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Self-reported anthropometric information cannot vouch for the accurate assessment of obesity prevalence in populations of middle-aged and older Korean individuals

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ABSTRACT

While there are strong correlations between self-reported and directly measured anthropometric data, the discrepancy and systematic errors associated with these, particularly among middle-aged and older persons residing in South Korea, remain a contentious issue.

All participants were selected from the Korean Longitudinal Study of Aging (KLoSA), a panel study conducted by the Korea Labor Institute; data from 510 participants (290 females; 56.9%) were analyzed. We considered general characteristics, including sex, age, education, marital status, employment, income, and residential region, and used self-rated health (SRH) as a generic indicator of health status. One-way ANOVA, *t*-test, and Scheffé's test ($\alpha = 0.1$) were employed to explore the difference between directly measured and self-reported values. Sensitivity and specificity values were used to assess the validity of obesity diagnoses based on self-reported body mass index (BMI: body weight in kilograms divided by the square of height in meters).

The means of BMI differences were 1.3 (±1.2) kg/m^2 among men and 1.8 (±1.5) kg/m^2 among women. In men, the difference could be attributed to measured BMI and residential region; among women, age and education level influenced the discrepancy in BMI. Scheffé's test ($\alpha = 0.1$) for multiple comparisons of group means revealed that women over the age of 65 years, with lower than middle-school education, who lived in rural areas, and had a measured BMI of 25 kg/m^2 or more, were more likely to have significant BMI discrepancies. In contrast, for men, significant predictors were living in rural areas and being obese. Although adequate correlations were seen in self-reported BMI, they indicated low sensitivity, with 46.5% and 60.1% among males and females, respectively. However, specificities were very high, at 97.8% and 98.0% for males and females, respectively. The diagnostic performance of self-reported BMI is insufficient for assessing obesity prevalence among middle-aged or older Koreans.

1. Introduction

Height and weight are important indicators of population health because of their role in the calculation of the BMI, a common measure of obesity and a simple evaluation of anthropometry and nutrition (World Health Organization, 2000). The BMI and waist circumference are typically used to assess obesity prevalence in a population, due to practical reasons such as low costs, minimal manipulation, and consent by the examinees (Gorber, Tremblay, Moher, & Gorber, 2007). For similar reasons, body weight and height are usually determined through a self-reported questionnaire.

Self-reported and measured values for height and weight are strongly correlated; thus, many studies assume that self-reported data are valid (Bray, 1978; Lee, Shin, Kim, Yoo, & Sung, 2011; Stewart, 1982). However, researchers have expressed concerns regarding discrepancies and systematic errors in self-reported values, as these are unreliable in population subgroups with a high prevalence of obesity (e.g., overweight women and middle-aged and elderly individuals) (Alvarez-Torices, Franch-Nadal,

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Alvarez-Guisasola, Hernandez-Mejia, & Cueto-Espinar, 1993; Craig & Adams, 2009; Crawley & Portides, 1995; Nieto-Garcia, Bush, & Keyl, 1990; Nyholm et al., 2007a, 2007b; Sherry, Jefferds, & Grummer-Strawn, 2007). High body mass is also a predictor of errors in reporting height measurements (Hill & Roberts, 1998; Rowland, 1990). In addition to intentional reporting errors, many people are unaware of their anthropometric data, particularly women and older adults (Ramos, Lopes, Oliveira, & Barros, 2009). In fact, systematic error can result from both intentional and unintentional misreporting, thus affecting reliability and, in turn, validity.

Any change in height that is related to aging has implications beyond descriptive anthropometry. If height changes with age, indexes of obesity such as the BMI would also change with age, independently of changes in actual obesity levels (Sorkin, Muller, & Andres, 1999). Aging is an important cause of height loss, resulting from postural change such as stooping and hyperkyphosis, and degenerative intervertebral disk disease (Briot, Legrand, Pouchain, Monnier, & Roux, 2010). Loss of height could also arise from several clinical conditions involving vertebral fractures, spinal compression, stenosis, high body mass, and osteoporosis (Berecki-Gisolf, Spallek, Hockey, & Dobson, 2010; Silverman, 1992; Szpalski & Gunzburg, 2003). This general decline in stature is likely to result in unintentional errors. The effects of errors would be more complex when resulting from intentional bias related to reporting weight, such as when BMI is used for obesity diagnosis.

To date, our knowledge regarding the accuracy of self-reported anthropometric data is based on Western studies. A review on this topic included 64 studies comparing self-reported and directly measured anthropometric data; 53 of the studies were conducted in North America and Europe, whereas only two were conducted in Asia (Japan). In all 64 studies, only height, weight, and BMI were defined as outcomes (Gorber et al., 2007). In South Korea, a few studies comparing self-reported data with directly measured data were conducted in clinical settings (Lee et al., 2011; Song & Yoon, 1995). Lee et al. found reasonable validity of self-reported height and weight, based on a Pearson's correlation coefficient that was greater than 0.9, a Kappa value greater than 0.7, a sensitivity of more than 80%, and a specificity of more than 90% (Lee et al., 2011). If anthropometric data are used for diagnosing obesity, rather than defining the average build or standard physique of a population, the actual accuracy of this data must be evaluated according to gold standard information, such as sensitivity and specificity. In the case of weight, whole body imaging and hydrostatic weighing are known as the gold standard; in this study, directly measured weight and height were used as benchmarks against which to compare self-reported values. The most important approach required for defining factors associated with the accuracy of self-reported information (i.e., reporting bias) is the comparison of subjective and objective information.

The evaluation of factors that are possibly related to reporting bias has implications for the actual researcher's understanding of data and the results obtained from those data. This is because self-reports are based on social norms and participants' self-perceptions and personal characteristics (Himes, Hannan, Wall, & Neumark-Sztainer, 2005). Relatively few studies have been conducted on factors associated with errors of self-reported height and weight in Asia.

Although many studies have focused on the discrepancy between self-reported and directly measured anthropometric data, the adequacy of those data in measuring corpulence has not been established. There would be differences in data indicating obesity prevalence, as obtained through anthropometric information provided in questionnaires on the one hand, and examiners' measurements on the other. Accordingly, differences in measuring tools must be addressed before the results are compared, interpreted, and used as a basis for any policy decisions. This is particularly important for the relevant stakeholders and policy makers when determining priorities for public health policy, practices, or interventions. Therefore, the first objective of this study was to probe differences between directly measured and self-reported BMI, based on several important variables in a sample of middle-aged and older Koreans. In addition, other than the adequate correlation between self-reported and directly measured values in weight and height, we defined the validity (sensitivity and specificity) of self-reported BMI for obesity assessment according to related factors and defined any differences between levels of those factors.

2. Methods

2.1. Data and study population

All participants were drawn from the panel data of the KLoSA, which used national multistage cluster sampling to select Koreans aged 45 years and older; the study began in 2006 and is conducted biannually by the Korea Labor Institute, Ministry of Labor (Korea Labor Institute, 2010). In the study, household interviews were conducted with a computer-assisted personal interviewing technique. The main questionnaire gathered data regarding the participants' demographic background, family structure, health, functional limitations and caregivers, health insurance and health care utilization, expectations, employment, individual income, housing, and assets. The first wave was conducted between July and December of 2006, with an individual response rate of 89.2%, representing 10,254 persons surveyed by trained interviewers. The second wave was conducted from July to October 2008 and included 8688 (3767 males; 43.4%) persons. For the biomarker pilot study, we randomly sampled 527 (301 females; 57.1%) participants from the panel study who responded during the second wave of the KLoSA. After excluding cases with incomplete anthropometric information ($n = 17$), data from 510 participants (290 females; 56.9%) were used for our analyses.

All the participants were 47 years or older at the time of the interview. Written informed consent was obtained before the KLoSA interview and the physical examination. The study protocol for the physical examination was reviewed and approved by the institutional review board of Seoul National University Hospital (College of Medicine).

2.2. Measures

2.2.1. BMI and obesity

The BMI, computed as body weight (in kilograms) divided by the square of height (in meters), was reported and measured. Measured BMI was calculated using direct measurements of weight and height; reported BMI was calculated using self-reported weight and height. A trained nurse visited participants and conducted the physical examination, including the direct measurements. Nurses used a scale (Omron Karada Scan HBF 362) for body weight measurement and a measuring tape for height. The measurements were taken while the participants were bare-footed and dressed lightly. Weight and height were measured twice; the mean of the two values was used to calculate BMI. Self-reported weight and height were obtained from the second-wave KLoSA survey questionnaire.

Based on recommendations from the WHO (World Health Organization, 1997), overweight and obesity are defined as BMI $\geq$25.0 kg/m^2 and $\geq$30.0 kg/m^2, respectively. However, the Korean National Health and Nutrition Examination Survey (KNHANES) defined obesity as BMI $\geq$25.0 kg/m^2, based on recommendations from the WHO and other groups regarding BMI and morbidity risk among East Asians (Deurenberg-Yap & Deurenberg, 2003;