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Trends in obesity and socioeconomic status in the Peruvian population between the years 2015-2024: an analysis of a national survey

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Abstract

Purpose: Obesity is a global health issue that is influenced by socioeconomic status, but its pattern of distribution may vary across contexts. There is little evidence in Peru of how socioeconomic inequalities in obesity have changed over time. The objective of this study was to assess the association between socioeconomic status and obesity among Peruvian adults during the 2015–2024 period and to describe temporal trends according to sex and area of residence.

Methods: Analytical cross-sectional repeated-series studies using Databases from the 2015-2024 Demographic and Family Health Survey (ENDES). Elevated BMI was defined as an obesity of a BMI $\geq$ 30 kg/m^2. Weighted prevalence estimates were calculated, and crude and adjusted PRs were obtained by Poisson regression models with robust variance accounting for the complex survey design.

Results: There were 278,824 participants in total. During the period from 2015 to 2024, the weighted prevalence of obesity in 2015 was 20.4% and advanced to 29.1% in 2024. Women consistently showed a higher prevalence of obesity than men throughout the study period, and likewise urban residents compared to rural. A positive socioeconomic gradient was found, being more common among those in the richest quintiles. Although obesity increased across all socioeconomic strata, this gradient continued over time.

Conclusion: In adjusted models, higher socioeconomic status, female sex, older age, urban residence and later survey years were independent determinants of obesity. In the last decade obesity prevalence in Peruvian adults increased significantly, particularly among women and is unequal between socioeconomic groups.

These results call for specific public health efforts to deal with the rising obesity levels as well as their unequal distribution among wealth groups.

Keywords: ENDES, obesity, socioeconomic status

1 Background

Obesity is a chronic illness and a serious public health challenge mainly because of its rising numbers and its strong link to diabetes type 2, high blood pressure, heart diseases and other long-lasting ailments. World-wide in the year 2022, 16% of the adult population was obese and 43% were overweight [1, 2].

This is evidence that excess body fat accumulation is not only an individual issue but also a result of social, environmental and economic factors. Socioeconomic status influences obesity through access to food, exposure to environments that promote weight gain, opportunities for physical activity, and access to health services. This relationship, however, is not the same everywhere. In Latin America, the social gradient of obesity differs by sex, urban or rural setting, and local level of development. For that reason, findings from high-income countries should not be applied to Peru without context- specific evidence [3–5].

In Peru, recent evidence suggests that the burden of adiposity is high and socially unequal. A nationwide study based on the 2018-2019 Demographic and Family Health Survey (ENDES) [6] found that abdominal obesity affected 73.8% of adults and was more highly concentrated among wealthier groups, with marked differences by sex. Consistently, a subsequent multilevel analysis showed that abdominal obesity in the country is determined not only by individual characteristics, but also by territorial contextual factors and the food environment. Furthermore, more recent evidence based on ENDES 2021–2023 has shown that relying exclusively on body mass index may underestimate a relevant proportion of clinically significant adiposity, reinforcing the need to study this problem from a population-based and social inequality perspective [6–9].

Despite this, national evidence examining socioeconomic inequality in obesity over time using comparable annual series from national surveys remains limited [5, 10]. ENDES provides a suitable data source for this purpose because it is conducted continuously, uses a complex sampling design, and is nationally representative. However, each survey round comprises an independent sample; therefore, it allows the assessment of population-level trends but not individual trajectories [11]. In this context, the present study aims to assess the association between socioeconomic status and obesity among Peruvian adults during the 2015–2024 period and to describe temporal trends according to sex and area of residence.

2 Methods

2.1 Study Population and Design

An observational, analytical, repeated cross-sectional study was conducted based on a secondary analysis of ENDES data corresponding to the 2015–2024 period.

ENDES is a nationally representative population-based survey designed to generate representative estimates of demographic and health indicators in Peru. It uses a probabilistic, two-stage, stratified, independent, and balanced sampling design, with representativeness at the national level, by urban and rural area, natural region, and department.

Sample selection is performed in two stages. In the first stage, clusters are selected with probability proportional to size; in the second stage, households within each cluster are selected using balanced sampling.

Furthermore, the survey incorporates weighting factors to correct for unequal probabilities of selection and adjust for non-response, thereby ensuring population representativeness.

For the present study, we used the health module for individuals aged 18 years and older (CSALUD01), supplemented with household information (RECH0, RECH23) and data from the individual module (RECH5). The databases were merged using unique household- and individual-level identifiers.

As shown in Figure 1, the inclusion criteria were as follows: being aged 18 years or older, having participated in the CSALUD01 module, belonging to the Peruvian population residing in urban or rural areas, having complete information on the variables of interest, and having participated in ENDES between 2015 and 2024. Participants were excluded if they had missing data on sampling weights, survey design variables, anthropometric measurements, or educational information; were aged < 18 years; were currently pregnant; or had implausible BMI values (<10 or >70 kg/m^2).

2.2 Variables

The dependent variable was obesity, defined using body mass index (BMI), calculated as weight in kilograms (QS900) divided by height in meters squared $(\text{QS901}/100)^2$; that is, $\text{BMI} = \text{weight}/\text{height}^2$. Obesity was defined as a BMI ≥ 30 kg/m^2. Weight and height were obtained primarily from the health module (CSALUD01: QS900, QS901) and, when these data were unavailable, were retrieved from the individual module (RECH5: HA2, HA3), considering only valid anthropometric measurements according to the QS902 variable.

The primary independent variable was socioeconomic status, measured using the household wealth index (HV270) categorized into quintiles. Age (QS23), sex (QSSEXO), educational level (QS25N), area of residence (HV025), and geographic region (SHREGION) were included as covariates [12].

In addition, the survey design variables were incorporated: cluster (qhcluster/HV001), stratum (HV022), and sampling weight (PESO15 AJUS for 2015 and PESO15 AMAS for 2016–2024), in order to obtain population-representative estimates.

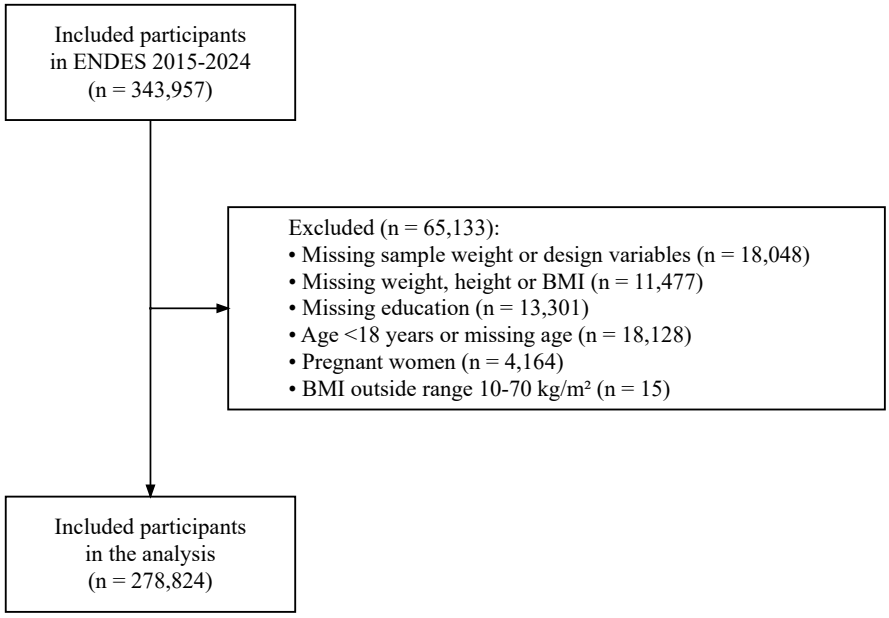


Fig. 1 Flowchart of participant selection for the study

2.3 Statistical analysis

The ENDES databases corresponding to the 2015–2024 period were processed and merged annually using the *tidyverse* and *haven* packages. Because ENDES uses a complex, stratified, two-stage sampling design, all descriptive and inferential analyses incorporating sampling weights, strata, and primary sampling units were conducted using the *survey* package. The complex survey design was specified using the primary sampling unit (HV001), the stratification variable (HV022), and the annual sampling weights for adults aged 18 years and older (PESO15_AJUS for 2015 and PESO15_AMAS for the 2016–2024 period).

To calculate BMI, given that the height variables in the "RECH5" questionnaire were stored in centimeters, BMI was calculated as weight/(height^2) $\times$ 10,000. Subsequently, the exclusion criteria were applied.

Categorical variables were summarized as weighted percentages, whereas continuous variables were described using weighted means and standard deviations. Weighted estimates of the annual prevalence of obesity and their 95% confidence intervals (95% CIs) were calculated using the *svymean* and *svyby* functions. Temporal trends were assessed graphically overall and stratified by sex and socioeconomic status.

Associations between socioeconomic status and obesity were evaluated using generalized linear models with a Poisson distribution and log link function, applying robust variance estimation through the survey design framework *('svyglm(..., family = quasipoisson(link = "log"))')*. Crude and adjusted prevalence ratios (PRs) with 95%

confidence intervals were estimated. The adjusted model included age (QS23), socioeconomic status (HV270), sex (QSSEXO), educational level (QS25N), area of residence (HV025), and geographic region (SHREGION). All statistical tests were two-sided, and a p-value < 0.05 was considered statistically significant.

3 Results

The analysis included data from the Peruvian Demographic and Family Health Survey (ENDES) corresponding to the 2015–2024 period, using publicly available secondary data. A total of 278,824 participants were analyzed during the study period. The descriptive characteristics of the weighted analytical population according to survey year are presented in Table 1.

The mean age of the analyzed population showed a gradual increase over the study period, from 40.8 ± 16.4 years in 2015 to 43.1 ± 17.0 years in 2024. Mean body mass index also increased slightly, from 26.6 ± 4.5 kg/m^2 in 2015 to 27.8 ± 4.9 kg/m^2 in 2024, with the highest mean value of 27.8 kg/m^2 observed in 2021, 2022, and 2024.

The proportion of participants with obesity increased from 20.4% in 2015 to 29.1% in 2024. The highest percentages were observed in 2024 (29.1%), 2022 (29.0%), and 2021 (28.9%), suggesting an overall increasing trend, although with slight annual fluctuations.

The distribution by sex was relatively balanced throughout the study period. The proportion of men decreased from 51.3% in 2015 to 48.8% in 2024, whereas the proportion of women increased from 48.7% to 51.2% over the same period. Regarding area of residence, the urban population predominated in every year, increasing from 67.9% in 2015 to 83.2% in 2024. In contrast, the rural population decreased from 32.1% in 2015 to 16.8% in 2024.

Regarding educational level, the proportion of individuals with no formal education was low throughout the study period, decreasing from 1.1% in 2015 to 0.5% in 2024. The proportion with primary education decreased from 28.8% to 19.1%, whereas secondary education remained one of the most frequent categories, with values close to 40% throughout the period, increasing slightly from 42.6% in 2015 to 43.0% in 2024. In contrast, the proportion with higher education increased from 27.5% in 2015 to 37.4% in 2024.

According to socioeconomic status, the poorest group did not account for the largest proportion throughout the entire period. Indeed, the proportion in this group decreased from 23.7% in 2015 to 17.1% in 2024. The remaining quintiles showed relatively similar proportions toward the end of the period, with values around 20% in 2024: poorer, 20.0%; middle, 21.0%; richer, 21.2%; and richest, 20.7%.

According to natural region, the capital category accounted for the largest proportion in most years after 2017, increasing from 26.7% in 2015 to 38.1% in 2024. The Coast remained relatively stable, changing from 26.7% to 25.9%, whereas the Highlands decreased from 31.2% to 23.4% and the Jungle from 15.4% to 12.6% between 2015 and 2024.

Figure 2 shows the annual trend in obesity prevalence among the analyzed population from ENDES Peru during the 2015–2024 period. Overall, an upward trend was

Table 1 Weighted descriptive characteristics of the analyzed population by year, ENDES Peru, 2015–2024

Variable	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Age, mean±SD	40.8±16.4	41.1±16.4	41.5±16.6	41.8±16.6	42.1±16.7	41.7±16.6	41.8±16.5	42.0±16.6	42.5±16.7	43.1±17.0
BMI, mean±SD	26.6±4.5	26.8±4.7	27.2±4.7	27.4±4.7	27.4±4.6	27.7±4.9	27.8±4.9	27.8±4.9	27.7±4.9	27.8±4.9
Obesity (%)	20.4	21.2	23.9	26.2	25.5	27.6	28.9	29.0	27.8	29.1
Male (%)	51.3	51.1	50.4	50.1	49.6	48.3	49.2	48.7	49.2	48.8
Female (%)	48.7	48.9	49.6	49.9	50.4	51.7	50.8	51.3	50.8	51.2
Urban (%)	67.9	66.9	81.0	82.2	82.3	82.7	82.0	82.7	82.7	83.2
Rural (%)	32.1	33.1	19.0	17.8	17.7	17.3	18.0	17.3	17.3	16.8
Education										
No education (%)	1.1	1.1	0.7	0.8	0.8	0.6	0.6	0.6	0.5	0.5
Primary (%)	28.8	28.0	22.3	21.4	21.4	19.0	20.1	20.0	19.4	19.1
Secondary (%)	42.6	41.9	42.6	42.0	40.8	44.1	44.3	44.6	44.1	43.0
Higher (%)	27.5	29.0	34.3	35.9	37.0	36.3	35.0	34.9	36.0	37.4
Socioeconomic Status										
Poorest (%)	23.7	24.0	16.6	16.7	16.8	15.5	17.6	17.4	17.4	17.1
Poor (%)	20.8	21.7	20.4	20.4	21.1	19.2	20.0	20.3	19.6	20.0
Middle (%)	18.8	19.1	21.4	21.1	20.9	21.7	21.1	21.5	20.9	21.0
Rich (%)	18.9	18.2	21.1	21.2	20.6	21.2	20.6	20.8	21.4	21.2
Richest (%)	17.8	17.0	20.5	20.6	20.7	22.3	20.7	19.9	20.8	20.7
Region										
Capital (%)	26.7	26.3	38.1	38.9	39.3	41.8	36.2	38.0	38.2	38.1
Coast (%)	26.7	25.2	25.4	25.6	25.6	24.7	27.1	26.1	25.9	25.9
Highlands (%)	31.2	32.4	24.5	23.8	23.5	22.1	23.8	23.5	23.2	23.4
Jungle (%)	15.4	16.1	12.0	11.8	11.7	11.5	12.8	12.4	12.7	12.6

ENDES: National Demographic and Family Health Survey; BMI: body mass index; SD: standard deviation. Continuous variables are presented as means ± SD; categorical variables are presented as percentages.

observed, with obesity prevalence increasing from 20.4% in 2015 to 29.1% in 2024, representing an absolute increase of 8.7 percentage points over the study period.

Between 2015 and 2018, obesity prevalence increased steadily, from 20.4% to 26.2%. The largest year-over-year increases were observed between 2016 and 2017, with an increase of 2.7 percentage points, and between 2017 and 2018, with an increase of 2.3 percentage points. In 2019, a slight decrease was observed compared with the previous year, with a prevalence of 25.5%.

Subsequently, prevalence increased again in 2020 and 2021, reaching 27.6% and 28.9%, respectively. In 2022, relative stabilization was observed, with a prevalence of 29.0%, followed by a decrease to 27.8% in 2023. And finally, in 2024, the highest value of the study period was observed with a prevalence of 29.1%.

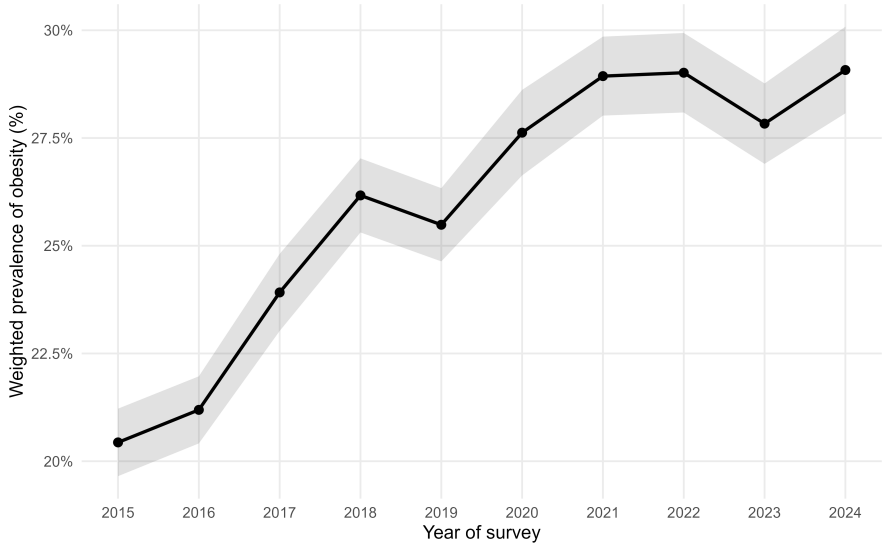


Fig. 2 Yearly trend of annual prevalence of obesity. Weighted estimates with 95% confidence intervals

Figure 3 shows the weighted annual prevalence of obesity by sex among the analyzed population from ENDES Peru during the 2015–2024 period. In all years evaluated, women had a higher prevalence of obesity than men, with a persistent gap throughout the series. Among men, prevalence increased from 15.8% in 2015 (95% CI: 14.8–16.7) to 24.1% in 2024 (95% CI: 22.8–25.4), representing an absolute increase of 8.3 percentage points.

Among men, the trend showed a sustained increase between 2015 and 2018, from 15.8% to 22.7%. In 2019, a decrease to 21.6% was observed, followed by a renewed increase in 2020 and 2021. The highest values were recorded in 2021, 2022, and 2024, all with a prevalence of 24.1%. In 2023, a relative decrease to 22.8% was observed, before a new increase in 2024.

Among women, the weighted prevalence of obesity also increased during the study period, from 25.4% in 2015 (95% CI: 24.3–26.4) to 33.8% in 2024 (95% CI: 32.5–35.2),

corresponding to an absolute increase of 8.4 percentage points. Prevalence increased progressively between 2015 and 2018, decreased slightly in 2019, and increased again from 2020 onward. Since that year, prevalence among women remained above 32%, reaching its highest value in 2024.

The absolute gap between women and men persisted throughout all years evaluated. This difference ranged from 7.0 percentage points in 2018 to 9.9 percentage points in 2023. In 2024, the gap was 9.7 percentage points, with a prevalence of 33.8% among women compared with 24.1% among men. Overall, these results show an increase in obesity in both sexes during the 2015–2024 period, although with a consistently greater burden among women.

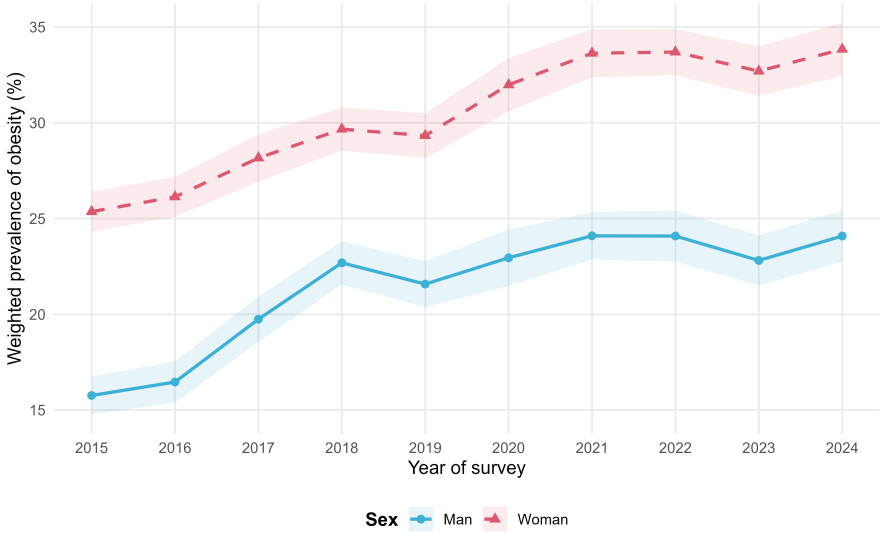


Fig. 3 Yearly prevalence of obesity by sex. Weighted estimates with 95% confidence intervals

Figure 4 shows the annual trend in the weighted prevalence of obesity according to socioeconomic status among the analyzed population from ENDES Peru during the 2015–2024 period. In all years evaluated, the poorest quintile had the lowest prevalence of obesity, whereas the middle, richer, and richest quintiles showed the highest prevalences. However, the pattern was not strictly monotonic in all years, because the richer quintile or the middle quintile exceeded the richest quintile in some periods.

In 2015, the weighted prevalence of obesity was 9.6% in the poorest quintile (95% CI: 8.7–10.5), 17.0% in the poorer quintile (95% CI: 15.7–18.2), 24.5% in the middle quintile (95% CI: 22.9–26.2), 27.6% in the richer quintile (95% CI: 25.6–29.6), and 27.1% in the richest quintile (95% CI: 24.9–29.2). The absolute gap between the richest quintile and the poorest quintile was 17.5 percentage points; when compared with the group with the highest prevalence that year, which was the richer quintile, the gap was 18.0 percentage points.

During the study period, the prevalence of obesity increased across all socioeconomic levels. Between 2015 and 2024, the poorest quintile increased from 9.6% to 17.1%, the poorer quintile from 17.0% to 28.0%, the middle quintile from 24.5% to 31.5%, the richer quintile from 27.6% to 33.9%, and the richest quintile from 27.1% to 32.6%. The largest absolute increase was observed in the poorer quintile, with an increase of 11.0 percentage points, followed by the poorest quintile, with 7.5 percentage points.

In 2024, the weighted prevalence of obesity was 17.1% in the poorest quintile (95% CI: 16.0–18.2), 28.0% in the poorer quintile (95% CI: 26.3–29.6), 31.5% in the middle quintile (95% CI: 29.5–33.4), 33.9% in the richer quintile (95% CI: 31.5–36.4), and 32.6% in the richest quintile (95% CI: 29.9–35.4). The gap between the richest quintile and the poorest quintile was 15.5 percentage points; when comparing the richer quintile with the poorest quintile, the difference was 16.8 percentage points.

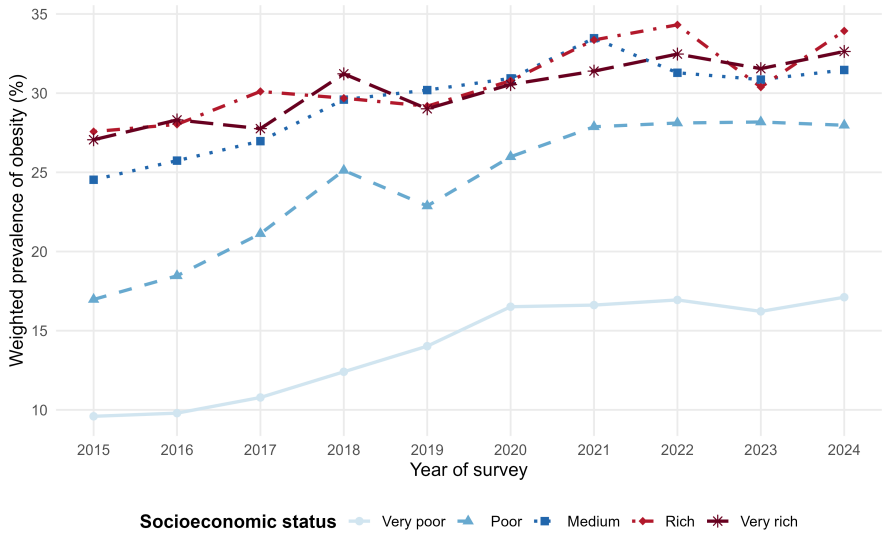


Fig. 4 Annual trend of obesity prevalence by socioeconomic level

Table 2 presents the sociodemographic factors associated with obesity using Poisson regression with robust variance in ENDES Peru 2015–2024. In the adjusted model, socioeconomic status remained positively associated with obesity. Compared with the "poorest" group, the adjusted prevalence ratio was higher in the poorer (adjusted PR: 1.49; 95% CI: 1.44–1.55), middle (adjusted PR: 1.68; 95% CI: 1.61–1.75), richer (adjusted PR: 1.72; 95% CI: 1.64–1.79), and richest quintiles (adjusted PR: 1.68; 95% CI: 1.60–1.77). All these associations were statistically significant ($p < 0.001$). The largest adjusted magnitude of association was observed in the richer quintile, not in the richest quintile.

Regarding survey year, using 2015 as the reference category, 2016 did not show a statistically significant association after adjustment (adjusted PR: 1.04; 95% CI: 1.00–1.09; p = 0.070). From 2017 onward, all years showed a higher adjusted prevalence of obesity compared with 2015. The highest adjusted prevalence ratios were observed in 2021 (adjusted PR: 1.31; 95% CI: 1.26–1.38) and 2022 (adjusted PR: 1.31; 95% CI: 1.25–1.37), followed by 2024 (adjusted PR: 1.30; 95% CI: 1.24–1.37). These results suggest a sustained increase in obesity prevalence in the years after 2015, even after adjustment for sociodemographic variables.

Age was strongly associated with obesity. Compared with the 18–30-year age group, adjusted prevalence was higher among those aged 31–40 years (adjusted PR: 1.70; 95% CI: 1.65–1.75), 41–50 years (adjusted PR: 1.99; 95% CI: 1.93–2.06), 51–60 years (adjusted PR: 1.96; 95% CI: 1.89–2.03), and 60 years or older (adjusted PR: 1.52; 95% CI: 1.45–1.58). The strongest association was observed in the 41–50-year age group.

Regarding sex, women had a 39% higher adjusted prevalence of obesity than men (adjusted PR: 1.39; 95% CI: 1.36–1.42; p < 0.001). With respect to area of residence, the rural population had a lower adjusted prevalence of obesity compared with the urban population (adjusted PR: 0.83; 95% CI: 0.80–0.86; p < 0.001).

Compared with the capital, the Coast had a slightly higher adjusted prevalence of obesity (adjusted PR: 1.07; 95% CI: 1.04–1.10; p < 0.001). In contrast, the Highlands (adjusted PR: 0.76; 95% CI: 0.74–0.79) and the Jungle (adjusted PR: 0.89; 95% CI: 0.86–0.92) had a lower adjusted prevalence of obesity compared with the capital.

Regarding educational level, after adjustment, all educational levels showed a lower prevalence of obesity compared with the group with no formal education. Primary education had an adjusted PR of 0.88 (95% CI: 0.80–0.97; p = 0.008), secondary education an adjusted PR of 0.87 (95% CI: 0.79–0.96; p = 0.004), and higher education an adjusted PR of 0.77 (95% CI: 0.70–0.84; p < 0.001). This pattern suggests that, once the other variables in the model were controlled for, higher educational attainment was associated with a lower prevalence of obesity. However, this finding should be interpreted cautiously because the reference category was small, potentially heterogeneous and the crude analysis did not show statistically significant associations for primary, secondary, or higher education.

Overall, the results in Table 2 indicate that obesity was independently associated with higher socioeconomic status, survey years after 2015, older age, female sex, urban residence, and region. In addition, after adjustment, primary, secondary, and higher educational levels were associated with a lower prevalence of obesity compared with the group with no formal education.

4 Discussion

The findings of the present study showed that socioeconomic status was significantly associated with obesity in the Peruvian adult population. Likewise, the prevalence of obesity increased between 2015 and 2024 across all socioeconomic strata, with a socioeconomic gradient persisting throughout the evaluated period. In addition, the weighted prevalence was higher among women.

Table 2 Sociodemographic factors associated with obesity using Poisson regression with robust variance, ENDES Peru 2015–2024

Variable	Crude PR (95% CI)	p value	Adjusted PR (95% CI)	p value
Socioeconomic status				
Poorest	1.00 (reference)		1.00 (reference)	
Poor	1.77 (1.71–1.83)	< 0.001	1.49 (1.44–1.55)	< 0.001
Middle	2.16 (2.09–2.24)	< 0.001	1.68 (1.61–1.75)	< 0.001
Rich	2.25 (2.18–2.33)	< 0.001	1.72 (1.64–1.79)	< 0.001
Richest	2.21 (2.13–2.30)	< 0.001	1.68 (1.60–1.77)	< 0.001
Survey year				
2015	1.00 (reference)		1.00 (reference)	
2016	1.04 (0.99–1.09)	0.142	1.04 (1.00–1.09)	0.070
2017	1.17 (1.11–1.23)	< 0.001	1.09 (1.04–1.15)	< 0.001
2018	1.28 (1.22–1.35)	< 0.001	1.19 (1.13–1.24)	< 0.001
2019	1.25 (1.19–1.31)	< 0.001	1.16 (1.10–1.21)	< 0.001
2020	1.35 (1.28–1.42)	< 0.001	1.24 (1.18–1.30)	< 0.001
2021	1.42 (1.35–1.49)	< 0.001	1.31 (1.26–1.38)	< 0.001
2022	1.42 (1.35–1.49)	< 0.001	1.31 (1.25–1.37)	< 0.001
2023	1.36 (1.29–1.43)	< 0.001	1.25 (1.20–1.31)	< 0.001
2024	1.42 (1.35–1.50)	< 0.001	1.30 (1.24–1.37)	< 0.001
Age in years				
18-30	1.00 (reference)		1.00 (reference)	
31-40	1.71 (1.67–1.76)	< 0.001	1.70 (1.65–1.75)	< 0.001
41-50	2.03 (1.97–2.09)	< 0.001	1.99 (1.93–2.06)	< 0.001
51-60	2.04 (1.97–2.11)	< 0.001	1.96 (1.89–2.03)	< 0.001
>60	1.60 (1.54–1.66)	< 0.001	1.52 (1.45–1.58)	< 0.001
Sex				
Male	1.00 (reference)		1.00 (reference)	
Female	1.43 (1.40–1.46)	< 0.001	1.39 (1.36–1.42)	< 0.001
Region				
Capital	1.00 (reference)		1.00 (reference)	
Coast	1.00 (0.98–1.03)	0.850	1.07 (1.04–1.10)	< 0.001
Highlands	0.58 (0.57–0.60)	< 0.001	0.76 (0.74–0.79)	< 0.001
Jungle	0.68 (0.66–0.70)	< 0.001	0.89 (0.86–0.92)	< 0.001
Area of residence				
Urban	1.00 (reference)		1.00 (reference)	
Rural	0.52 (0.51–0.54)	< 0.001	0.83 (0.80–0.86)	< 0.001
Educational level				
No education	1.00 (reference)		1.00 (reference)	
Primary	0.94 (0.85–1.03)	0.195	0.88 (0.80–0.97)	0.008
Secondary	1.01 (0.92–1.12)	0.781	0.87 (0.79–0.96)	0.004
Higher	0.99 (0.90–1.09)	0.822	0.77 (0.70–0.84)	< 0.001

PR: prevalence ratio; CI: confidence interval; BMI: body mass index; ENDES: National Demographic and Family Health Survey.

The persistent rise in obesity reported in this study may reflect an epidemic and nutritional transition which seems to be advancing across Peru towards more progressive transitions for diet, physical activity and the built environment [8, 10]. This trend was in line with findings from studies where rapid urbanization and economic development have been related to increasing obesity burden in low- to middle-income settings [13–18]. This pattern may be explained by several mechanisms, such as higher income

groups having access to ultra-processed and energy-dense foods; a shift toward sedentary lifestyles, westernized patterns of consumption and changes in food environment [19–21].

This study was designed to assess the association between obesity and socioeconomic status, which showed that people who belonged to the wealthier quintiles clearly showed an increased burden of disease than those in lower socioeconomic groups. This is in line with the patterns seen in other low- and middle-income countries, where obesity often grows among higher socioeconomic groups first [6, 17, 22–24]. This stands in sharp contrast to patterns observed for example from high-income countries, where lower socioeconomic status is generally associated with higher obesity rates [25–27]. The stable nature of this gradient is in line with findings in middle-income countries experiencing these types of nutritional and epidemiological transitions, wherein as economies open up, they are highly correlated with increased exposure to energy-dense diets and less physically active lifestyles [13]. This pattern may be driven by several interrelated mechanisms. Higher-income groups may be more exposed to ultra-processed and energy-dense foods which are often more accessible in urban retail settings, although they can also be costly [28, 29]. Second, economic development and labor market transitions toward service-sector and office-based occupations may reduce routine physical activity [30, 31]. Thirdly, a greater dependence on motorized transport and also lower levels of energetic commuting may act to promote sedentary way of lives in higher socioeconomic groups [32]. Moreover, more affluent residents of cities may be even less insulated against obesogenic environments like high levels of processed food marketing, greater density of fast-food outlets and lesser structural incentives for incorporating physical activity into everyday life. Cultural and behavioral factors may also underlie the trends; for example, dietary westernization, time poverty promoting consumption of fast or ready-to-eat foods, cultural norms surrounding meal timing [33–35]. Finally, the gradual dissemination of these risks to lower-income groups can contribute to clarifying the general increase in obesity, even if relative differences between wealth quintiles remain fundamentally stable.

During this study period, women presented a higher burden of obesity than men. This trend is in line with findings from international literature which shows that there are heterogeneous distributions of obesity among men and women and that these have likely resulted by a combination of biological, social, cultural and environmental factors [36].

Regionally, these findings align with recently reported evidence from Latin America, where a high obesity burden was identified, especially among women. A systematic review and meta-analysis of abdominal obesity in the region showed significant sexual dimorphism discarding the suggestive concept that sex differences only modulate the prevalence of general adiposity determined by BMI. It is crucial since BMI may underestimate or not capture the differences in body composition and metabolic risk between males and females [37].

This pattern is consistent with recent evidence available for Peru and Latin America, where the burden of obesity, especially when assessed using indicators of central adiposity, tends to be higher among women. In Peruvian studies based on national surveys, abdominal obesity has also been reported more frequently among

women, although socioeconomic inequalities may be expressed with different magnitudes according to sex [6]. Similarly, recent reviews in Peruvian and Latin American populations show that the magnitude of obesity varies according to the anthropometric indicator used, but consistently indicate a substantial burden of excess adiposity among adult women [10, 37].

In the present study, increases in the prevalence of obesity were observed during the years coinciding with the COVID-19 pandemic period, particularly around the years following the onset of public health restrictions. This pattern should not be interpreted as direct causal evidence; however, the temporal coincidence between the pandemic period and the observed increases in obesity is epidemiologically relevant. During the pandemic, changes were reported in mobility, physical activity, food access, family routines, psychosocial stress, and consumption patterns, all of which may have favored behaviors related to body weight gain [38, 39].

This behavior is comparable to that described in Latin American studies during the early stage of the pandemic, where perceived changes in body weight, reduced physical activity, and modifications in eating habits during lockdown were reported. In this sense, the increases observed in ENDES during the years close to COVID-19 may reflect a temporary intensification of pre-existing obesogenic exposures rather than the emergence of an entirely new phenomenon [39].

In addition, the pandemic period may have modified dietary patterns. Difficulties in accessing certain foods, less frequent shopping, greater time spent at home, consumption of more energy-dense products, and changes in meal schedules may have contributed to an environment more favorable to weight gain. In the Peruvian population, changes in dimensions of the neighborhood food system and in consumption associated with variations in body weight were described during the first lockdowns [40].

Therefore, the findings suggest that the COVID-19 period may have coincided with temporary increases in the prevalence of obesity within a broader upward trend. The most robust interpretation is that the pandemic did not initiate the problem, but may have intensified pre-existing conditions related to obesogenic environments, sedentary behavior, and changes in dietary patterns. Due to the repeated cross-sectional design of the study, this relationship should be understood as a plausible temporal association rather than a demonstrated causal relationship.

This study has certain limitations. Since this is a repeated cross-sectional study of ENDES data, it does not permit causal inference, so associations between obesity and sociodemographic variables must be interpreted as epidemiological relationships and not direct effects. Furthermore, only the variables which were available in a secondary dataset were available for analysis. Residual confounding may exist as other relevant variables were not available, including dietary assessment, physical activity, sleep, stress and comorbidities and medication use. The second limitation includes that obesity was defined solely by BMI, which does not differentiate fat mass from lean mass nor body fat distribution. Thus, the results are more representative of BMI-defined obesity than clinically or metabolically relevant obesity. While complex sampling design was incorporated, the individual annual comparisons may be confounded by operational and methodological changes in the survey, response burden

and other potential disruptions induced by COVID-19. Thus, the rise seen in that time frame should be regarded as a possible temporal correlation not an established result. The association of higher educational levels with obesity has to be interpreted cautiously since the change in direction after adjustment indicates confounding by socioeconomic measures, residence, age and survey year. Higher education should not be interpreted as having a protective effect.

One of the strengths of this study is that it uses a national, periodic, publicly available survey (ENDES), which can evaluate trends in obesity while helping to inform health policies in Peru. The larger sample size and ten years of coverage offered more stability in the analysis of annual patterns, sex differences, and the socioeconomic gradient. Also, the use of anthropometric measures mitigated bias related to self-reported weight and height. Use of weights, strata and clusters adjusted for the complex sampling design, which enhances population validity of estimates. For a cross-sectional study, Poisson regression with robust variance was performed to estimate prevalence ratios.

This implies that future studies should be conducted to investigate the obesity dynamics in Peru. Longitudinal studies are necessary to better examine the causal pathways involved between socio-economic status and obesity, as cross-sectional designs alone do not prove the temporality or direction of effect. Second, it would be necessary to include more detailed behavioral and environmental exposure variables (e.g., dietary patterns, physical activity intensity, sedentary time, food environment characteristics or calories intake), which are not sufficiently reflected in ENDES. Third, employment of alternative anthropometric indices of adiposity (eg, waist circumference, waist-to-height ratio or body composition metrics) may reflect cardiometabolic risk more accurately than BMI. Moreover, clarifying contextual phenomena such as urbanization, disparity between regions, and neighborhood environmental factors (food access, physical activity infrastructure, urban connectivity) may require multilevel and spatial analytical methods. Answers will be needed from systematic evaluations of the impacts of public health policies and interventions over time on their effects, both on overall levels of obesity and on sustaining or increasing persistent socioeconomic inequalities in obesity.

5 Conclusions

In the present study, a sustained increase in obesity was observed among the Peruvian adult population during the 2015–2024 period, with a greater burden among women, urban residents, and middle-aged adults. Likewise, a persistent socioeconomic gradient was identified, with a higher prevalence in the quintiles with higher socioeconomic status, although the increase was observed across all strata. The adjusted analysis confirmed that socioeconomic status, age, female sex, urban residence, and some survey years after 2015 were independently associated with obesity. Finally, the increases coinciding with the COVID-19 period suggests a possible temporary intensification of the trend, without implying direct causality.

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6 List of abbreviations

ENDES: National Demographic and Family Health Survey
INEI: National Institute of Statistics and Informatics
BMI: Body Mass Index
SD: Standard Deviation
PR: prevalence ratio
CI: confidence interval

7 Declarations

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Competing interests

The authors declare no conflicts of interest.

Ethics approval and consent to participate

The study protocol was approved by the Ethics Committee of Universidad Peruana Unión (approval code: 2026-CEEPG-00068). This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. All participants provided verbal informed consent to participate in the survey. The analysis used anonymized, publicly available secondary data from the ENDES survey.

Consent for publication

Not applicable

Availability of data and materials

All the datasets analyzed in this study are publicly available from the INEI website.

Materials availability

Not applicable

Authors' contributions

All the authors contributed to the writing of this manuscript.

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