Original Article

Recent trends in the prevalence of underweight, overweight, and obesity in Korean adults: The Korean National Health and Nutrition Examination Survey from 1998 to 2014

Hyun-Young Shin [a, b], Hee-Taik Kang [c, *]

[a] Department of Family Medicine, Myongji Hospital, Seonam University, College of Medicine, Gyeonggi-do, Republic of Korea
[b] Department of Epidemiology and Health Promotion and Institute for Health Promotion, Graduate School of Public Health, Yonsei University, Seoul, Republic of Korea
[c] Department of Family Medicine, School of Medicine, Chungbuk National University, Cheongju-city, Republic of Korea

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ABSTRACT

Background: Recent obesity studies have reported that the rising trend in obesity has stabilized or leveled off. Our study aimed to update estimates of the recent prevalence trend in obesity based on the Korean National Health and Nutrition Examination Survey 1998–2014.

Methods: A total of 66,663 subjects were included and defined as being either underweight, overweight, or obese, in accordance with a BMI of 18.5 kg/m^2 or lower, 23 kg/m^2 or higher, and 25 kg/m^2 or higher, respectively.

Results: The prevalence of underweight in KNHANES I through VI surveys was 5.4%, 6.1%, 5.8%, 6.5%, 7.6%, and 7.5%, respectively, in men (p for trend = 0.04, β = 0.003) and 4.7%, 3.3%, 3.4%, 3.3%, 2.7%, and 2.6%, respectively, in women (p for trend = 0.03, β = −0.002). Also for KNHANES I through VI, the respective prevalence of overweight/obesity was 50.3%, 57.2%, 62.5%, 62.3%, 61.4%, and 61.3% in men (p for trend<0.01, β = 0.009) and 48.3%, 50.3%, 50.0%, 47.8%, 47.0%, and 45.3% in women (p for trend<0.01, β = −0.01), respectively.

Conclusions: The obesity occurrence in men was trending upward with respect to overweight/obesity and for grade 1 and 2 obesity, but not for abdominal obesity. However, the obesity trends in women were leveling off from overweight/obesity, grade 1 obesity, and abdominal obesity measures. Further studies are required with data on muscle mass and adiposity for effective obesity control policies.

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Introduction

Obesity is disease of global epidemic proportions that has increased during the recent decades.[1] It is related to non-communicable diseases, such as type 2 diabetes, hypertension, dyslipidemia, cardiovascular diseases, musculoskeletal disorders, and certain malignancies,[2] as these are associated with environmental factors, including family lifestyles and unhealthy behaviors. The World Health Organization (WHO) aims to stop obesity by 2025 as part of the program called "Global Action Plan for the Prevention and Control of Non-Communicable Diseases 2013–2020",[3] and has suggested diverse efforts, such as following a healthy diet with physical activity, for prevention. It has also advocated regular monitoring of epidemiological facts in obesity.

Recent studies have reported that the rising trends of obesity have stabilized or leveled off in some European countries and China.[4] However, several Korean studies have reported that the trends of obesity in Korea have increased in men, but neither increased nor decreased in women.[5–7] It should be noted that more recent trends still needs to be reported. Our study, therefore, aimed to report more recent trends in obesity prevalence in Korea by including a longer time frame of years, from 1998 through 2014, than previous reports and assessing various measures, including abdominal obesity and the population of underweight, based on data from the Korean National Health and Nutrition Examination Survey (KNHANES).

* Corresponding author. Department of Family Medicine, School of Medicine, Chungbuk National University, Chungdae-ro, Seowon-gu, Cheongju, Chungbuk, 28644, Republic of Korea.
E-mail address: KANGHT0818@gmail.com (H.-T. Kang).
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Methods

The KNHANES is a cross-sectional, nationally representative survey conducted by the Korean Ministry of Health and Welfare and has been performed in 6 phases: the KNHANES phase I (1998), II (2001), III (2005), IV (2007–2009), V (2010–2012), and VI (2013–2015) studies. As the most recent data (from 2015) was unavailable, the data from 1998 to 2014 are included in this study. The KNHANES is composed of a Health Interview Survey, a Health Behavior Survey, a Health Examination Survey, and a Nutrition Survey. Households as sampling units were stratified, and the information was collected through a multistage probability-based sampling design based on sex, age, and geographic area, using household registries. On completion of this survey, participants provided written informed consent for use of their data for further analyses and were given the right to refuse to participate, in accordance with the National Health Enhancement Act.

Of the 177,056 participants in the KNHANES I-VI, we excluded those younger than 20 years and those who did not have information for body mass index (BMI) (n = 10,393). After these exclusions, a total of 66,663 participants (28,594 men and 38,069 women) were included in the final analysis. The Institutional Review Board (IRB) of the Korea Centers for Disease Control and Prevention approved this study.

Measurement and definition of underweight, overweight, and obesity

Physical examinations were performed by a trained medical staff, following standardized procedures. Body weight, height, and waist circumference were measured to the nearest 0.1 kg and 0.1 cm, respectively, with participants wearing light indoor clothing without shoes. Waist circumference was checked at the midpoint between the lower border of the rib cage and the iliac crest. BMI was calculated as the ratio of weight in kilograms to height in meters squared (kg/m^2). According to the Asia-Pacific regional guidelines of the WHO and International Obesity Task Force, we defined the cutoff points for being underweight, overweight, and obesity as a BMI of $18.5 \ kg/m^2$ or lower, $23 \ kg/m^2$ or higher, and $25 \ kg/m^2$ or higher, respectively.[8] We further stratified obesity as grade 1 (BMI $\geq 25 \ kg/m^2$) and grade 2 (BMI $\geq 30 \ kg/m^2$), which were not mutually exclusive. Abdominal obesity was defined as waist circumference ≥ 90 cm for men and ≥ 85 cm for women using the cut-off points in Korea.[9]

Statistical analysis

KNHANES data from the Korea National Statistical Office were used to define the standard population. In order to represent the entire Korean adults without biased estimates, sampling weights were applied to account for the complex sampling, which included stratification by district at the first step and stratification by sex and age at the second step. Furthermore, to avoid bias from changes in age and sex distributions in each phase, adjustments to age and sex were made using the Korean population distribution in the year 2005.

All data on continuous variables were presented as means (standard errors [SEs]) and one-way analysis of variance was used to compare mean values for continuous variables, such as age, BMI, and waist circumference, across KNHANES phases. Linear regression analyses for P trends and logistic regression analyses for odds ratios (ORs) were used. All analyses were conducted using SAS statistical software (version 9.2; SAS Institute Inc., Cary, NC, USA). All statistical tests were two-sided, and statistical significance was determined at P-value <0.05.

Results

The 66,663 participants included in this study were distributed as follows: 7962 from KNHANES I, 6572 from KNHANES II, 5462 from KNHANES III, 17,126 from KNHANES IV, from 18,255 KNHANES V, and 11,286 from KNHANES VI (Table 1).

Table 2 shows the changes in BMI and waist circumference according to sex and age group (20–39 years, 40–59 years, and 60 years or older) across the KNHANES phases. Mean BMI in men increased overall across the KNHANES phases (p for trend<0.001, β = 0.12), whereas it decreased in women (p for trend = 0.03, β = −0.05). Mean BMI increased in men of all age groups (all p for trend<0.05), whereas it only decreased in the middle-aged group among women (p for trend<0.001, β = −0.18). Waist circumference in men showed no significant change overall (p for trend = 0.65, β = 0.03), as waist circumference increased in the youngest group but decreased for the middle-aged group across the KNHANES phases (p for trend = 0.002, β = 0.30 and p for trend<0.001, β = −0.29, respectively). However, waist circumference in women decreased overall (p for trend<0.001, β = −0.24), as the waist circumference of the middle-aged and the oldest groups decreased across the KNHANES phases (p for trend<0.001, β = −0.60 and p for trend<0.001, β = −0.41, respectively).

The prevalence of being underweight, overweight/obese, grade 1 and grade 2 obesity, or abdominal obesity is presented in Fig. 1. The prevalence of being underweight in KNHANES I through VI was 5.4%, 6.1%, 5.8%, 6.5%, 7.6%, and 7.5% in men (p for trend = 0.04, β = 0.003) and 4.7%, 3.3%, 3.4%, 3.3%, 2.7%, and 2.6% in women (p for trend = 0.03, β = −0.002). The underweight prevalence trend in men decreased with the KNHANES phase (p for trend = 0.002, β = −0.03), while that in women increased (p for trend = 0.04, β = 0.003). The KNHANES I through VI prevalence of overweight/obesity was 50.3%, 57.2%, 62.5%, 62.3%, 61.4%, and 61.3% in men (p for trend <0.01, β = 0.009) and 48.3%, 50.3%, 50.0%, 47.8%, 47.0%, and 45.3% in women (p for trend<0.01, β = −0.01), respectively. The prevalence trend of overweight/obesity in men increased (p for trend<0.01, β = 0.009), whereas that in women decreased (p for trend<0.01, β = −0.01). Trends in the prevalence of grade 1 obesity

Table 1
Study subjects according to KNHANES phase, age group, and sex.

	Total	I (1998)	II (2001)	III (2005)	IV (2007–2009)	V (2010–2012)	VI (2013–2014)
Men, unweighted *n* (%)	28,594 (100)	3597 (100)	2864 (100)	2325 (100)	7254 (100)	7769 (100)	4785 (100)
20–39 years	9417 (32.9)	1582 (44.0)	1192 (41.6)	768 (33.0)	2354 (32.5)	2172 (28.0)	1349 (28.2)
40–59 years	10,933 (38.2)	1350 (37.5)	1125 (39.3)	1003 (43.1)	2720 (37.5)	2915 (37.5)	1820 (38.0)
≥60 years	8244 (28.8)	665 (18.5)	547 (19.1)	554 (23.8)	2180 (31.1)	2682 (34.5)	1616 (33.8)
Women, unweighted *n* (%)	38,069 (100)	4365 (100)	3708 (100)	3137 (100)	9872 (100)	10,486 (100)	6501 (100)
20–39 years	12,750 (33.5)	1879 (43.0)	1561 (42.1)	1128 (36.0)	3230 (32.7)	3108 (29.6)	1844 (28.4)
40–59 years	14,059 (36.9)	1540 (35.3)	1343 (36.2)	1248 (39.8)	3578 (36.2)	3883 (37.0)	2467 (37.9)
≥60 years	11,260 (29.6)	946 (21.7)	804 (21.7)	761 (24.3)	3064 (31.0)	3495 (33.3)	2190 (33.7)