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Gender differences in health-related quality of life associated with abdominal obesity in a Korean population

Jina Choo,[1] Seonhui Jeon,[2] Juneyoung Lee[3]

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For numbered affiliations see end of article.

Correspondence to
Dr Juneyoung Lee;
jyleeuf@korea.ac.kr

ABSTRACT

Objectives: Overall obesity, as measured by body mass index (BMI), has been associated with a low level of health-related quality of life (HRQOL), but little is known about abdominal obesity. This cross-sectional study aimed to determine whether abdominal obesity, as measured by waist circumference (WC), would be significantly associated with HRQOL independent of overall obesity, and if so, whether the association would differ by gender among the Korean population.

Design: Cross-sectional study.

Setting: South Korea.

Participants: Using data from the 2007–2009 Korea National Health and Nutrition Examination Survey, a total of 13 754 men and women aged 19–65 years were selected, and information about height (cm), weight (kg), WC (cm) and the EuroQOL-5 Dimensions (EQ-5D) scores for HRQOL were taken.

Results: Not only an overall obesity (as categorised into obese, overweight or non-overweight groups based on BMI) but also an abdominal obesity (defined by WC ≥90 cm for men and ≥85 cm for women) was significantly associated with lower EQ-5D scores, after adjusting for age, gender, socioeconomic variables and a number of comorbidities. Even after adjusting BMI effect, the association between abdominal obesity and lower EQ-5D scores remained significant for women, but not for men.

Conclusions: Among the Korean population aged 19–65 years, abdominal obesity was associated with impaired HRQOL, independently of overall obesity. Furthermore, this association differed by gender, being significant only for women. Therefore, primary healthcare professionals should pay attention to gender differences in the impact of obesity on HRQOL when evaluating population-based health programmes.

Strengths and limitations of this study

- The first study reporting a significant association between abdominal obesity and health-related quality of life (HRQOL) in the general population, with the adjustment for all the potential confounding factors.
- Our study results may not guarantee a causal relationship between abdominal obesity and HRQOL, due to the nature of a cross-sectional study design, and also might not be generalisable to other cultural population groups.
- More attention should be given to the modifying effects of gender when analyzing the impacts of abdominal obesity on HRQOL.

INTRODUCTION

Obesity is a major public health concern, and its prevalence is currently on the rise not only in low-income and middle-income countries but also in high-income countries. The WHO has estimated that one billion people are overweight and more than 300 million are obese worldwide, based on the criteria for an overall obesity as measured by body mass index (BMI).[1] In South Korea, 26% of adults aged 19 years and over were overweight or obese in 1998, specifically 25.1% for men and 26.2% for women. By 2009, this figure had risen to 31.3%, specifically 35.8% of men and 26% of women.[2]

Overall obesity as measured by BMI is a well-established risk factor for coronary heart disease and type II diabetes mellitus.[3 4] Furthermore, overall obesity is linked to impaired health-related quality of life (HRQOL). Several previous studies have reported that individuals who were overweight and obese showed significantly lower levels of HRQOL than those with normal weight in the general population of Western countries, including the US, the UK, German and Spanish populations.[5–8] However, few studies have reported an association between overall obesity and HRQOL in Asian populations, even among Koreans.[9]

Abdominal obesity has received attention for its multiple health outcomes. The Nurses' Health Study reported that abdominal obesity, as measured by waist circumference (WC), was independently associated with the risk for coronary heart disease and

cancer in women.[10 11] A meta-analysis showed that, for a 1 cm increment in WC, the relative risk of cardiovascular events increased by 2%.[12] Nonetheless, abdominal obesity has not yet been studied in predicting HRQOL, beyond overall obesity, among the general population.

The impact of obesity may vary by gender. Significantly a higher number of women considered themselves as overweight than did men, and also reported experiencing discomfort due to excessive weight, than did men.[13 14] This implies that gender may be one of the significant factors that could modify an association of obesity with HRQOL. However, it has rarely been considered in the epidemiological literature on the study of obesity and HRQOL in the general population. A few studies have reported that obesity had a much greater impact on HRQOL impairment and mortality for obese women relative to obese men among Americans.[15] However, such a gender difference may differ by population groups with diverse sociocultural contexts. Although fatness was valued traditionally for being associated with prosperity and good health in Korea before the 1980s, thinness has recently become to be valued with the rapid economic growth over the past several decades, especially among women.

In this respect, this study aimed to determine whether abdominal obesity and overall obesity would be significantly associated with HRQOL, as measured by the EuroQOL-5 Dimensions (EQ-5D), after adjusting for potential confounding factors. We then examined whether the association of abdominal obesity with HRQOL would remain significant even after controlling for an effect of overall obesity. We also evaluated whether gender differences existed in the association between abdominal obesity and HRQOL. To investigate these, we utilised nationally representative Korean population data from the fourth round of the Korea National Health and Nutrition Examination Survey (KNHANES IV) conducted in 2007–2009.

METHODS

Design and study population

A cross-sectional design was used in the present study. The KNHANES is a cross-sectional and nationally representative study using a multistage stratified cluster sampling for the selection of household units among non-institutionalised civilians in Korea, which has been conducted by the Korea Centers for Disease Control and Prevention. The KNHANES IV was conducted over 3 years 2007–2009 using three rolling sampling surveys.[16] Owing to these sampling characteristics, findings obtained from the 2007–2009 data in the KNHANES IV should be interpreted as multi-year average estimates.[16 17] The survey consisted of a Health Interview Survey, Health Examination and Nutrition Survey.

The total number of participants in the KNHANES IV was 24 437, who were recruited across all life stages from infancy to old age.[16] Of the KNHANES IV data, our study used 13 754 participants aged 19–65 years. We did not include the elderly population group because they were not considered as part of the post World War II birth cohort who adapted to westernised lifestyles and manifested obesity-related health conditions.[18]

Measures

Our measure of HRQOL is the EQ-5D,[19 20] which is a generic measure of HRQOL considering five dimensions, namely mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Each dimension is scored at 1 of 3 levels, depending on whether the respondent has no problems (score=1), some problems (score=2) or serious problems (score=3) with each of the dimensions. The EQ-5D score at each dimension was converted to a single summary index by applying a formula that attaches weights to each of the levels in each dimension. A number of such formulas, or value sets, are available for different countries, based on the valuation of the EQ-5D from general population samples. The KNHANES uses weights obtained from the Korean population by the Korea Centers for Disease Control and Prevention.[21] After applying these weights, an EQ-5D index score represents the status of health, with a score of zero being equivalent to death, negative scores representing health states worse than death and a maximum score of 1.[20]

Our obesity measures are BMI and WC. BMI was calculated by weight in kilograms divided by height in metres squared (kg/m^2). Overall obesity was classified into three categories according to the BMI categories defined by the WHO[22]: non-overweight, BMI <25; overweight, BMI 25–29.9 and obese, BMI ≥30 kg/m^2. WC was measured in centimetres (cm) at the end of normal expiration and to the nearest 0.1 cm, measuring at the midpoint between the lower borders of the rib cage and the iliac crest with a measuring tape (Seca, Germany). Abdominal obesity was determined as WC of 90 cm or greater for men and 85 cm or greater for women, according to the criterion for abdominal obesity as defined by the Korean Society for the Study of Obesity.[23] Each measurement was taken by trained nurses during the KNHANES IV health examination survey.

The following sociodemographic and health-related variables were obtained from the KNHANES IV database: age, household income (highest, middle-high, middle-low and low levels), education (≤6, 7–9, 10–12 and ≥13 years), employment (yes, no), marital status (married, separated/widowed/divorced and never married), smoking status (current-smokers, ex-smokers and non-smokers) and numbers of comorbidities. The comorbidities used in this study were defined as disease status diagnosed by physicians, consisting of coronary heart disease, stroke, diabetes mellitus, asthma, chronic obstructive pulmonary disease, renal failure and cancers.

Ethical consideration

All participants in the survey provided their informed consent. This study was conducted in accordance with the declaration of Helsinki.

Data analysis

All data analyses were conducted using SAS statistical software, V.9.2 (SAS Institute Inc, Cary, North Carolina, USA). The demographic characteristics of the study participants were expressed as either means (SE) or numbers and prevalence (SE), as appropriate, for total participants as well as for men and women. The survey weights were taken into account to obtain the SEs of prevalence. Gender differences for all participants' demographic, socioeconomic and anthropometric characteristics as well as for EQ-5D scores were analysed with Student t test or χ^2 test, as appropriate, using the SURVEYMEANS or SURVEYFREQ procedures in SAS to reflect the study weights, respectively. A multivariable analysis for gender differences for EQ-5D scores, adjusting for obesity measures and other demographic and socioeconomic variables, was performed using multiple linear regression models. Two models with and without an interaction effect between gender and BMI categories of obese, overweight and non-overweight (models I and II), including each of these main effects, were examined. For the differential effect of abdominal obesity on EQ-5D scores by gender, three models—model I for gender and WC main effects only, model II for gender, WC and BMI main effects and model III for an interaction effect of gender and WC along with those main effects—were examined. Common variables adjusted in the models were age, education level, income level, employment status, marital status and a number of comorbidities. For these regression analyses, the SURVEYREG procedure in SAS was used. All reported p values are two-tailed, and p<0.05 was considered to be statistically significant.

RESULTS

Participants' characteristics

The demographic, socioeconomic and anthropometric characteristics of the adult population of the KNHANES IV (N=13 754) are summarised in tables 1 and 2. The total sample had a mean age of 40.4 years, with more women (n=7832) than men (n=5922; table 1). Women comprised a lower proportion of the population who were at the highest and middle-high levels of household income (p=0.005), highly educated (p<0.001), employed (p<0.001) and never married (p<0.001) than men. Of the total, 9.3% had one or more comorbidities, but there was no significant difference by gender.

Table 1 Participants' demographic and socioeconomic characteristics (N=13 754)

	Total (N=13 754)			Men (n=5922)			Women (n=7832)			
	N	Per cent	(SE)	n	Per cent	(SE)	n	Per cent	(SE)	p Value*
Survey year										0.867
2007	2367	19.8	(2.0)	986	19.7	(2.0)	1381	20.0	(2.0)	
2008	5426	40.0	(2.5)	2323	40.0	(2.5)	3103	40.0	(2.5)	
2009	5961	40.1	(2.5)	2613	40.3	(2.5)	3348	40.0	(2.5)	
Age (years), mean (SE)	13 754	40.4	(0.18)	5922	40.2	(0.22)	7832	40.7	(0.20)	0.074
Household income										0.005
Highest	4243	32.7	(1.0)	1902	33.8	(1.1)	2341	31.6	(1.0)	
Middle-high	4089	30.9	(0.7)	1791	31.2	(0.8)	2298	30.6	(0.8)	
Middle-low	3412	25.2	(0.7)	1420	24.3	(0.8)	1992	26.1	(0.8)	
Low	1699	11.2	(0.5)	676	10.7	(0.6)	1023	11.6	(0.6)	
Education (years)										<0.001
≤6	2270	12.4	(0.4)	689	8.8	(0.4)	1581	16.1	(0.5)	
7–9	1584	10.4	(0.4)	670	9.7	(0.5)	914	11.1	(0.4)	
10–12	5590	44.3	(0.7)	2442	45.0	(0.9)	3148	43.5	(0.7)	
≥13	4194	32.9	(0.8)	2062	36.5	(0.9)	2132	29.2	(0.8)	
Employment										<0.001
Yes	8794	65.8	(0.5)	4801	80.8	(0.7)	3993	50.3	(0.8)	
No	4802	34.2	(0.5)	1050	19.2	(0.7)	3752	49.7	(0.8)	
Marital status										<0.001
Married	10 156	69.7	(0.7)	4347	68.3	(1.0)	5809	71.1	(0.8)	
Separated/widowed/divorced	1162	7.2	(0.3)	283	4.3	(0.3)	879	10.2	(0.4)	
Never-married	2341	23.1	(0.7)	1241	27.4	(0.9)	1100	18.7	(0.7)	
Number of comorbidities										0.253
0	12 205	90.7	(0.3)	5209	90.4	(0.5)	6996	91.0	(0.4)	
1	1294	8.3	(0.3)	578	8.5	(0.4)	716	8.2	(0.4)	
≥2	177	1.0	(0.1)	96	1.1	(0.1)	81	0.8	(0.1)	

*Significance levels for gender difference analysed with Student t test or χ^2 test, as appropriate, using the SURVEYMEANS or SURVEYFREQ procedures in SAS to reflect the study weights.
Number of comorbidities was defined as a number of diseases that a subject possesses out of coronary heart diseases, stroke, diabetes mellitus, asthma, chronic obstructive pulmonary disease, renal failure and cancers.

A total of 69% of the participants were non-overweight, 27% were overweight and 4.1% were obese. Women had a lower average of BMI than men (p<0.001), with a lower prevalence of overweight and obesity than men (24.9% vs 37.5%, p<0.001). Based on the Korean criterion of abdominal obesity, women comprised a lower proportion of the population with abdominal obesity than men (21.1% vs 25%, p<0.001).

The EQ-5D yielded a mean score of 0.958 for the total participants, with 0.946 for women versus 0.969 for men (table 2). For the five subdomains of the EQ-5D (ie, mobility, self-care, usual activities, pain/discomfort and anxiety/depression), the highest proportion of the population manifested pain/discomfort (20%), followed by anxiety/depression, while the lowest one was problems in self-care (1.7%). Women represented significantly greater proportions of the population manifesting any problem across all the domains of the EQ-5D than men, except for the self-care domain.

Figure 1 shows gender-specific adjusted means for EQ-5D scores according to the BMI and WC categories in the fully adjusted models with interaction terms. Overweight and obese women exhibited significantly lower EQ-5D scores compared with non-overweight women, with a decreasing trend as degree of obesity increases; however, no group is statistically different among men (figure 1A). The same patterns were observed in the WC categories despite adjusting for BMI (figure 1B).

Associations between BMI categories and EQ-5D scores and gender differences

Compared with the non-overweight individuals, the overweight individuals reported significantly lower EQ-5D scores (β=−0.005, p=0.007; model I of table 3), but obese individuals did not. There was a significant interaction effect between gender and BMI categories on EQ-5D (β=−0.011, p=0.002 for women and overweight; β=−0.018, p=0.030 for women and obese; model II of table 3). This finding indicated that overweight and obese women had significantly lower EQ-5D scores than non-overweight women, but such significance was not apparent for men (model II of table 3; see also figure 1A).

In the EQ-5D domains, the prevalence of any problem in mobility, usual activities and pain/discomfort differed significantly according to BMI category, with an increasing trend as degree of obesity increases (see online supplemental figure S1). The crude and multivariate associations between BMI category and each domain of EQ-5D by gender are shown in online supplemental tables S1 and S2. After adjusting for all the confounding variables, we found that morbidity in men and

Table 2 Participants' anthropometric characteristics and EQ-5D (N=13 754)

	Total (N=13 754)			Men (n=5922)			Women (n=7832)			
	N	Per cent	(SE)	n	Per cent	(SE)	n	Per cent	(SE)	p Value*
BMI, mean (SE)	13 684	23.60	(0.04)	5888	24.16	(0.05)	7796	23.03	(0.05)	<0.001
BMI categories										<0.001
Non-overweight	9362	68.7	(0.5)	3658	62.5	(0.7)	5704	75.1	(0.6)	
Overweight	3789	27.3	(0.5)	2004	33.3	(0.7)	1785	21.0	(0.6)	
Obese	533	4.1	(0.2)	226	4.2	(0.3)	307	3.9	(0.3)	
WC, mean (SE)	13 677	80.80	(0.1)	5888	84.09	(0.2)	7789	77.39	(0.2)	<0.001
WC categories										<0.001
Normal waist	10 251	76.9	(0.5)	4323	75.0	(0.7)	5928	78.9	(0.6)	
Abdominal obesity	3426	23.1	(0.5)	1565	25.0	(0.7)	1861	21.1	(0.6)	
EQ-5D, mean (SE)	13 638	0.958	(0.001)	5861	0.969	(0.001)	7777	0.946	(0.001)	<0.001
Morbidity										<0.001
Any problem	1395	8.1	(0.3)	435	5.9	(0.3)	960	10.4	(0.4)	
None	12 244	91.9	(0.3)	5427	94.1	(0.3)	6817	89.6	(0.4)	
Self-care										0.214
Any problem	295	1.7	(0.1)	118	1.6	(0.2)	177	1.9	(0.2)	
None	13 344	98.3	(0.1)	5744	98.4	(0.2)	7600	98.1	(0.2)	
Usual activities										<0.001
Any problem	903	5.2	(0.2)	301	4.0	(0.3)	602	6.5	(0.3)	
None	12 736	94.8	(0.2)	5561	96.0	(0.3)	7175	93.5	(0.3)	
Pain/discomfort										<0.001
Any problem	3009	20.0	(0.5)	976	15.4	(0.6)	2033	24.8	(0.7)	
None	10 629	80.0	(0.5)	4885	84.6	(0.6)	5744	75.2	(0.7)	
Anxiety/depression										<0.001
Any problem	1691	11.4	(0.4)	423	6.7	(0.4)	1268	16.3	(0.6)	
None	11 948	88.6	(0.4)	5439	93.3	(0.4)	6509	83.7	(0.6)	

*Significance levels for gender difference analysed with Student t test or χ^2 test, as appropriate, using the SURVEYMEANS or SURVEYFREQ procedures in SAS to reflect the study weights.
BMI, body mass index; EQ-5D, EuroQOL-5 Dimensions Scores; WC, waist circumference.

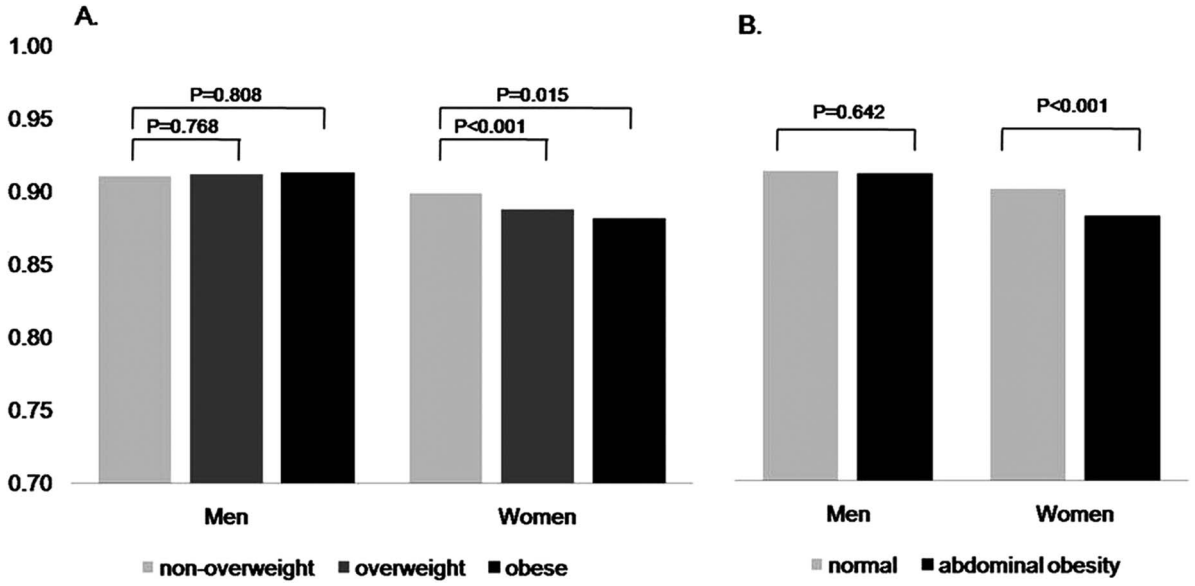

Figure 1 Gender-specific means of EQ-5D according to BMI (A) and WC (B) categories (N=13 754). Mean values of EQ-5D adjusted for age, gender, education, household income, employment, marital status and number of comorbidities (A) and further for BMI (B); BMI was categorised into non-overweight (BMI<25 kg/m^2), overweight (BMI≥25 kg/m^2) and obesity (BMI≥30 kg/m^2) and WC into normal waist and abdominal obesity (WC≥90 cm for men and ≥85 cm for women). BMI, body mass index; EQ-5D, EuroQOL-5 Dimensions Scores; WC, waist circumference.

morbidity, usual activities and pain/discomfort in women were more likely to be prevalent for any problem among overweight or obese groups compared with the reference category of non-overweight group (see online supplemental table S2).

Associations between WC categories and EQ-5D scores and gender differences

Compared with those with normal waists, individuals with abdominal obesity showed significantly lower EQ-5D scores (β=−0.009, p<0.001; model I of table 4). This significant association remained unchanged even after the effect of BMI was adjusted for in the model (β=−0.009, p=0.002; model II of table 4). Furthermore, a significant interaction effect between gender and WC categories on EQ-5D was found (β=−0.017, p<0.001 for women and abdominal obesity; model III of table 4). This finding indicated that women with abdominal obesity had significantly lower EQ-5D scores compared with those with normal waists, but such significance was not apparent for men (model III of table 4; see also figure 1B), even after adjusting for BMI.

In the EQ-5D domains, the prevalence of any problem in all the domains of EQ-5D differed significantly according to WC category, with more prevalence in individuals with abdominal obesity (see online supplemental figure S2). The crude and multivariate associations between WC category and each domain of EQ-5D by gender are shown in online supplemental tables S3 and S4. Women with

Table 3 Association between BMI categories and EQ-5D and its gender difference (N=13 754)

Variables	Model I			Model II		
	Coeff.	(SE)	p Value	Coeff.	(SE)	p Value
BMI categories						
Obese	−0.008	(0.004)	0.063	0.001	(0.005)	0.808
Overweight	−0.005	(0.002)	0.007	−0.001	(0.002)	0.768
Gender						
Women	−0.016	(0.002)	<0.001	−0.012	(0.002)	<0.001
Gender×BMI						
Women×obese				−0.018	(0.008)	0.030
Women×overweight				−0.011	(0.004)	0.002

Reference group for BMI categories=non-overweight group; reference group for gender=men.
Gender×BMI=interaction effect between gender and BMI.
p Values are from multiple linear regression models.
Model I: adjusted for age, education, income, employment, marital status and number of comorbidities.
Model II: adjusted for model I plus an interaction term between gender and BMI category.
BMI, body mass index; Coeff., regression coefficient; EQ-5D, EuroQOL-5 Dimensions Scores.

Table 4 Association between WC categories and EQ-5D and its gender difference (N=13 754)

Variables	Model I			Model II			Model III		
	Coeff.	(SE)	p Value	Coeff.	(SE)	p Value	Coeff.	(SE)	p Value
WC categories									
Abdominal obesity	−0.009	(0.002)	<0.001	−0.009	(0.003)	0.002	−0.002	(0.004)	0.642
Gender									
Women	−0.016	(0.002)	<0.001	−0.016	(0.002)	<0.001	−0.012	(0.002)	<0.001
BMI categories									
Obese				0.001	(0.005)	0.878	0.001	(0.005)	0.828
Overweight				0.000	(0.002)	0.849	0.000	(0.002)	0.844
Gender×WC									
Women×abdominal obesity							−0.017	(0.004)	<0.001

Reference group for WC categories=normal waist group; reference group for gender=men.
Gender×WC=interaction effect between gender and WC.
p Values are from multiple linear regression models.
Model I: adjusted for age, education, income, employment, marital status and comorbidities.
Model II: adjusted for model I plus BMI category.
Model III: adjusted for model II plus an interaction term between gender and WC category.
BMI, body mass index; Coeff., regression coefficient; EQ-5D, EuroQOL-5 Dimensions Scores; WC, waist circumference.

abdominal obesity were more likely to manifest a problem in the domains of mobility, usual activities, pain/discomfort and anxiety/depression (except for self-care) than those with normal waist (see online supplemental table S4). However, this pattern was not apparent in men.

DISCUSSION

In this cross-sectional population-based study among the Korean population aged 19–65 years, overall and abdominal obesity were significantly associated with lower EQ-5D scores after adjusting for age and socioeconomic variables such as income, education, marital status and employment, as well as for comorbidities. Noticeably, the association between abdominal obesity and HRQOL remained significant even after controlling for overall obesity. Furthermore, such associations between obesity and HRQOL differed by gender, being significant among women but not among men.

To the best of our knowledge, this significant association between abdominal obesity and HRQOL, after controlling for possible potential confounders and overall obesity, is the first one studied in the general population. In fact, Faulkner *et al*[24] reported such an association among 90 patients with schizophrenia, showing that higher levels of WC were significantly associated with impaired physical quality of life, as measured by SF-12, and its association was independent of BMI levels. Meanwhile, epidemiological cohort studies have demonstrated independent associations of abdominal obesity with the risk for chronic diseases, such as type II diabetes, cardiovascular disease or some cancers such as hepatocellular carcinoma and breast, colon and uterus cancer.[12 25 26] Unlike these chronic diseases, HRQOL reflects a comprehensive health outcome, assessing people's own functional abilities across multiple domains including physical and psychological well-being. For this reason, HRQOL has also been known as a predictor for mortality in older or female population samples.[26 27]

A few studies have reported a stronger association between overall obesity (as measured by BMI) and HRQOL among women than among men.[28] Unlike the previous studies, our study showed that the statistically significant association of abdominal obesity with HRQOL was apparent among women but not among men. Based on our data (model III in table 4), the coefficient for abdominal obesity in women was approximately 0.02 (the coefficient for the WC variable (−0.002)+the coefficient for an interaction term of women×abdominal obesity (−0.017)), indicating a variation in EQ-5D scores between women with and without abdominal obesity in the fully adjusted model (even further after the adjustment for BMI). In other words, EQ-5D levels were impaired by 2% in women with abdominal obesity compared with those with normal waists. The magnitude of variation in the present study merits discussion of whether this is clinically meaningful. A few studies have investigated the smallest change in EQ-5D score that can be regarded as clinically meaningful, that is, the minimal clinically important difference (MCID).[20 29 30] The mean MCID of EQ-5D was 0.04–0.07 across a range of conditions (eg, post-traumatic stress disorder, rheumatoid arthritis, limb reconstruction, osteoarthritis or chronic obstructive disease). The mean MCIDs were all obtained from patient groups, and none of these studies focused specifically on obesity within the general population. Nevertheless, we speculate that the mean MCID for abdominal obesity in the present study may have a lower value than the minimum MCIDs previously reported for various patient groups. Furthermore, no previous studies have reported coefficients for the association between abdominal obesity and HRQOL in a fully adjusted model, where BMI was even adjusted. In this respect, the statistically

significant 2% decrease of EQ-5D in women with abdominal obesity among the general population may also be clinically meaningful.

The gender difference in the association between abdominal obesity and HRQOL cannot be fully investigated in the present study, but could be explained by two potential conjectures. First, this may be related to biophysical problems resulting from abdominal obesity among women. Women usually report worse health than men, which may be a result of sleepiness and fatigue.[31] In fact, sleepiness and fatigue are major symptomatic consequences of abdominal obesity associated with insulin resistance, which is an underlying mechanism for the development of abdominal obesity.[32] Moreover, women report worse pain than men, as Unruh[13] argued that women were more likely to report greater frequency, severity and duration of pain than do men, and moreover, to respond to pain more than do men, especially due to obesity. Stone and Broderick[14] showed that overweight and obese individuals reported more daily pain than non-overweight individuals, and the obesity–pain association was stronger for women than for men.

The gender differences in the associations between overall or abdominal obesities and HRQOL may further be explained within the psychological and sociocultural context of women's lives. The impact of obesity on psychological well-being may not be comparable between women and men.[33] Obese women could be more likely than their male counterparts to experience poor psychological well-being such as body dissatisfaction, low self-esteem and depression,[33] which may be more prominent in Korea than other countries in light of the Korean cultural background. Today's society values thinness for women's bodies and exerts an intense pressure on women to engage in appearance monitoring and surveillance for their attractiveness, mostly projecting attributes such as health.[34 35] Since the 2000s, dieting, body contouring and plastic surgeries have been actively introduced among women in Korean society, with an increasing demand for well-being and good health. According to the results of one survey, 99% of Korean women were not fully satisfied with their own bodies and 53% considered having either cosmetic or plastic surgery.[36] It was also argued that women's sense of worth is considerably determined by their appearance, and as a result, women are more limited in exercising their power and abilities, by means other than appearance, in Korean society than in other societies.[37] This may, in part, be ingrained in the Korean patriarchal culture permeated by Confucian family norms and traditions. Women in Korean society are more likely to internalise men's views of their own bodies more than women in other societies.[38] In this sociocultural context, overweight and obese women may consider themselves a marginalised group from thin or non-overweight women in the dynamics of health and practice. Thus, such conditioning may increase body dissatisfaction,[35] which may in turn result in depressive symptoms among overweight and obese women.[39]

Our study has several strengths. This is the first study to elucidate the association between abdominal obesity and HRQOL in the general population. Moreover, this study distinguishes itself from previous studies in the adjustment for all the potential confounding factors (ie, age, household income, education, employment, marital status and comorbidities) to be identified in the association between obesity and HRQOL. Nevertheless, our study also has some limitations. Because the measurement of abdominal obesity in the KNHANES has been confined to WC, advanced or modified indices beyond WC (ie, imaging techniques measured by CT and MRI, waist-to-hip ratio, waist-to-height ratio or sagittal abdominal diameter) could not be addressed in this study.[40 41] Thus, although WC was found to be an adequate index of abdominal adiposity to assess a large population, other abdominal adiposity indices may need to be included to investigate the association with HRQOL. Furthermore, our study results may not guarantee a causal relationship between abdominal obesity and HRQOL, due to the nature of a cross-sectional study design, and also might not be generalisable to other cultural population groups.

CONCLUSIONS

Abdominal obesity was significantly associated with lower HRQOL in general Korean population, which was independent of overall obesity. This association differed by gender, being significant especially among women but not among men. Therefore, abdominal obesity, as measured by WC, needs to be assessed in order to monitor and evaluate HRQOL in caring for populations in preventing and reducing obesity. In particular, primary healthcare professionals should pay more attention to gender differences in the impacts of obesity on HRQOL when evaluating population-based health programmes.

Author affiliations
[1]College of Nursing, Korea University, Seoul, South Korea
[2]Medical Division, Green Cross Corp, Yongin, South Korea
[3]Department of Biostatistics, College of Medicine, Korea University, Seoul, South Korea

Contributors JC developed the hypothesis of this study and prepared the manuscript draft. JL and SJ were involved in data collection and analysis and provided expert consultation on data interpretation. All authors were involved in the review and revision of the manuscript and gave final approval of the manuscript.

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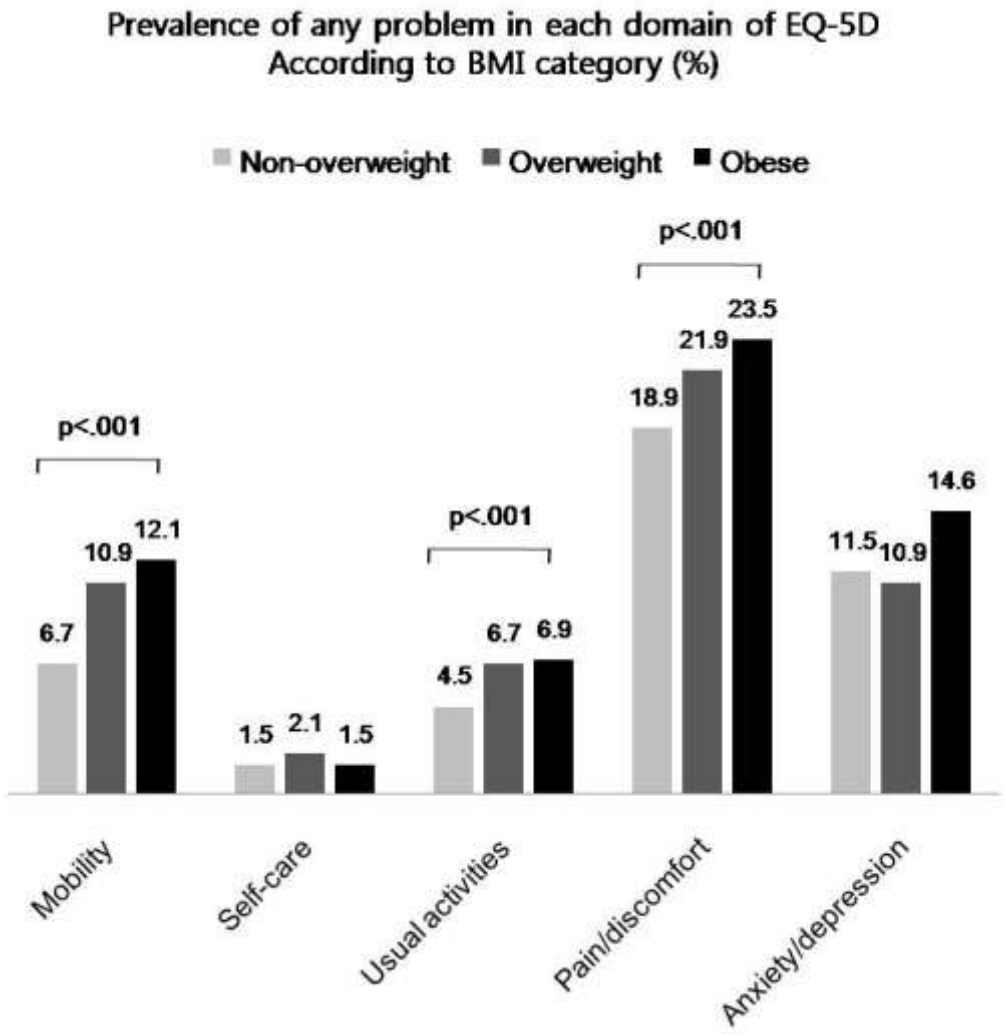
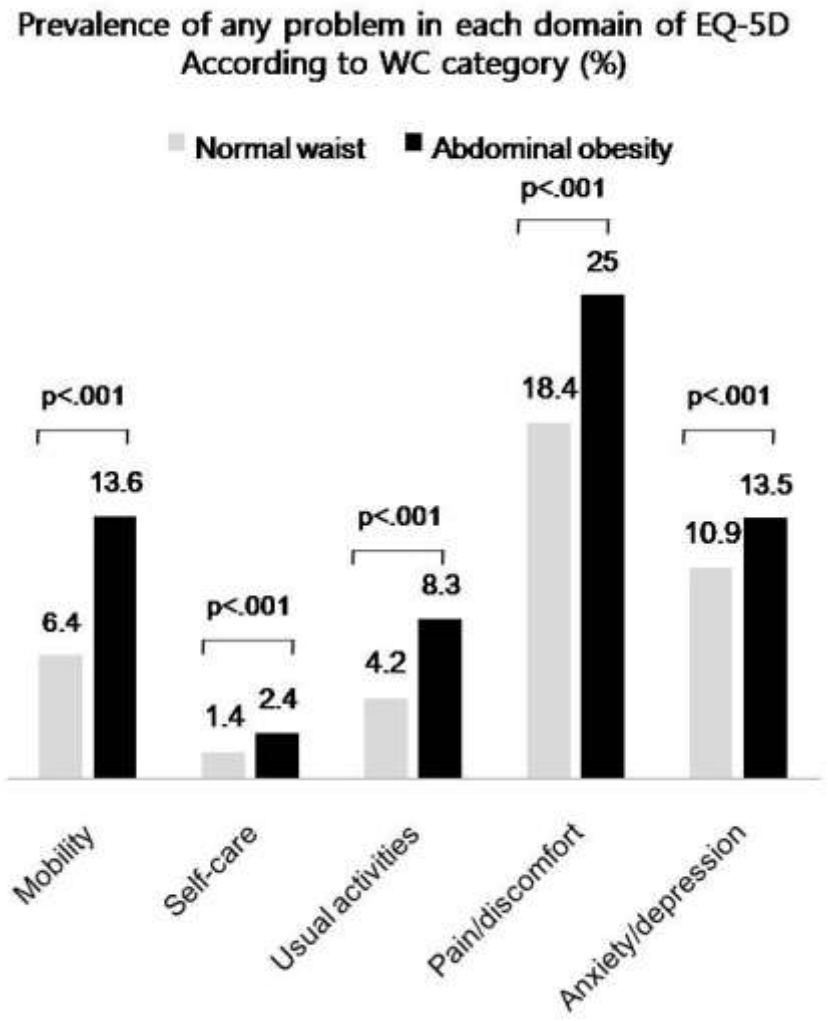


Supplemental Figure 1. Prevalence of any problem in each domain of EQ-5Daccording to BMI category (N=13,754)

BMI, body mass index

P-values are obtained by chi-square tests



Supplemental Figure 2. Prevalence of any problem in each domain of EQ-5Daccording to WC category (N=13,754)

WC, waist circumference

P-values are obtained by chi-square tests

Supplemental Table 1.Crude associations between BMI category and each domain of EQ-5D by gender(N=13,754)

	Men (n=5,922)				Women (n=7,832)			
	Non-overweight	Overweight	obese	p-value[a]	Non-overweight	Overweight	obese	p-value[a]
Mobility				.127				<.001
Any problem	253(5.3)	158 (6.7)	16 (6.6)		530 (7.9)	361 (17.8)	62 (18.2)	
None	3,366 (94.7)	1,830 (93.3)	209 (92.4)		5,38 (92.1)	1,414 (82.2)	244 (81.8)	
Self-care				-				<.001
Any problem	75 (1.6)	35 (1.5)	0 (0.0)		101 (1.5)	59 (3.0)	14 (3.3)	
None	3,544 (98.4)	1,953 (98.5)	225 (100.0)		5,567 (98.5)	1,716 (97.0)	292 (96.7)	
Usual activities				.801				<.001
Any problem	186 (3.9)	98 (4.1)	8 (3.1)		341 (5.0)	213 (10.9)	42 (11.3)	
None	3,433 (96.1)	1,890 (95.9)	217 (96.9)		5,327 (95.0)	1,562 (89.1)	264 (88.7)	
Pain/discomfort				.945				<.001
Any problem	604 (15.2)	327 (15.6)	33 (15.5)		1,324 (22.1)	591 (32.4)	104 (32.5)	
None	3,014 (84.8)	1,661 (84.4)	192 (84.5)		4,344 (77.9)	1,184 (67.6)	202 (67.5)	
Anxiety/depression				.111				<.001
Any problem	282 (7.2)	121 (5.6)	16 (8.1)		864 (15.2)	337 (19.5)	64 (21.8)	
None	3,337 (92.8)	1,867 (94.4)	209 (91.9)		4,804 (84.3)	1,438 (81.5)	242 (78.2)	

BMI=body mass index

[a]Significance levels analyzed with chi-square tests

Supplemental Table 2.Multivariate associations between BMI category and each domain of EQ-5D by gender (N=13,754)

	Odds ratio (95% confidence interval)					
	Men (n=5,922)			Women (n=7,832)		
	Non-overweight	Overweight	Obese	Non-overweight	Overweight	Obese
Mobility	reference	**1.3 (1.02 – 1.65)**	1.2 (0.59 – 2.61)	reference	**1.4 (1.18 – 1.69)**	**1.6 (1.10 – 2.38)**
Self-care	reference	1.0 (0.60 – 1.61)	0.0 (0.00 – 0.00)	reference	1.0 (0.68 – 1.54)	1.1 (0.59 – 2.11)
Usual activities	reference	1.1 (0.80 – 1.55)	0.6 (0.22 – 1.79)	reference	**1.3 (1.01 – 1.62)**	1.4 (0.90 – 2.22)
Pain/discomfort	reference	1.0 (0.82 – 1.18)	1.0 (0.66 – 1.57)	reference	**1.2 (1.07 – 1.44)**	1.3 (0.93 – 1.76)
Anxiety/depression	reference	0.8 (0.61 – 0.99)	1.2 (0.67 – 2.18)	reference	1.1 (0.90 – 1.27)	1.3 (0.88 – 1.78)

BMI=body mass index

Odds ratios (95% confidence interval) are from logistic regression models after adjusting for age, education, income, employment, marital status, no. of co-morbidities, and an interaction term between gender and BMI category

Supplemental Table 3.Crude associations between WC category and each domain of EQ-5D by gender (N=13,754)

	Men (n=5,922)			Women (n=7,832)		
	Normal waist	Abdominal obesity	p-value[a]	Normal waist	Abdominal obesity	p-value[a]
Mobility			<.001			<.001
Any problem	280 (5.2)	145 (7.7)		521 (7.6)	431 (20.8)	
None	3,996 (94.8)	1,409 (92.3)		5,368 (92.4)	1,422 (79.2)	
Self-care			.727			<.001
Any problem	81 (1.4)	28 (1.6)		99 (1.4)	75 (3.4)	
None	4,195 (98.6)	1,526 (98.4)		5,790 (98.6)	1,778 (96.6)	
Usual activities			.140			<.001
Any problem	203 (3.7)	87 (4.6)		327 (4.8)	268 (12.8)	
None	4,073 (96.3)	1,467 (95.4)		5,562 (95.2)	1,585 (87.2)	
Pain/discomfort			.036			<.001
Any problem	682 (14.6)	279 (17.1)		1,338 (22.0)	679 (34.7)	
None	3,593 (85.3)	1,275 (82.9)		4,551 (78.0)	1,174 (65.3)	
Anxiety/depression			.717			<.001
Any problem	316 (6.8)	103 (6.5)		871 (14.8)	393 (22.0)	
None	3,960 (93.2)	1,451 (93.5)		5,018 (85.2)	1,460 (78.0)	

WC=waist circumference

[a]Significance levels analyzed with chi-square tests

Supplemental Table 4.Multivariate associations between WC category and each domain of EQ-5D by gender(N=13,754)

Sub-domains	Odds ratio (95% confidence interval)			
	Men (n=5,922)		Women (n=7,832)	
	Normal waist	Abdominal obesity	Normal waist	Abdominal obesity
Mobility	reference	1.1 (0.82 – 1.49)	reference	**1.3 (1.13 – 1.74)**
Self-care	reference	0.9 (0.47 – 1.81)	reference	1.2 (0.81 – 1.91)
Usual activities	reference	1.1 (0.74 – 1.65)	reference	**1.5 (1.11 – 1.95)**
Pain/discomfort	reference	1.1 (0.86 – 1.28)	reference	**1.3 (1.08 – 1.51)**
Anxiety/depression	reference	1.0 (0.74 – 1.29)	reference	**1.3 (1.08 – 1.59)**

WC=waist circumference

Odds ratios (95% confidence interval) are from logistic regression models after adjusting for age, education, income, employment, marital status, and no. of co-morbidities, and an interaction term between gender and WC category