**Review**

# Diagnosis of Obesity: 2022 Update of Clinical Practice Guidelines for Obesity by the Korean Society for the Study of Obesity

Ji-Hee Haam[1], Bom Taeck Kim[2], Eun Mi Kim[3], Hyuktae Kwon[4], Jee-Hyun Kang[5], Jung Hwan Park[6], Kyoung-Kon Kim[7], Sang Youl Rhee[8,9], Yang-Hyun Kim[10,*], Ki Young Lee[11,*]

[1]Department of Family Medicine, CHA Bundang Medical Center, CHA University, Seongnam; [2]Department of Family Practice and Community Health, Ajou University School of Medicine, Suwon; [3]Department of Dietetics, Kangbuk Samsung Hospital, Seoul; [4]Department of Family Medicine, Seoul National University Hospital, Seoul; [5]Department of Family Medicine, Konyang University College of Medicine, Daejeon; [6]Department of Internal Medicine, Hanyang University College of Medicine, Seoul; [7]Department of Family Medicine, Gachon University College of Medicine, Incheon; [8]Department of Endocrinology and Metabolism, College of Medicine, Kyung Hee University, Seoul; [9]Center for Digital Health, Medical Science Research Institute, Kyung Hee University Medical Center, Seoul; [10]Department of Family Medicine, Korea University College of Medicine, Seoul; [11]Department of Internal Medicine, Gachon University Gil Medical Center, Incheon, Korea

The prevalence of obesity has consistently increased worldwide, and many obesity-related diseases are emerging as major health problems. Body mass index (BMI) is used to define obesity and is highly correlated with body fat mass. Moreover, obesity-related morbidities increase linearly with the increase in BMI. The Korean Society for the Study of Obesity defined overweight as a BMI $\geq$ 23 kg/m$^2$ and obesity as a BMI $\geq$ 25 kg/m$^2$, based on a significant increase in obesity-related diseases. A waist circumference of $\geq$ 90 cm in men and $\geq$ 85 cm in women are defined as abdominal obesity, which is also correlated with obesity-related diseases. These diagnostic criteria are the same as in the previous version; however, the updated guidelines put greater emphasis on the use of morbidity as the basis for obesity and abdominal obesity diagnoses. These new guidelines will help to identify and manage high-risk groups for obesity-related comorbidities among Korean adults.

**Key words:** Diagnosis, Obesity, Abdominal obesity, Body mass index, Waist circumference, Comorbidity

## INTRODUCTION

Obesity is a chronic disease characterized by excess body fat deposition and high body mass index (BMI), which is calculated by dividing weight (kg) by height squared (m$^2$). According to the 2021 obesity fact sheet,[1] the prevalence of obesity consistently increased over the previous 11 years. Consequently, many obesity-related diseases have emerged as health problems.[2] The diagnosis of

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obesity is important because it serves as a criterion for starting treatment.

Herein, we intend to conduct a comprehensive review of the diagnostic section outlined in the 2022 Clinical Practice Guidelines for Obesity by the Korean Society for the Study of Obesity (KSSO).[3]

## DEFINITION OF OBESITY

### Diagnostic criteria for obesity in adults

BMI is used to define obesity because it is highly correlated with body fat in most populations and with obesity-related comorbidities such as diabetes mellitus, hypertension, and dyslipidemia.[4-8] Therefore, it is recommended to measure the BMI every year to evaluate the risk of obesity and comorbid diseases.[9]

The World Health Organization (WHO) defines overweight as a BMI $\geq 25$ kg/m$^2$ and obesity as a BMI $\geq 30$ kg/m$^2$, regardless of race or sex.[10] In Europe, the same definition of obesity is used to prevent confusion in health promotion, disease prevention, and management, despite the existence of a racially diverse population.[11] However, Asian populations, including Koreans, have an increased risk of diabetes and cardiovascular diseases, even at a BMI $\leq 25$ kg/m$^2$; therefore, different BMI criteria for obesity are needed for different races.[10,12] Based on the fact that Asians have higher morbidity and mortality even with lower BMI and waist circumference (WC), the WHO Asia-Pacific region defined BMI $\geq 23$ kg/m$^2$ as overweight and $\geq 25$ kg/m$^2$ as obese.[12] Meanwhile, the WHO Expert Committee agreed that the WHO BMI cutoff points should remain as international classifications but identified additional points for taking public health action on the risks of obesity-related comorbidities. BMI $\geq 23$ kg/m$^2$ represents increased risk and BMI $\geq 27.5$ kg/m$^2$

represents high-risk.[13] The American Association of Clinical Endocrinologists/American College of Endocrinology obesity guidelines in 2016 and the American Diabetes Association guidelines in 2022 defined a BMI $\geq 25$ kg/m$^2$ as overweight but recommended that Asians consider a BMI $\geq 23$ kg/m$^2$ as overweight.[9,14] Moreover, there are diverse definitions of obesity among the Asian populations. In Japan, a BMI $\geq 23$ kg/m$^2$ is defined as overweight and a BMI $\geq 25$ kg/m$^2$ is defined as obesity,[15] whereas in China, overweight is defined as a BMI $\geq 24$ kg/m$^2$ while obesity is defined as a BMI $\geq 28$ kg/m$^2$.[16] The diagnostic criteria for obesity in each region/country are shown in Table 1.[2,10,12,15-18]

### BMI and the risk of obesity-related comorbidities in Korean adults

The KSSO analyzed data from the National Health Insurance Corporation from 2009 to 2015 and reported the status of obesity and the risk of obesity-related comorbidities in Koreans in the 2017 obesity fact sheet, which showed that the risk of type 2 diabetes, hypertension, and dyslipidemia linearly increased as BMI increased from the range of 23 to 25 kg/m$^2$.[2] In addition, among young adults aged 20 to 39 who received health checkups from the National Health Insurance Corporation from 2009 until 2017, disease incidence was found to be significantly higher in the BMI range of 23 to 24.9 kg/m$^2$ compared to normal weight, with a 2.4-fold increase in the risk of type 2 diabetes, a 1.2-fold increase in the risk of myocardial infarction, and a 1.2-fold increase in the risk of ischemic stroke. The risk of myocardial infarction, ischemic stroke, and type 2 diabetes increased 1.6-, 1.6-, and 6.5-fold respectively, in patients with a BMI range of 25 to 29.9 kg/m$^2$ compared to normal weight individuals.[19]

**Table 1.** Diagnostic criteria of obesity by region/country (body mass index, kg/m$^2$)

| Region/Country | Pre-obesity (overweight) | Obesity | Organization |
|---|---|---|---|
| International definition | 25–29.9 | ≥30 | WHO[10] |
| The United States | 25–29.9 | ≥30 | AHA/ACC/TOS[17] |
| Australia | 25–29.9 | ≥30 | Australian Government National Health and Medical Research Council[18] |
| Asia-Pacific region | 23–24.9 | ≥25 | WHO/IASO/IOTF. The Asia-Pacific perspective[12] |
| Korea | 23–24.9 | ≥25 | Korean Society for the Study of Obesity[2] |
| Japan | 23–24.9 | ≥25 | Japan Society for the Study of Obesity[15] |
| China | 24–27.9 | ≥28 | Cooperative Meta-Analysis Group of the Working Group on Obesity in China[16] |

WHO, World Health Organization; AHA, American Heart Association; ACC, American College of Cardiology; TOS, The Obesity Society; IASO, International Association for the Study of Obesity; IOTF, International Obesity Task Force.

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Accordingly, the KSSO defined overweight as a BMI $\geq 23$ kg/m$^2$ and obesity as a BMI $\geq 25$ kg/m$^2$ based on a significant increase in obesity-related diseases. The diagnostic criteria for obesity are the same as those in the previous version, but the new guidelines further highlight the use of morbidity as the basis for diagnosis of obesity. The KSSO uses comorbidity, not mortality, as the diagnostic criterion for obesity.

The use of obesity-related comorbidities rather than mortality to define obesity is aimed at preventing obesity-related comorbidities, since their incidence increases linearly with increasing BMI in patients in their 20s to 60s.[2,20-24] However, the relationship between BMI and mortality may differ depending on the characteristics of the study cohort such as age, comorbidities, smoking status, cause of death, and duration of follow-up.[25-27] For example, among older adults with many comorbidities, there is a tendency to show a U-shaped or inverse J-shaped graph skewed to the right and the lowest mortality rate in overweight or obese ranges of BMI.[28] In a large-scale cohort study of Koreans, nonsmoking men showed the lowest mortality rate for all causes at the overweight range (BMI 23.0 to 24.9 kg/m$^2$), while smoking men showed the lowest mortality rate at the obesity range (BMI 25.0 to 27.9 kg/m$^2$).[29] However, in a study of Taiwanese subjects, mortality and cardiovascular disease incidence due to all causes increased significantly from a BMI of 25 kg/m$^2$ upwards in the entire population and in nonsmokers.[30] In 2016, the Global BMI Mortality Collaboration conducted a meta-analysis of 239 prospective studies that showed that all-cause mortality in East Asians increased significantly with a BMI $\geq 25$ kg/m$^2$.[31] Thereby, when mortality is used as the cutoff for obesity diagnosis, it is highly variable and inconsistent; therefore, from the viewpoint of disease prevention, it is necessary to set the diagnosis of obesity at the point when obesity-related comorbidities increase. Moreover, because the criteria for diagnosing obesity in Korean adults are clinically aimed at screening and managing high-risk groups for obesity-related diseases, morbidities were used as the diagnostic criteria.

## Stage of obesity in adults

The obesity stage in Korean adults was classified based on an increase in obesity-related comorbidities according to the BMI level. Overweight and obesity were defined as BMI $\geq 23$ and $\geq 25$ kg/m$^2$, respectively (Table 2).[2] The incidence of obesity-related comorbidi-

**Table 2.** Risk of comorbidity according to obesity and abdominal obesity

| Classification* | Body mass index (kg/m$^2$) | Risk of comorbidity according to abdominal obesity | |
| --- | --- | --- | --- |
| | | < 90 cm (men) < 85 cm (women) | ≥ 90 cm (men) ≥ 85 cm (women) |
| Underweight | < 18.5 | Low | Average |
| Normal | 18.5–22.9 | Average | Increased |
| Pre-obese (overweight) | 23–24.9 | Increased | Moderate |
| Class I obesity | 25–29.9 | High | Severe |
| Class II obesity | 30–34.9 | Moderate | Very severe |
| Class III obesity | ≥ 35 | Severe | Very severe |

Adapted from Seo et al.[32]
*Pre-obese may be defined as overweight or at-risk weight, and obese class III may be defined as extreme obesity.

ties, such as type 2 diabetes, hypertension, and dyslipidemia, increases proportionally with an increase in BMI; however, the rate of increase slows and eventually levels off at a BMI of 35 to 37 kg/m$^2$. Based on these results, the KSSO added a class III obesity to the existing classification, which previously only had two stages, defined as a BMI of 25 to 29.9 kg/m$^2$ for class I obesity, a BMI of 30 to 34.9 kg/m$^2$ for class II obesity, and a BMI $\geq 35$ kg/m$^2$ for class III obesity, instead of defining a BMI of 25 to 29.9 kg/m$^2$ as class I obesity and a BMI $\geq 30$ kg/m$^2$ as class II obesity as was previously done (Table 2, Fig. 1).[32]

In Korea, the term "severe obesity" has been used arbitrarily with varying definitions, thereby causing confusion. Therefore, the KSSO officially defined class III obesity (BMI $\geq 35$ kg/m$^2$) as "severe obesity" starting from the 2018 KSSO guideline.[32] Additionally, a BMI of 23 to 24.9 kg/m$^2$ is defined as the "pre-obesity stage" (overweight or at-risk weight) because it implies the potential to progress to obesity if not managed carefully.[32]

## Diagnostic criteria for abdominal obesity in adults

In Korea, the standard for abdominal obesity in adults is defined as a WC of $\geq 90$ cm for men and $\geq 85$ cm for women.[33] Measuring the BMI alone for obesity has limitations in accurately reflecting body fat mass, especially in athletes or those with muscle loss. Thus, factors such as age, sex, race, body fluid status, and muscle mass should be considered when determining the degree of obesity.[34,35] WC measurement also corrects errors in BMI in patients with low muscle mass, elderly individuals, and those with weight loss-inducing diseases.[17,36,37] In addition, because abdominal obesity is a superior predictor of cardiovascular diseases and other obesity-related

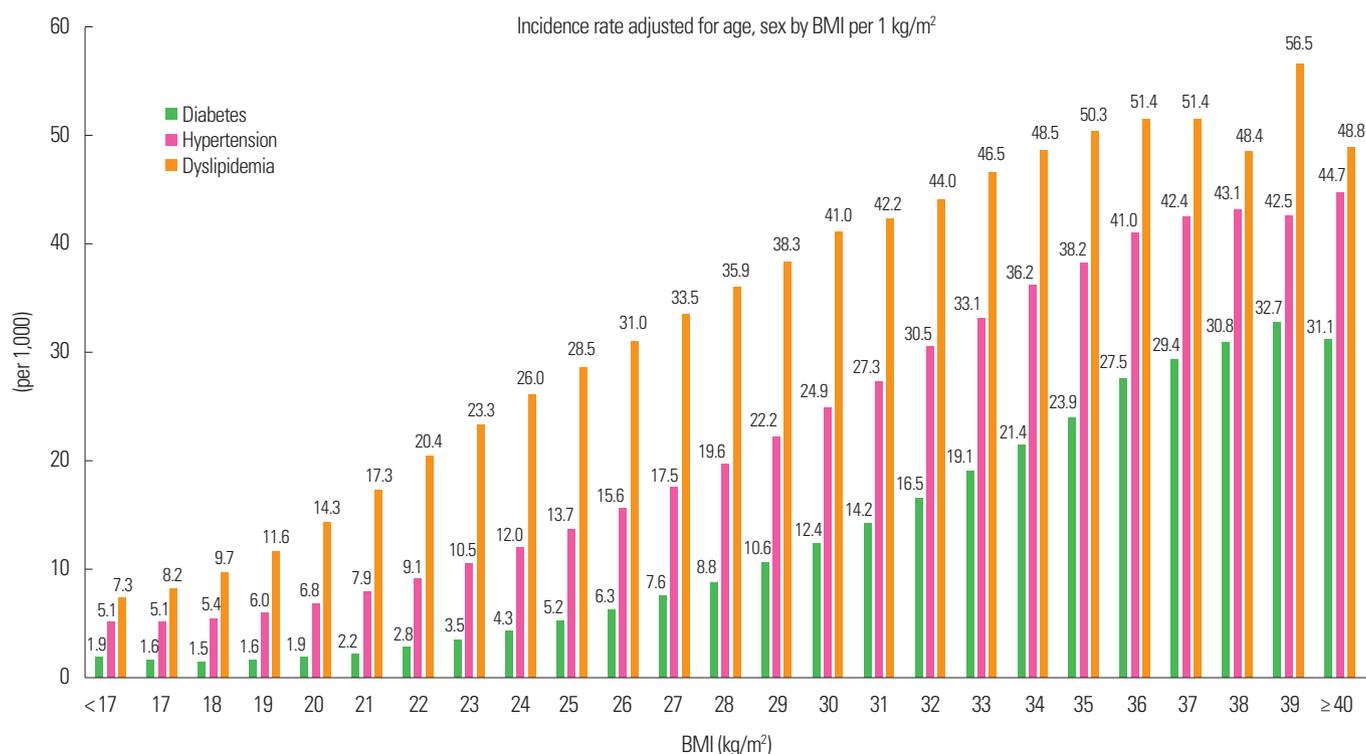Haam JH, et al. Diagnosis of Obesity: 2022 Guidelines by KSSO

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**Figure 1.** The incidence rate of type 2 diabetes, hypertension, and dyslipidemia according to body mass index (BMI) level. Data derived from the National Health Insurance Service Health Checkup Data 2006 to 2015. Adapted from Seo et al.[2]

comorbidities than overall obesity, measuring WC in addition to BMI is recommended.[38-41] In the long-term follow-up of the Coronary Artery Risk Development in Young Adults (CARDIA) study, using either one of the criteria, BMI ≥ 25 kg/m², WC ≥ 94 cm for men, and ≥ 80 cm for women, predicted cardiovascular disease better than the BMI criterion alone.[42] In addition, WC has been reported to be a strong predictor of mortality in all BMI ranges, showing a linear and positive correlation with mortality rates in various studies, including a Korean population study.[43-50] In cases of abdominal obesity, independent of BMI, the incidences of metabolic syndrome, type 2 diabetes, hypertension, dyslipidemia, coronary artery disease, and cerebral artery disease increased. Therefore, when abdominal obesity is diagnosed, it is necessary to consider the increased risk of comorbidities more than when the risk classification is based on BMI alone (Table 2).

The discrimination point for diagnosing abdominal obesity varies by race and gender, and the KSSO recommends a diagnosis of abdominal obesity in Korean adults with a WC ≥ 90 cm for men and ≥ 85 cm for women, considering the risk of morbidity associated with increased WC and the prevalence of abdominal obesity.

In this guideline, the cutoff point for abdominal obesity is the same as that in the previous version, but this guideline additionally emphasizes that the risk of morbidity should be considered for these criteria. Moreover, this guideline explains that WC is a better predictor of mortality because it shows a more linear positive correlation with mortality than BMI alone. In a Korean study by the KSSO, the WC at the point of occurrence of two or more metabolic syndrome risk factors suggested by the International Diabetes Federation, was used as the criterion for abdominal obesity.[33] The diagnostic criteria for abdominal obesity in other regions and countries, including East Asian countries such as China and Japan, are summarized in Table 3.[16,33,51-54]

## MEASUREMENT OF OBESITY AND ABDOMINAL OBESITY IN KOREANS

To obtain accurate BMI measurements, weight should be measured after an 8-hour fast and after voiding, with minimal clothing and no shoes. As the obesity stage increases, the daily weight variation also increases. Therefore, measurements should be taken un-

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**Table 3.** The diagnostic criteria for abdominal obesity in other regions and countries (waist circumference, cm)

| Region/Country | Men | Women | Organization |
|---|---|---|---|
| Korea | ≥90 | ≥85 | Korean Society for the Study of Obesity[33] |
| Europe | ≥94 | ≥80 | IDF[51] |
| South Asia (China, Malaysia, India) | ≥90 | ≥80 | |
| China | ≥90 | ≥80 | |
| Japan | ≥85 | ≥90 | |
| Eastern Mediterranean and Middle East (Arab) | ≥94 | ≥80 | |
| Sub-Saharan Africa | ≥94 | ≥80 | |
| Ethnic South and Central America | ≥90 | ≥80 | |
| America | ≥102 | ≥88 | AHA/NHLBI (Adult Treatment Panel III)[52] |
| Japan | ≥85 | ≥90 | Japan Society for the Study of Obesity[53] |
| China | ≥85 | ≥80 | Cooperative Meta-Analysis Group of the Working Group on Obesity in China[16] |
| Korea | ≥90 | ≥85 | Consensus Statement from the IAS and ICCR Working Group on Visceral Obesity (2020)[54] |
| Japan | ≥85 | ≥90 | |
| Jordan | ≥98 | ≥96 | |
| China | ≥80 | ≥80 | |
| Tunisia | ≥85 | ≥85 | |
| India | ≥90 | ≥80 | |
| Iran | ≥89 | ≥91 | |

IDF, International Diabetes Federation; AHA, American Heart Association; NHLBI, National Heart Lung and Blood Institute; IAS, International Atherosclerosis Society; ICCR, International Chair on Cardiometabolic Risk.

der constant conditions at the same time each day. Height should be measured with the heel against the wall and feet 60° apart, with the head, buttocks, and heels against the wall, and the subject taking a deep breath. The weight was measured and recorded to the nearest 0.1 kg, while heights were measured and recorded to the nearest 0.1 cm.

When measuring WC, selecting a standardized anatomical location is crucial. To measure WC, individuals should stand with feet approximately 25 to 30 cm apart with weight evenly distributed and breathing comfortably. Measurements should be taken at the midpoint between the lowermost rib and the top of the iliac crest (WHO) or at the level of the iliac crest (National Institutes of Health) using a measuring tape. The tape should be loose enough to avoid applying pressure to the soft tissue, and measurements should be recorded to the nearest 0.1 cm. In severely obese women or in women after childbirth or menopause, subcutaneous fat may overlap with the waist and cause the measurement to be greater than the actual WC. In such cases, subcutaneous fat should be lifted and placed in an upright position.[55]

Other methods for measuring body fat, such as bioelectrical impedance analysis or dual-energy X-ray absorptiometry (DEXA) can be considered for diagnosing obesity. To evaluate abdominal obesity, abdominal computed tomography or magnetic resonance imaging may be used in addition to measuring WC. Traditionally, the American Endocrine Society has defined obesity as a body fat percentage of ≥25% in men and ≥35% in women.[56] A study of Japanese individuals using DEXA to identify the discrimination point for body fat percentage that increases the risk of cardiovascular disease, also showed similar results (24% for men and 35% for women).[57] In a study of Korean adults, even when the BMI was within the normal range, men with a body fat percentage ≥26% and women with a body fat percentage ≥36% can be considered obese with accompanying cardiovascular risk.[58] However, large-scale studies in Korea have reported that BMI is more closely related to body fat mass than to body fat percentage,[59] and evidence for the discrimination point of body fat percentage is currently lacking.[60-63] Considering the current limitations in clinical use and cost, the use of BMI and WC to diagnose obesity should be prioritized.

## CONCLUSION

BMI and WC cutoff points are important for predicting the risk of comorbidities. The Korean adult obesity diagnostic criteria were reasonably set at a BMI of ≥23 kg/m² for overweight (pre-obesity) and ≥25 kg/m² for obesity, considering the significant increase in obesity-related comorbidities in the high-risk groups for clinical management. In Korea, diagnosis of abdominal obesity is given for a WC ≥90 cm in men and ≥85 cm in women; this measurement is better correlated with cardiovascular disease and other obesity-related comorbidities than overall obesity, and measuring WC in addition to BMI is therefore recommended. Diagnostic criteria for obesity and abdominal obesity in Korean adults will help identify and manage high-risk groups for obesity-related comorbidities.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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## AUTHOR CONTRIBUTIONS

Study concept and design: JHH and YHK; acquisition of data: BTK and EMK; analysis and interpretation of data: HK and JHK; drafting of the manuscript: JHH and YHK; critical revision of the manuscript: BTK, JHK, JHP, KKK, and SYR; and study supervision: YHK and KYL.

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