Epidemiology & Health Data Insights
(eISSN 3080-8111)

Original Article

Socioeconomic Inequalities in Obesity Among Korean Adults: The Role of Lifestyle Factors in KNHANES 2022–2024

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Received: May 07, 2026
Accepted: Jul 07, 2026

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Citation: Issayeva Z, Eun KS. Socioeconomic Inequalities in Obesity Among Korean Adults: The Role of Lifestyle Factors in KNHANES 2022–2024. Epidemiology and Health Data Insights. 2026;2(5):ehdi050. https://doi.org/10.63946/ehdi/18958

ABSTRACT

Background: Obesity is increasingly understood as a health outcome shaped by social conditions, yet evidence on socioeconomic inequalities in obesity in South Korea remains mixed, particularly with regard to lifestyle behaviours and sex differences.

Methods: This study uses pooled data from the Korea National Health and Nutrition Examination Survey (KNHANES) 2022–2024 (N=11,714 adults aged 19–64 years). Obesity was defined as body mass index ≥25 kg/m². Socioeconomic status (SES) was assessed using education, income, occupation, and a composite SES index. Lifestyle factors, including physical activity, smoking, alcohol consumption, sleep duration, and working hours, were included in sequential regression models to assess whether associations between socioeconomic status and obesity were attenuated after adjustment for these factors. Survey-weighted logistic regression models were estimated, with additional analyses stratified by sex.

Results: Lower socioeconomic status was associated with a higher likelihood of obesity, although the strength and pattern of this relationship differed between men and women. Among women, clear inverse gradients were observed across education, income, and the composite SES index. Among men, associations were weaker and less consistent. Adjustment for lifestyle factors attenuated several socioeconomic associations with obesity, although socioeconomic differences remained evident, particularly among women. The composite SES index showed more consistent associations than individual socioeconomic indicators.

Conclusion: Socioeconomic inequalities in obesity persist in South Korea and differ substantially by sex. Associations between socioeconomic status and obesity were attenuated after adjustment for lifestyle factors, although socioeconomic differences remained evident after adjustment. These findings highlight the importance of considering both behavioural and broader structural factors when addressing obesity inequalities.

Keywords: Obesity; Socioeconomic Factors; Health Behaviour; Life Style; South Korea

Introduction

Obesity has become a major public health concern worldwide, with prevalence rising steadily in both high-income and middle-income countries [1,2]. These trends are closely linked to broader structural changes accompanying economic development, including a shift toward more sedentary forms of work, increased availability of energy-dense foods, and changes in everyday health behaviours [3]. In addition to its increasing prevalence, obesity is associated with a wide range of adverse health outcomes, including cardiovascular disease, type 2 diabetes, and premature mortality [4].

Importantly, obesity is not evenly distributed across populations. A substantial body of research has shown that obesity is socially patterned and associated with socioeconomic status (SES), although the direction and magnitude of this relationship vary across countries and population groups [5,6]. In many high-income countries, individuals with lower SES, particularly women, tend to have higher rates of obesity [7]. These inequalities have been linked to differences in educational opportunities, material resources, health literacy, occupational conditions, and access to health-promoting environments.

South Korea provides an important context for examining socioeconomic inequalities in obesity. Although obesity prevalence has historically been lower than in many Western countries, rates have increased steadily in recent decades [8]. Rapid economic development, urbanization, changing labour market structures, and shifts in dietary and lifestyle patterns have transformed the social environment in which obesity develops. At the same time, South Korea is characterized by intense educational competition, long working hours, and workplace cultures that may shape health behaviours in ways that differ from those observed in other high-income countries [9, 10].

Previous studies using the Korea National Health and Nutrition Examination Survey (KNHANES) have identified socioeconomic differences in obesity, particularly among women. Lower educational attainment and lower income have been associated with higher obesity prevalence, whereas findings among men have been weaker, inconsistent, or in some cases reversed [11, 12]. These sex differences suggest that socioeconomic inequalities in obesity may be influenced by distinct social, occupational, and behavioural processes among men and women.

Lifestyle behaviours are widely recognized as important correlates of obesity. Physical activity, smoking, alcohol consumption, sleep duration, and working conditions have all been associated with body weight and metabolic health [13,14]. However, these behaviours are also socially patterned. Individuals in different socioeconomic positions often experience varying levels of occupational demands, access to health-promoting resources, time constraints, and exposure to health risks, which may contribute to differences in obesity prevalence across socioeconomic groups [15]. In the present study, lifestyle factors are examined as behavioural characteristics associated with both socioeconomic position and obesity and are included in sequential regression models to assess whether socioeconomic associations with obesity are attenuated after adjustment for these factors.

Despite a growing body of research, several gaps remain. First, many studies rely on single indicators of socioeconomic status, such as education or income, which may not fully capture the multidimensional nature of socioeconomic position [16]. Second, much of the existing Korean evidence is based on earlier survey waves and may not reflect recent changes in obesity prevalence, labour market conditions, and health behaviours. Third, relatively few studies have simultaneously examined multiple dimensions of socioeconomic status alongside behavioural factors using recent nationally representative data.

To address these gaps, this study uses nationally representative data from the Korea National Health and Nutrition Examination Survey (KNHANES) 2022–2024 to examine socioeconomic inequalities in obesity among Korean adults aged 19–64 years [17]. Socioeconomic status is assessed using education, household income, occupation, and a composite SES index that captures multiple dimensions of social stratification. Sequential regression models are used to assess whether associations between socioeconomic status and obesity are attenuated after adjustment for lifestyle characteristics. Analyses are further stratified by sex to explore potential differences between men and women.

By integrating socioeconomic, behavioural, and sex-specific perspectives, this study provides updated evidence on obesity inequalities in South Korea and contributes to a better understanding of how socioeconomic and behavioural factors are associated with obesity among Korean adults.

Methods

Study Design and Data Source

This study uses data from the Korea National Health and Nutrition Examination Survey (KNHANES), a nationally representative cross-sectional survey conducted by the Korea Disease Control and Prevention Agency (KDCA) [17]. KNHANES is designed to assess the health and nutritional status of the Korean population using a complex, multistage, stratified cluster sampling design. The survey includes three main components: a health interview, a health examination, and a nutrition survey. Anthropometric measurements, including height and weight, are obtained by trained personnel using standardized protocols to ensure measurement accuracy. The present study pooled data from the ninth wave of KNHANES (2022–2024), the most recent survey years available at the time of analysis. Combining multiple survey years increases statistical power and improves the stability of population estimates. Following KDCA recommendations, sampling weights were adjusted by dividing the original survey weights by the number of pooled survey years.

Study Population

The analytic sample was restricted to adults aged 19–64 years in order to focus on the working-age population, for whom socioeconomic status (SES) is most clearly reflected by educational attainment, income, and occupation. Individuals younger than 19 years or older than 64 years were excluded. Among 11,809 age-eligible participants, those with missing data on key socioeconomic, lifestyle, outcome, or covariate variables were excluded using a complete-case approach. After applying these criteria, the final analytic sample consisted of 11,714 individuals.

Measures

Obesity was defined using body mass index (BMI), calculated as weight in kilograms divided by height in meters squared (kg/m²). Height and weight were measured directly during the health examination component of KNHANES [17]. Consistent with recommendations for Asian populations, obesity was defined as BMI ≥25 kg/m² [18]. A binary outcome variable was created (1 = obese, 0 = non-obese), and continuous BMI was used in descriptive analyses.

Socioeconomic Status (SES) was measured using three commonly used indicators representing distinct dimensions of social stratification: educational attainment, household income, and occupation. Educational attainment was categorized into three levels: middle school or less, high school, and college or higher. Household income was measured using KNHANES income quintiles. Occupation was classified into four categories: white-collar, service/sales, manual, and not employed.

To capture the multidimensional nature of socioeconomic position, a composite SES index was constructed using education, income, and occupation. Educational attainment was coded from 1 (middle school or less) to 3 (college or higher), household income from 1 (lowest quintile) to 5 (highest quintile), and occupation from 1 (not employed) to 4 (white-collar). Higher values consistently represented more advantaged socioeconomic position. Because the three indicators were measured on different scales and contained different numbers of categories, each variable was standardized using z-scores prior to combination. Standardization placed all indicators on a common scale with a mean of zero and a standard deviation of one, ensuring that variables with a larger numerical range did not contribute disproportionately to the composite measure. The standardized education, income, and occupation scores were then averaged to create a composite SES score, giving equal weight to each socioeconomic dimension. Higher values indicated more advantaged socioeconomic position. The resulting composite SES score was categorized into quartiles (Q1–Q4), with Q1 representing the lowest socioeconomic position and Q4 representing the highest. Categorization into quartiles was used to facilitate interpretation and comparison across socioeconomic groups while retaining sufficient variation in the distribution of the composite SES measure. The composite index was intended to summarize multiple observed dimensions of socioeconomic position rather than measure a single latent construct.

Lifestyle Factors were included as behavioural characteristics associated with both socioeconomic status and obesity. These included physical activity, smoking status, alcohol consumption, sleep duration, and working hours. Physical activity was categorized as engaging in moderate or vigorous physical activity versus no reported moderate or vigorous physical activity. Smoking status was classified as current smoker (daily or occasional smoker) versus non-current smoker (former or never smoker). Alcohol consumption was categorized as frequent alcohol consumption (≥2–3 times per week) versus less frequent consumption (≤2–4 times per month) based on self-reported drinking frequency during the previous year. Sleep duration was assessed using self-reported average daily sleep time and categorized as short sleep (<6 hours/day) versus ≥6 hours/day. Working hours were measured as average weekly working hours, and long working hours were defined as more than 52 hours

per week, consistent with Korean labour regulations. These lifestyle factors were selected because they are established correlates of obesity and may vary across socioeconomic groups.

Covariates. The analysis controlled for demographic characteristics that may be associated with both socioeconomic status and obesity, including age, sex, marital status, region of residence, and survey year (2022–2024). Age was categorized into four groups (19–29, 30–39, 40–49, and 50–64 years). Marital status was classified as married or not married. Region of residence was categorized into the capital region, metropolitan cities, and provinces. Survey year was included as a categorical variable to account for potential temporal variation across the 2022–2024 survey period. Sex was included in the overall models and was additionally examined through sex-stratified analyses.

Statistical Analysis

All analyses accounted for the complex survey design of KNHANES, including sampling weights, clustering, and stratification variables. Descriptive statistics were used to summarize the characteristics of the study population and examine the distribution of obesity across socioeconomic groups and lifestyle factors. Weighted means and proportions were reported.

Survey-weighted logistic regression models were estimated to examine the association between socioeconomic status (SES) and obesity. A sequential modeling approach was used. Model 1 included individual SES indicators (education, household income, and occupation) and demographic covariates (age, sex, marital status, region, and survey year). Model 2 additionally adjusted for lifestyle factors, including physical activity, smoking status, alcohol consumption, sleep duration, and working hours. Model 3 examined the association between the composite SES index and obesity while adjusting for demographic covariates. Model 4 additionally adjusted for lifestyle factors. This sequential modelling approach was used to compare SES–obesity associations before and after adjustment for lifestyle factors. Regression models were estimated using complete cases for all variables included in each model, resulting in smaller analytic samples than those used in the descriptive analyses. Because additional covariates contained missing values, complete-case sample sizes varied across models and are reported in the corresponding tables.

To examine potential sex differences in socioeconomic inequalities in obesity, sex-stratified analyses were conducted separately for men and women. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance was defined as $P < 0.05$. All analyses were conducted using Stata/IC 16.1 (StataCorp, College Station, TX, USA).

Results

The study sample consisted of 11,714 Korean adults aged 19–64 years. Overall obesity prevalence (BMI ≥25 kg/m²) was 37.9%, with a markedly higher prevalence among men compared to women (48.7% vs. 26.4%) (Table 1).

Table 1. Characteristics of the study sample: Korean adults aged 19-64 years, KNHANES 2022-2024.

Characteristic	Total	Men	Women
Unweighted N	11,714	5,053	6,661
Age, mean (SD)	43.1 (13.0)	42.8 (12.9)	43.4 (13.0)
Educational attainment, %			
Middle school or less	7.2	5.8	8.7
High school	37.1	37.0	37.2
College or higher	53.9	55.3	52.4
Household income quintile, %			
Lowest	6.0	5.8	6.2
Low	12.9	11.1	14.7
Middle	21.9	21.0	22.8
High	28.3	29.4	27.1
Highest	30.7	32.5	28.8
Occupation, %			
Not employed	26.84	18.11	35.88
Manual	20.48	29.48	11.17
Service/sales	16.01	13.6	18.5

White-collar	36.67	38.81	34.46
Marital status, %			
Married	69.5	64.2	72.9
Not married	31.5	35.8	27.1
Region, %			
Capital region	52.3	51.6	53.1
Metropolitan cities	19.9	19.9	19.9
Provinces	27.8	28.6	27.0
BMI, mean (SD)	24.3 (4.1)	25.3 (3.8)	23.2 (4.0)
Obesity, %	37.9	48.7	26.4
Lifestyle factors %			
Physically active	52.9	55.0	50.8
Current smoker	19.2	32.5	5.3
Frequent alcohol consumption	23.0	32.1	15.2
Short sleep (<6 h/day)	11.1	10.6	11.8
Long working hours (>52 h/week)	12.1	15.7	7.7

Note. Values are weighted means (standard deviations) and weighted percentages derived from the KNHANES complex survey design. Unweighted sample sizes are reported.

Descriptive analyses revealed socioeconomic differences in obesity prevalence, although the patterns varied by sex. Obesity prevalence was higher among individuals with lower educational attainment and tended to decrease with increasing household income. Among women, a clear socioeconomic gradient was observed across multiple indicators. Obesity prevalence declined from 44.1% among women with middle school education or less to 21.7% among those with a college education or higher. Similarly, obesity prevalence decreased from 31.8% in the lowest income quintile to 20.3% in the highest income quintile. In contrast, the pattern among men was less consistent. Men with a college education had slightly higher obesity prevalence than those with lower levels of education, and obesity prevalence varied only modestly across income groups (Table 2).

Table 2. Obesity prevalence by socioeconomic status and sex among Korean adults aged 19–64 years, KNHANES 2022–2024.

Variable/category	Total obesity %	Men obesity %	Women obesity %
Education			
Middle school or less	45.4	47.2	44.1
High school	37.8	46.0	29.2
College or higher	36.9	50.5	21.7
Household income quintile			
Lowest	36.6	41.5	31.8
Low	37.8	47.9	29.8
Middle	40.2	50.1	30.6
High	39.1	49.9	26.6
Highest	35.5	48.3	20.3
Occupation			
Not employed	33.0	44.4	27.1
Manual	44.1	48.1	33.3
Service/sales	37.8	50.2	28.3
White-collar	37.8	51.1	22.3
Composite SES quartile			
Q1 (lowest)	38.5	44.5	33.6
Q2	36.9	48.0	26.9
Q3	38.2	50.2	22.4
Q4 (highest)	37.7	51.0	20.4

Similar sex differences were observed across composite SES quartiles. Among women, obesity prevalence declined steadily from 33.8% in the lowest SES quartile to 20.5% in the highest SES quartile. Among men, obesity prevalence showed the opposite tendency, increasing from 44.5% in the lowest SES quartile to 51.0% in the highest SES quartile. Figure 1 illustrates these contrasting patterns.

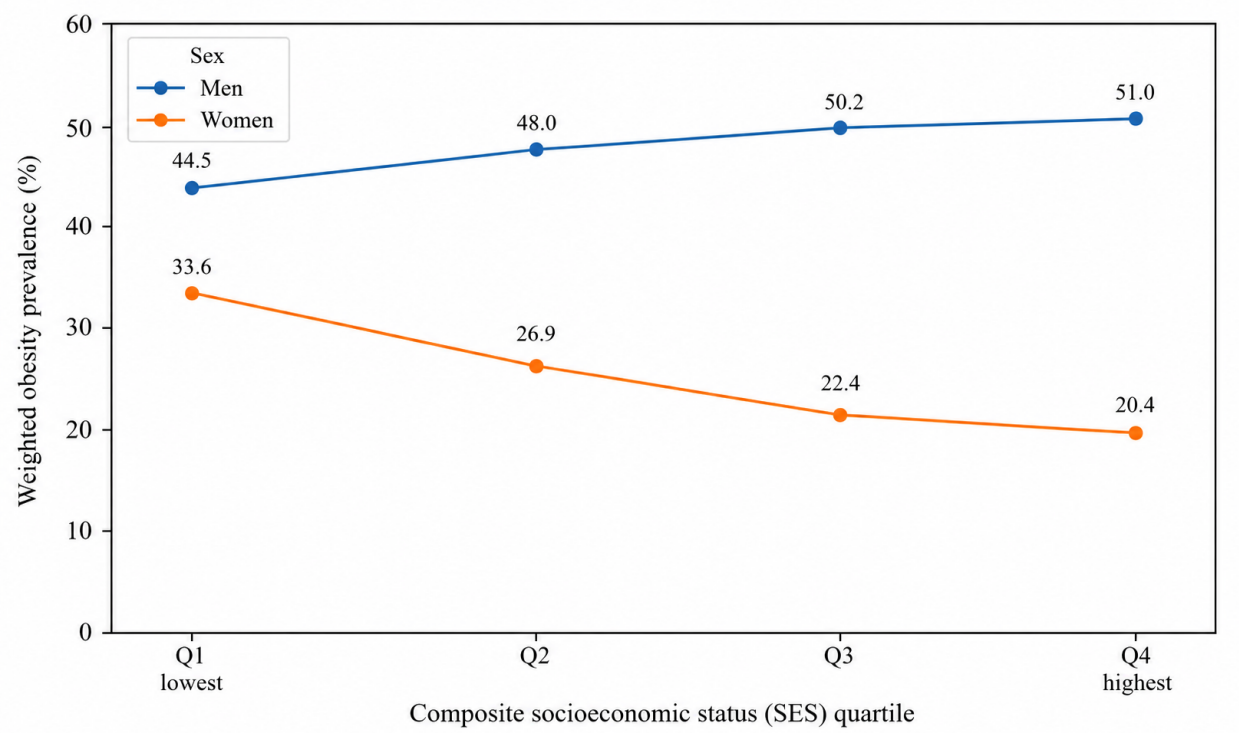

Figure 1. Weighted obesity prevalence (%) across composite socioeconomic status quartiles by sex.

Associations between individual socioeconomic indicators and obesity are presented in Table 3. After adjustment for demographic characteristics and lifestyle factors (Model 2), educational attainment remained significantly associated with obesity. Individuals with middle school education or less had higher odds of obesity than those with a college education or higher (OR=1.37, 95% CI: 1.09–1.74). Household income also showed significant associations with obesity. Compared with individuals in the highest income quintile, those in the middle- and high-income categories had higher odds of obesity (OR=1.24, 95% CI: 1.06–1.45 and OR=1.25, 95% CI: 1.09–1.44, respectively). Among occupational groups, service and sales workers had higher odds of obesity than white-collar workers (OR=1.28, 95% CI: 1.10–1.48). Women had substantially lower odds of obesity than men (OR=0.35, 95% CI: 0.31–0.38). Of the lifestyle variables, short sleep duration (<6 hours/day) was associated with higher odds of obesity (OR=1.32, 95% CI: 1.12–1.55), whereas physical activity, smoking, alcohol consumption, and long working hours were not significantly associated with obesity in the fully adjusted model.

Table 3. Logistic regression of obesity using individual SES indicators.

Variable	Model 1†: SES + covariates	Model 2‡: + lifestyle factors
Education: Middle school or less vs College+	1.54 (1.25-1.88)***	1.37 (1.09-1.74)**
Education: High school vs College+	1.04 (0.93-1.16)	1.03 (0.91-1.17)
Income: Lowest vs Highest	1.15 (0.93-1.42)	1.10 (0.81-1.49)
Income: Low vs Highest	1.23 (1.06-1.44)**	1.15 (0.96-1.37)
Income: Middle vs Highest	1.28 (1.12-1.48)***	1.24 (1.06-1.45)**
Income: High vs Highest	1.23 (1.08-1.40)**	1.25 (1.09-1.44)**
Occupation rank: Not empl. vs White-collar	1.00 (0.87-1.14)	0.98 (0.84-1.14)
Occupation rank: Manual vs White-collar	1.08 (0.94-1.25)	1.10 (0.95-1.28)
Occupation rank: Service/sales vs White-collar	1.23 (1.07-1.42)**	1.28 (1.10-1.48)***

Variable	Model 1†: SES + covariates	Model 2‡: + lifestyle factors
Women vs men	0.36 (0.33-0.40)***	0.35 (0.31-0.38)***
Physically active		0.99 (0.89-1.10)
Current smoker		0.91 (0.80-1.04)
Frequent alcohol consumption (≥2–3 t/week)		0.96 (0.86-1.08)
Short sleep (<6 h/day)		1.32 (1.12-1.55)**
Long working hours (>52 h/week)		1.16 (0.99-1.37)
Unweighted N	10,780	8,330

*Note. Values are odds ratios (95% confidence intervals). *P<0.05; **P<0.01; ***P<0.001.*

†Model 1 adjusted for age, sex, marital status, region, and survey year.

‡Model 2 additionally adjusted for physical activity, smoking, alcohol consumption, short sleep, and long working hours.

Role of Lifestyle Factors and Sex Differences

Table 4 presents models using the composite SES index. In the model adjusted for demographic characteristics (Model 3), individuals in the lowest SES quartile had higher odds of obesity than those in the highest SES quartile (OR=1.16, 95% CI: 1.02–1.32). After additional adjustment for lifestyle factors (Model 4), the association was attenuated and no longer statistically significant (OR=1.11, 95% CI: 0.95–1.30). Similar to the individual SES models, short sleep duration remained significantly associated with obesity (OR=1.32, 95% CI: 1.12–1.55), whereas the other lifestyle variables were not significantly associated with obesity.

Table 4. Logistic regression of obesity using composite SES quartiles.

Variable	Model 3‡: composite SES + covariates	Model 4§: + lifestyle factors
Composite SES Q1 (lowest) vs Q4†	1.16 (1.02-1.32)*	1.11 (0.95-1.30)
Composite SES Q2 vs Q4	1.05 (0.92-1.21)	1.09 (0.94-1.27)
Composite SES Q3 vs Q4	1.00 (0.89-1.13)	1.04 (0.91-1.19)
Physically active		0.98 (0.88-1.08)
Current smoker		0.93 (0.82-1.05)
Frequent alcohol consumption (≥2–3 t/week)		0.97 (0.86-1.08)
Short sleep (<6 h/day)		1.32 (1.12-1.55)**
Long working hours (>52 h/week)		1.16 (0.99-1.36)
Unweighted N	10,780	8,330

*Note. Values are odds ratios (95% confidence intervals). *P<0.05; **P<0.01; ***P<0.001.*

†Q4 is the highest SES reference category.

‡Model 3 adjusted for age, sex, marital status, region, and survey year.

§Model 4 additionally adjusted for lifestyle factors.

Sex-stratified analyses revealed clear differences in the association between socioeconomic status and obesity (Table 5). Among women, lower socioeconomic status was consistently associated with higher odds of obesity. Women in the lowest SES quartile had 63% higher odds of obesity than those in the highest SES quartile (OR=1.63, 95% CI: 1.28–2.07), and elevated odds were also observed among women in the second SES quartile (OR=1.41, 95% CI: 1.12–1.78). In contrast, the pattern among men differed substantially. Men in the lowest SES quartile had lower odds of obesity than those in the highest SES quartile (OR=0.81, 95% CI: 0.65–0.99), while no significant differences were observed for the middle SES quartiles. Short sleep duration was associated with higher odds of obesity in both men (OR=1.25, 95% CI: 1.01–1.56) and women (OR=1.35, 95% CI: 1.08–1.70). Other lifestyle factors were not significantly associated with obesity in the sex-stratified models.

Table 5. Sex-stratified associations between composite SES and obesity among Korean adults.

Variable	Men OR (95% CI) (N=4,057)	Women OR (95% CI) (N=4,273)
Composite SES Q1 vs Q4	0.81 (0.65-0.99)*	1.63 (1.28-2.07)***
Composite SES Q2 vs Q4	0.91 (0.75-1.11)	1.41 (1.12-1.78)**
Composite SES Q3 vs Q4	0.98 (0.82-1.16)	1.11 (0.89-1.39)
Physically active	0.95 (0.83-1.10)	0.96 (0.83-1.12)
Current smoker	0.90 (0.78-1.03)	1.32 (0.98-1.78)
Frequent alcohol consumption	1.06 (0.90-1.25)	0.85 (0.73-1.00)
Short sleep (<6 h/day)	1.25 (1.01-1.56)*	1.35 (1.08-1.70)**
Long working hours (>52 h/week)	1.18 (0.97-1.43)	1.12 (0.84-1.48)

*Note. Values are odds ratios (95% confidence intervals). *P<0.05; **P<0.01; ***P<0.001.*

Models adjusted for age, marital status, region, survey year, physical activity, smoking, alcohol consumption, short sleep, and long working hours. Q4 (highest SES quartile) served as the reference category for SES comparisons. Models were estimated using KNHANES survey weights, strata, and PSU variables. Sample sizes shown are unweighted complete-case sample sizes.

Overall, these findings indicate that socioeconomic inequalities in obesity persist in South Korea, but differ substantially by sex. Socioeconomic disadvantage was associated with higher obesity risk among women, whereas associations among men were weaker and, in some cases, operated in the opposite direction. The composite SES index captured multiple dimensions of socioeconomic position and showed more consistent associations with obesity than the individual socioeconomic indicators. Associations between socioeconomic status and obesity were attenuated after adjustment for lifestyle factors, although socioeconomic differences remained evident, particularly among women. Short sleep duration remained independently associated with obesity across several models.

Discussion

Socioeconomic inequalities in obesity and sex differences

This study examined socioeconomic inequalities in obesity among Korean adults using recent nationally representative data from KNHANES 2022–2024. The findings indicate that socioeconomic status remains an important correlate of obesity in South Korea, although the pattern differs substantially between men and women. In descriptive analyses, obesity prevalence declined consistently across socioeconomic groups among women, whereas a weaker and partly reversed pattern was observed among men. Similar findings were observed in multivariable analyses, where lower socioeconomic status was associated with higher odds of obesity among women but not among men.

A key finding of this study is the clear inverse socioeconomic gradient observed among women. Lower levels of education, income, and composite socioeconomic status were consistently associated with higher obesity prevalence and higher odds of obesity. Women in the lowest socioeconomic quartile had significantly higher odds of obesity than those in the highest quartile. This finding is consistent with previous studies from South Korea and other high-income countries, which have reported stronger socioeconomic inequalities in obesity among women than among men [19]. Several mechanisms may contribute to this pattern, including differences in access to health-promoting resources, health literacy, dietary behaviours, occupational opportunities, and social norms related to body weight and appearance. Social expectations regarding body weight and appearance may also contribute to the stronger socioeconomic gradient observed among women [20]. Previous research has suggested that women with greater educational and economic resources may be better positioned to engage in health-promoting behaviours and weight-management practices, while also facing stronger social pressures related to body image. These factors may reinforce socioeconomic differences in obesity among women and contribute to the more pronounced gradient observed in the present study.

In contrast, the association between socioeconomic status and obesity among men was weaker and less consistent. Men in the lowest socioeconomic quartile had lower odds of obesity than those in the highest quartile, while no significant differences were observed across the middle socioeconomic groups. Similar sex-specific patterns have been reported in previous studies and suggest that the relationship between socioeconomic position and obesity may operate differently among men and

women [9, 11, 19]. In the Korean context, occupational structures, work-related social practices, and cultural expectations may contribute to these differences. Higher socioeconomic status among men may be associated with sedentary occupations, greater access to food, and social activities involving frequent eating and drinking, potentially weakening the inverse socioeconomic gradient commonly observed among women.

The descriptive and multivariable findings further showed that men in the lowest socioeconomic quartile had lower odds of obesity than those in the highest socioeconomic quartile, while men with college education exhibited obesity prevalence comparable to or higher than that of less educated men. One possible explanation is the concentration of higher-SES men in white-collar occupations, which are often characterized by prolonged sitting, lower levels of occupational physical activity, and long working hours [21]. In the Korean context, workplace culture may also contribute to obesity risk through frequent work-related dining and alcohol-centred social gatherings. Another possible explanation is the healthy worker effect. Men in lower socioeconomic groups may be more likely to be employed in physically demanding occupations that require a certain level of physical functioning and involve higher levels of occupational energy expenditure [22]. In contrast, higher-SES men are more likely to work in sedentary white-collar occupations characterized by prolonged sitting and lower levels of occupational physical activity. As a result, occupational activity may partially counterbalance obesity risk among some lower-SES men despite other socioeconomic disadvantages. Future studies incorporating detailed dietary information and occupational activity measures could help clarify these mechanisms. These occupational and social factors may offset some of the health advantages typically associated with higher socioeconomic status and help explain why socioeconomic gradients in obesity among men differ from those observed among women.

An additional contribution of this study is the use of a composite socioeconomic status index incorporating education, income, and occupation. Compared with individual indicators, the composite measure captures multiple dimensions of socioeconomic position and provides a broader assessment of socioeconomic inequalities in obesity. Although the magnitude of associations was attenuated after adjustment for lifestyle factors, socioeconomic differences remained evident, particularly among women. These findings highlight the importance of considering socioeconomic position as a multidimensional construct rather than relying on a single indicator [15, 19].

Lifestyle factors showed limited associations with obesity in the fully adjusted models. Short sleep duration remained significantly associated with obesity, whereas physical activity, smoking, alcohol consumption, and long working hours were not consistently associated with obesity after adjustment. Associations between socioeconomic status and obesity were attenuated after inclusion of lifestyle variables. This finding suggests that socioeconomic differences in obesity coexist with differences in behavioural factors, although the cross-sectional design does not permit conclusions regarding causal pathways. However, the persistence of socioeconomic inequalities, particularly among women, indicates that broader social and structural factors are also likely to play an important role [23, 24]. From a policy perspective, these findings suggest that interventions focused solely on individual behaviour change may be insufficient. Efforts to reduce obesity inequalities should also consider wider socioeconomic conditions that shape health behaviours and opportunities across the life course.

Limitations and Study Contributions

Several limitations should be considered when interpreting these findings. The cross-sectional design of KNHANES precludes causal inference and does not allow the temporal ordering of socioeconomic status, lifestyle factors, and obesity to be established. Consequently, the observed associations should not be interpreted as causal relationships. Obesity was assessed using body mass index (BMI), which does not distinguish between fat mass and lean body mass and may not fully capture differences in body composition across population subgroups. In addition, lifestyle variables were based on self-reported information and may be subject to recall error or social desirability bias.

Although KNHANES collects detailed nutritional information, dietary factors such as total energy intake, dietary quality, and dietary patterns were not included in the present analysis. Because diet is an important determinant of obesity and may vary across socioeconomic groups, residual confounding related to dietary behaviours cannot be excluded. Complete-case analysis was used in the regression models, resulting in the exclusion of participants with missing data and the possibility of selection bias if excluded individuals differed systematically from those included in the analyses. Furthermore, the "not employed" occupational category may represent a heterogeneous group including homemakers, students, unemployed individuals, retirees, and others with potentially different obesity risk profiles. An additional limitation relates to the measurement of socioeconomic

position. The SES indicators used in this study were measured at a single point in time and therefore reflect contemporaneous socioeconomic circumstances rather than long-term socioeconomic experiences. Although the composite SES index captures multiple dimensions of socioeconomic position, it does not directly measure long-term socioeconomic trajectories or cumulative socioeconomic disadvantage across the life course.

Despite these limitations, the study makes several important contributions. Using recent nationally representative KNHANES 2022–2024 data, it provides updated evidence on socioeconomic inequalities in obesity among working-age Korean adults. The inclusion of education, household income, occupation, and a composite socioeconomic status index allowed multiple dimensions of socioeconomic position to be examined simultaneously. The composite SES measure also enabled a broader assessment of socioeconomic inequalities than would be possible using any single indicator alone. In addition, the sex-stratified analyses revealed markedly different socioeconomic patterns of obesity among men and women, highlighting the importance of considering sex-specific socioeconomic and behavioural contexts when examining obesity inequalities. By focusing on a contemporary Korean population and incorporating both individual and composite measures of socioeconomic position, the study contributes to the growing evidence on social determinants of obesity in South Korea and other East Asian settings.

Conclusion

In conclusion, this study provides updated evidence that socioeconomic inequalities in obesity persist in South Korea and remain closely linked to sex and socioeconomic circumstances. Lower socioeconomic status was associated with a higher likelihood of obesity, particularly among women, while patterns among men were less consistent and appeared to be influenced by different occupational and social contexts. Associations between socioeconomic status and obesity were attenuated after adjustment for lifestyle factors, although socioeconomic inequalities remained evident, particularly among women.

These findings highlight the importance of adopting a multidimensional approach to socioeconomic status and considering both individual behaviours and broader structural determinants when addressing obesity. Public health strategies should move beyond a narrow focus on lifestyle modification and incorporate policies that promote equitable access to health-supportive environments, improve working conditions, and address socioeconomic disadvantage. At the same time, the results underscore the need for sex-sensitive approaches, given the markedly different socioeconomic patterning of obesity observed among men and women. Interventions targeting socioeconomic inequalities in obesity may be particularly important for women, while policies addressing workplace culture and behavioural norms may be more relevant for men.

Overall, the findings suggest that obesity inequalities in South Korea are associated with both behavioural and broader socioeconomic factors. These results highlight the potential importance of considering not only individual lifestyle behaviours but also wider social and environmental conditions when developing strategies to address obesity inequalities. Future research would benefit from longitudinal data to better understand how socioeconomic conditions, lifestyle factors, and obesity are related over time, as well as from incorporating additional factors such as dietary patterns and psychosocial stress to provide a more comprehensive understanding of these relationships.

Acknowledgements

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Ethics Statement: The Korea National Health and Nutrition Examination Survey (KNHANES) data are publicly available for research purposes and are fully anonymised to ensure participant confidentiality. The survey is conducted in accordance with established ethical standards and has received approval from the relevant institutional review boards of the Korea Disease Control and Prevention Agency (KDCA). As this study is based on secondary analysis of publicly available anonymised data, additional ethical approval and informed consent were not required. All analyses were conducted in accordance with recognised ethical guidelines for research involving human participants and the use of secondary data.

Data Availability Statement: The data that support the findings of this study are publicly available from the Korea National Health and Nutrition Examination Survey (KNHANES) and can be accessed through the official Korea Disease Control and Prevention Agency (KDCA) website (https://knhanes.kdca.go.kr) upon reasonable request and registration.

Acknowledgments: This study used data from the Korea National Health and Nutrition Examination

Survey (KNHANES), conducted by the Korea Disease Control and Prevention Agency (KDCA).

Author Contributions: Study concept and design: ZI; acquisition of data: ZI; analysis and interpretation of data: ZI and KSE; drafting of the manuscript: ZI; critical revision of the manuscript: ZI and KSE; statistical analysis: ZI; administrative and technical support: ZI and KSE; and study supervision: KSE

Declaration of Generative AI and AI-Assisted Technologies: During the preparation of this work, the authors used ChatGPT (GPT-5.3) solely for grammar check and enhancing the image quality of visual materials (figures). All substantive aspects of the manuscript, including study design, data analysis, and interpretation, were conducted by the author(s). The authors carefully reviewed and revised the outputs and take full responsibility for the final content of the manuscript.

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