIANEV survey, which continues to provide valuable data for research.

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