

Gender disparity in the secular trends for obesity prevalence in Korea: analyses based on the KNHANES 1998-2009

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Background/Aims: A similar gender-associated trend in obesity is observed worldwide. Nevertheless, systematic analyses of gender-specific characteristics in the general Korean population are rare.

Methods: We analyzed the prevalence of obesity in Korean adults aged ≥ 19 years based on data collected from the Korea Health and Nutrition Examination Surveys I to IV, and verified the obesity prevalence characteristics by gender.

Results: The prevalence of obesity in Korean males increased during the past 12 years from 25.1% to 35.7%, and the trend for an increase in obesity was significant in all age groups ($p < 0.001$). In contrast, no significant trend over the past 12 years was identified for females, but the prevalence of obesity in the 30- to 39-year, 40- to 49-year, and 50- to 59-year subgroups decreased significantly ($p < 0.05$). However, the obesity prevalence in the 60- to 69-year and > 70 -year female subgroups increased significantly ($p < 0.05$).

Conclusions: We observed a gradually widening gender disparity due to an increase in the prevalence of male obesity and a decrease in the obesity prevalence among young and middle-aged women.

Keywords: Epidemiology; Prevalence; Obesity; Korea; Sex characteristics

INTRODUCTION

Globally, 1.1 billion individuals are overweight, of which 312 million are obese; projections of these parameters are rising [1]. Obesity increases the risk of diverse chronic diseases; thus, the life expectancy of obese people is up to 7 years shorter than that of normal individuals [2,3]. The prevalence of obesity is rapidly increasing in Korea and other Asian countries, and it has important effects on the morbidity and mortality of associated diseases [4,5]. However, the specifics of obesity epidemics vary according to region,

ethnicity, and population, and are changing dynamically with time [6,7].

Gender-specific data are a basic requirement for assessing the epidemiological characteristics of a particular population. The obesity trend according to gender is generally similar in most areas worldwide, and the average body mass index (BMI) and prevalence of obesity in females are higher than those of males in all age groups [8]. Nevertheless, systematic analyses of gender-specific characteristics of the general Korean population have not been performed; thus, the gender disparity in obesity has not been investigated in detail.

In this study, we assessed secular changes in the prevalence of obesity in the past 12 years in Korea using representative population-based data from the Korea National Health and Nutrition Examination Survey (KNHANES). We also investigated whether these changes differed by gender.

METHODS

KNHANES

The KNHANES is a nationwide, population-based, and cross-sectionally designed health survey conducted by the Korean Ministry of Health and Welfare. The KNHANES I was conducted in 1998, the KNHANES II in 2001, the KNHANES III in 2005, and the KNHANES IV in 2007 to 2009. The details of the KNHANES I, II, and III have been reported previously [4,9].

Unlike KNHANES I to III, which were conducted in the corresponding years, KNHANES IV was conducted consecutively from July 2007 to December 2009. The KNHANES IV subject population was defined as households and individuals included in the 2005 Korean Population and Housing Census. Relevant households were selected randomly using stratified and multistage probability sampling. Rolling survey methods were applied. The sample for each year was the probability sample representing all parts of the country, which was determined by assigning weights to each respondent, and each rolling sample had both homogenous and independent characteristics.

Similar to the previous KNHANES, the KNHANES IV evaluated those > 1 year of age in the sampled households using a health interview, health examination, and nutritional survey. The health interview and examination were conducted in adjacent public offices or equipped mobile examination centers. The nutrition survey was conducted by house-to-house inquiries. In total, 9,421 households and 31,705 individuals were screened. Of these, 23,632 (74.5%) participated in the health examination survey, and 22,137 (81.8%) in the nutrition survey. All subjects participated voluntarily, and informed consent was obtained.

Methods

First, we assessed the prevalence of obesity in Koreans

> 19 years of age who underwent health examinations for KNHANES I to IV. Additionally, subjects who participated in the KNHANES were subdivided according to gender and 10-year age increments, and the prevalence of obesity in each subgroup was compared longitudinally. Finally, to confirm whether the gender- and age-specific epidemiological characteristics of obesity appeared as actual differences in obesity prevalence, a prevalence odds ratio (POR) and the trends for males and females in each group were estimated.

Obesity was diagnosed anthropometrically using data from the health examination of each KNHANES. Height was measured using portable stadiometers to the nearest 0.1 cm. Weight was measured using a calibrated balance-beam scale to the nearest 0.1 kg. Obesity was defined as BMI ≥ 25 kg/m², according to the Korean Society for the Study of Obesity [10].

Statistical analyses

Sampling weights based on the sample design of each KNHANES were used to calculate obesity prevalence. The prevalence of obesity in all KNHANES studies was adjusted to the age structure of the 2005 Korean population for comparative purposes. The PASW version 18.0 software (SPSS Inc., Chicago, IL, USA) was used for subgroup analyses. A linear-by-linear association test was performed to assess the trend in obesity prevalence among participants in each KNHANES. The Cochran-Mantel-Haenszel test was used to evaluate the significance of the male:female prevalence ratio. The *p* values < 0.05 were considered to indicate statistical significance.

RESULTS

The prevalence of obesity in Korean adults

The standardized prevalence of obesity was 26.0%, 29.2%, and 31.3%, in the KNHANES I, II, and III, respectively, and a significant increasing trend was identified (Table 1). However, the prevalence of obesity in the KNHANES IV was 31.1%. The prevalence of male obesity was 25.1%, 31.8%, 34.7%, and 35.7% in the KNHANES I, II, III, and IV, respectively, and a significant increasing trend was observed (*p* < 0.001) (Fig. 1A). The prevalence of female obesity was 26.2%, 27.4%, 27.3%, and 25.7% in the KNHANES I, II, III, and IV,

Table 1. Prevalence of obesity in the Korean population, based on the Korea National Health and Nutrition Examination Survey (KNHANES) I–IV data

Age group	KNHANES I (1998)	KNHANES II (2001)	KNHANES III (2005)	KNHANES IV (2007–2009)	<i>p</i> for trend ^a
19–29	15.2 (1.1)	17.3 (1.2)	19.3 (1.8)	22.4 (1.0)	< 0.001
30–39	24.6 (1.1)	25.6 (1.3)	29.0 (1.5)	28.6 (0.8)	< 0.001
40–49	31.6 (1.3)	35.8 (1.4)	35.2 (1.6)	34.1 (1.0)	0.255
50–59	35.6 (1.6)	37.2 (1.8)	42.1 (1.7)	39.4 (1.0)	0.014
60–69	30.2 (1.7)	38.3 (2.1)	39.6 (2.2)	38.9 (1.2)	< 0.001
70+	22.2 (1.9)	29.5 (2.2)	31.5 (2.2)	30.5 (1.2)	0.001
Total	26.0 (0.6)	29.2 (0.6)	31.3 (0.7)	31.1 (0.4)	< 0.001

Values are presented as percentage (standard error).

^aBy linear-by-linear association test.

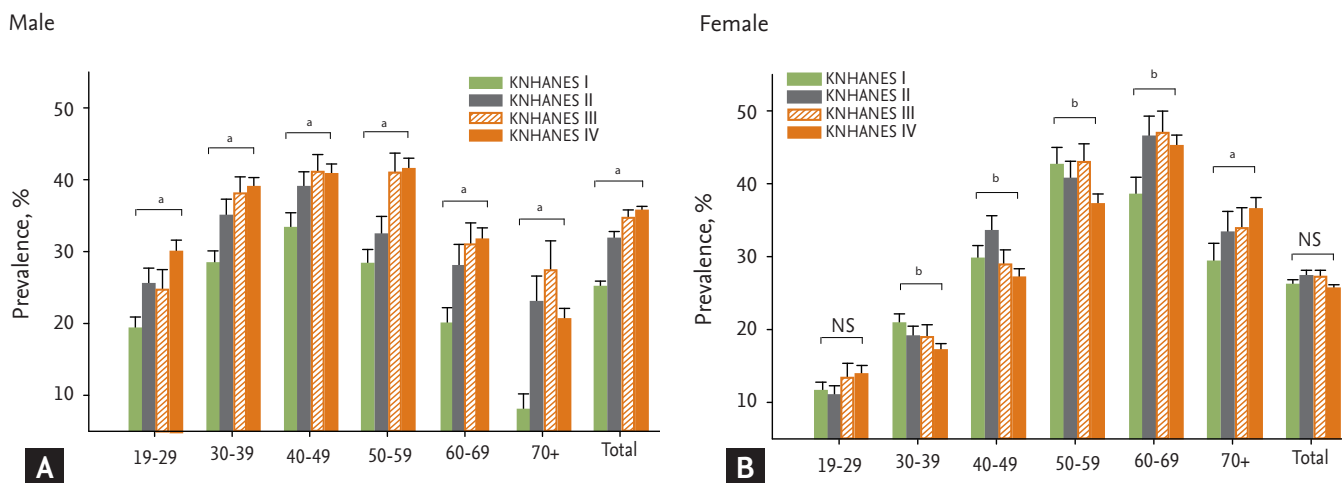


Figure 1. Age-standardized prevalence of obesity in the Korean population based on the Korea National Health and Nutrition Examination Survey (KNHANES) I–IV data. (A) Male. (B) Female. NS, not significant. ^a*p* < 0.01, ^b*p* < 0.05, by linear-by-linear association.

respectively, and no significant trend was observed (*p* = 0.245) (Fig. 1B).

Epidemiological characteristics according to age and gender

The prevalence of obesity increased with age in both males and females (Fig. 1). The prevalence of male obesity was highest in the 40- to 49-year (40.8%, in KNHANES IV) and 50- to 59-year (41.5%, in KNHANES IV) subgroups. In contrast, the prevalence of female obesity was highest in the 60- to 69-year (45.3%, in KNHANES IV) subgroup. However, the overall prevalence of obesity decreased in the > 60-year male sub-

group and in the > 70-year female subgroup.

The prevalence of male obesity showed a consistent and significant increasing trend during the past 12 years in all age groups (Fig. 1A). Despite the blunting of this trend in KNHANES IV, the trend of a consistent increase in obesity prevalence was maintained in the 19- to 29- and 30- to 39-year subgroups. However, the trend in the prevalence of female obesity was distinct from that of males, and differences among generations were also observed. A significantly decreasing trend in female obesity prevalence in the 30- to 39-, 40- to 49-, and 50- to 59-year subgroups was evident in the most-recent KNHANES (Fig. 1B). However, the trend in the

60- to 69- and > 70-year female subgroups increased significantly in the most-recent KNHANES, similar to that of males.

Age-specific POR

A significantly increasing trend in the prevalence of male obesity during the past 12 years was identified, in comparison with that in females (Fig. 2). Estimation of age-specific POR showed that the prevalence of obesity in male subjects was significantly higher in the 19- to 29-, 30- to 39-, and 40- to 49-year subgroups of all KNHANES. This gender disparity was most distinct in the 30- to 39-year subgroup. In contrast, this disparity was reversed in the > 60-year subgroup, and the prevalence of female obesity was significantly higher in all KNHANES. Nevertheless, the trend for an increase in the prevalence of male obesity was significant in the > 60-year subgroup; thus, the POR disparity decreased significantly.

DISCUSSION

A similar gender-associated trend in obesity epidemics worldwide, excluding Africa, has been reported [8]. The trend for obesity prevalence generally increases with age in both males and females but decreases after the age of 60 years [3,8]. Additionally, the average BMI and prevalence of obesity in females are in most studies significantly higher than those of males, likely due to the effect of child bearing on obesity [3,7]. However, the gender disparity in the changes in obesity prevalence in Koreans in the current study showed distinct differences from that reported in other epidemiological studies. Our results indicated that the overall prevalence of obesity in Koreans has increased since 1998. However, the prevalence of obesity in females has not differed significantly during this time. In contrast, the prevalence of male obesity has increased continuously; thus, these findings indicate a significant gender disparity. In particular, the most remarkable

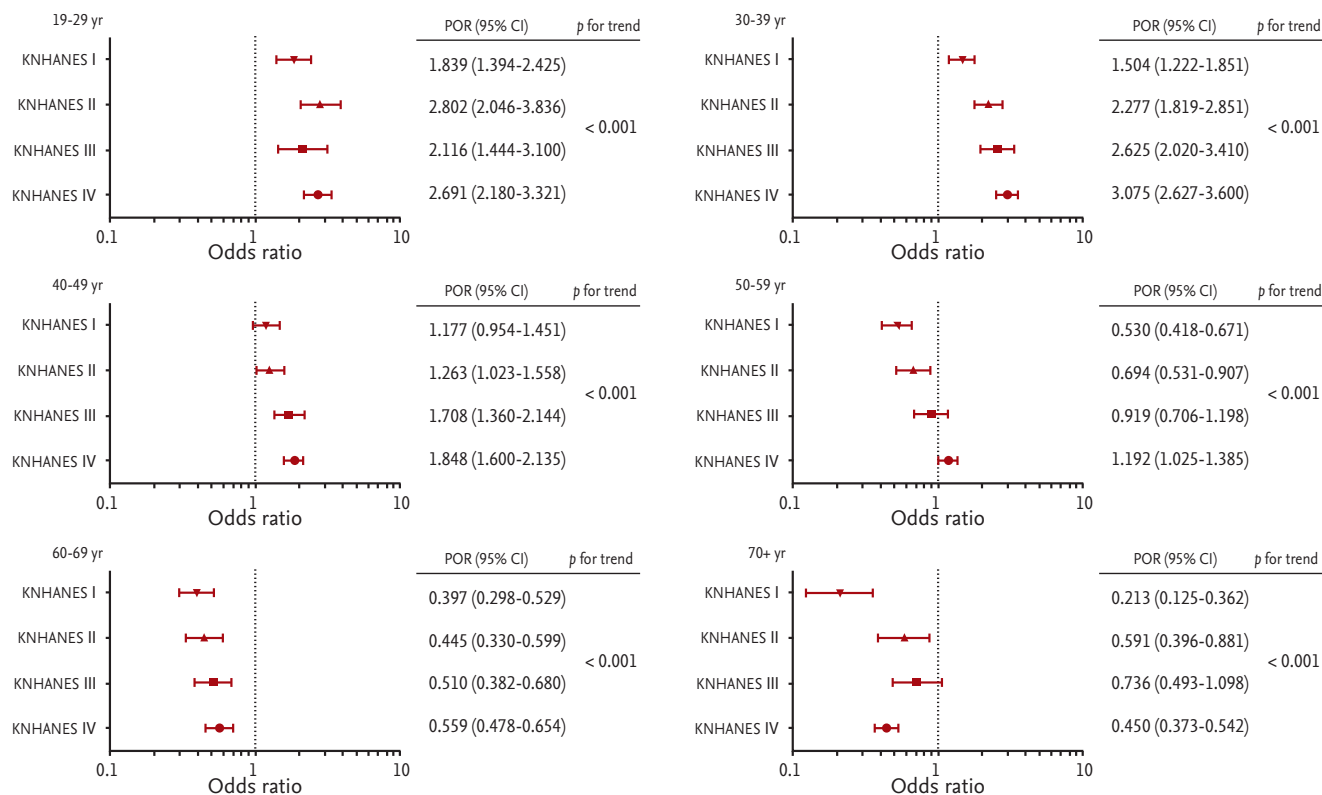


Figure 2. Age-specific prevalence odds ratios (POR) with 95% confidence intervals (CIs) for obesity in Korea National Health and Nutrition Examination Survey (KNHANES) male subjects compared with female subjects.

finding of this study was the consistent increase in the prevalence of male obesity in all age groups, whereas the trend in female obesity prevalence differed according to age. The prevalence of obesity in the 30- to 39-, 40- to 49-, and 50- to 59-year female subgroups during the past 12 years decreased continuously. However, in the 60- to 69- and > 70-year subgroups, the trend increased gradually. Due to the increase in the prevalence of male obesity and the age-related trend in females, the prevalence of male obesity in young and middle-aged subgroups was more than three times higher than that in females. This trend was reversed in older age groups, and the prevalence of female obesity was up to 50% higher than that in males. The reason for this gender disparity is unclear. However, the appearance of such changes within a relatively short period of time is likely associated more with the social and environmental changes experienced by Koreans than with biomedical factors.

Obesity is associated with cultural complexity, which causes an increased prevalence of male obesity [11]. Cultural complexity factors pertinent to this increase in male obesity include decreased physical labor and a sedentary lifestyle due to the increase in the number of clerical workers [11-13]. A trend for an increase in the prevalence of male obesity has been identified in Western countries, regardless of ethnic background [12-14]. Factors similar to those reported previously may have affected the increase in the prevalence of male obesity we report here. However, the increase in the proportion of the population participating in economic activity, a rise in the average marriage age, a reduction in birth rate, and a social preference for thin females may have affected the decreased trend of obesity prevalence in the young and middle-aged female subgroups [15-19]. Additionally, factors such as biological changes caused by menopause, a decrease in the socially active population due to retirement, and a decrease in the relative importance of thinness may be mediating the effects of the increase of obesity prevalence in the older female subgroups [15,19]. Our findings suggest that the effect of cultural complexity on obesity is not limited to a single gender, but that obesity affects both genders and manifests as different phenotypes in males and females in response to social demands.

The limitations of our study are as follows. First,

each KNHANES was conducted with different subjects; thus, it is possible that unintentional errors may have occurred when estimating obesity prevalence and when comparing the trends. Additionally, unlike KNHANES I, II, and III, KNHANES IV was conducted consecutively; thus, the subjects and methods used in the surveys were inconsistent. However, the KNHANES collected nationally representative data and is the most accurate cross-sectional evaluation of the health status of contemporary Koreans. Furthermore, the prevalence estimated in each KNHANES was standardized according to the 2005 population and compared; thus, potential errors pertinent to survey methods were likely not substantial.

In conclusion, the prevalence of obesity in Korean males showed a progressively increasing trend in all age groups. However, the prevalence of obesity in Korean females showed a continuously decreasing trend in the young and middle-aged subgroups but an increasing trend in the older subgroup. Thus, a typical gender disparity was observed in the Korean population. The BMI of Asians is relatively lower, but their visceral fat percentage is higher, than that of Caucasians; thus, the relative risk of obesity-associated chronic diseases is high [20]. It is also well-known that obesity can affect future morbidity, mortality, and medical costs of many associated diseases [21-24]. Therefore, it is possible that the gender disparity in the prevalence of obesity may become a trigger for numerous changes in Korean health status in the medium to long term. Thus more attention should be paid to gender disparities in chronic diseases pertinent to obesity that may in future manifest in Koreans.

KEY MESSAGE

1. The prevalence of obesity in Korean males showed a progressively increasing trend in all age groups.
2. However, the prevalence of obesity in Korean females showed a continuously decreasing trend in the young and middle-aged subgroups.
3. Thus, a typical gender disparity was observed in the Korean population.

Conflict of interest

No potential conflict of interest relevant to this article is reported.

Acknowledgments

This study used the Korea National Health and Nutrition Examination Survey (KNHANES I to IV) data collected by the Korea Centers for Disease Control and Prevention.

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