Journal of Obesity & Metabolic Syndrome 2022;31:313-324
https://doi.org/10.7570/jomes22051

Original Article

jomes
pISSN 2508-6235
eISSN 2508-7576

Self-perceived Weight and Mortality in Korean Adults Based on the Korea National Health and Nutrition Examination Survey Data Linked to Cause of Death Statistics

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Background: This study aimed to determine the associations between self-perceived weight, weight perception, and mortality risk among Korean adults.

Methods: Data from the 2007 to 2015 Korea National Health and Nutrition Examination Survey and the 2007 to 2019 Cause of Death Statistics were linked for this cohort study. A complex samples Cox regression analysis involving 42,453 participants (17,056 male; 25,397 female) was performed after excluding those who died within 1 year of the follow-up period, those with a history of cancer, those with cardiovascular diseases, those without body mass index (BMI) data, and those without self-perceived weight data.

Results: During 7.85 years of follow-up, the overall mortality rate was 3.8% (4.5% for male and 3.1% for female). Self-perceived thin weight status was associated with a 43% to 68% higher risk of all-cause mortality and a 2.48-times higher risk of cardiovascular mortality compared to self-perceived just right weight status after controlling for sociodemographic characteristics, health-related behaviors, underlying health status, BMI, and metabolic syndrome. After adjusting for the confounding factors, those who underestimated their weight had a 27% reduced risk of all-cause mortality than those who correctly estimated their weight. The risks of all-cause mortality and cardiovascular mortality were 2.14-times higher and 2.32-times higher, respectively, in the underweight group with an accurate weight estimation than in the normal weight group with an accurate weight estimation. However, all-cause mortality was 47% lower among participants with obesity who overestimated their weight.

Conclusion: Self-perceived thinness and accurately perceived underweight status were associated with increased risks of all-cause mortality and cardiovascular mortality among Korean adults.

Key words: Self concept, Weight perception, Mortality

Received August 30, 2022
Reviewed November 1, 2022
Accepted December 10, 2022

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INTRODUCTION

Recent cross-sectional studies have indicated that subjectively perceived weight status is related to self-rated health and health-related quality of life. Perceptions of self as underweight or overweight have been linked to greater odds of suboptimal self-rated health and general life satisfaction, independent of body mass index (BMI), by the Canadian Community Health Survey (n = 87,545 adults; age, 18–65 years).[1] During a study of young adults 24 to 34 years of age (n = 7,044 female; n = 6,594 male), independent of BMI, those who thought they were overweight or underweight reported having worse health than those who thought their weight was normal.[2] According to data from the Korea National Health and Nutrition Examination Survey (KNHANES; n = 43,883 adults; age 19 years

or older), participants who underestimated or overestimated their weight were more likely to have a poor health-related quality of life than those who accurately perceived their weight.[3] During another study based on the KNHANES data (n = 8,397 male, n = 11,211 female; age, 40–80 years), individuals who accurately estimated their underweight status regardless of sex or age and those who correctly identified themselves as obese during middle age were most likely to have poorer self-rated health.[4]

The self-perceived weight status can be affected by subjectively perceived weight discrimination. Self-perceived weight discrimination has been associated with physical issues such as obesity, chronic infections, and an increased burden of chronic diseases, as well as mental health issues such as stress and dementia.[5,6] It has also been linked to unhealthy lifestyles and an increased mortality risk.[5] Considering the association between subjectively perceived weight and self-rated health, which was independent of actual weight;[2] the relationship between self-rated health and mortality risk,[7,8] and the relationship between weight discrimination and mortality risk,[5] it can be hypothesized that self-perceived weight may be associated with mortality risk, and that this relationship may be independent of actual weight. However, self-perceived weight and weight perception have been associated with long-term weight gain. Among overweight or obese teenagers, the underestimated weight assessment group gained less weight than the accurate weight assessment group, and self-perceived obesity increased the risk of obesity after 12 years.[9,10] A systematic review study also indicated that individuals who perceive their weight status as overweight are more likely to report trying to lose weight but eventually gaining more weight.[11] Considering the relationship between weight gain and high mortality risk,[12] a relationship between weight perception and mortality risk can be assumed.

The associations between self-perceived weight, weight perception, and mortality risk have not received as much attention as the relationship between BMI and the risk of death, which has been the topic of several studies.[13-16] Evidence of long-term health issues associated with self-perceived weight and weight perception can be found by examining the relationships between self-perceived weight, weight perception, and the risk of death, independent of the measured weight status and whether it has been considered. Therefore, this study aimed to evaluate the relationships between self-perceived weight, weight perception, and mortality risk among Korean adults using the KNHANES data linked to the Cause of Death Statistics.

METHODS

Study participants

The KNHANES evaluates the health and health-related behaviors of the Korean population and serves as the foundation for developing and assessing health policies. Furthermore, it includes a health interview, health examination survey, and nutrition survey. The KNHANES data were gathered using a rolling sampling design that involved a complex, stratified, and multistage probability cluster survey.[17] Consent was obtained from the KNHANES participants since 2007 by linking with the following data: Statistics Korea's Death Statistics; the Korea Central Cancer Registry of the National Cancer Center; Claims Data of the National Health Insurance Service; and Health Insurance Review and Assessment Service. Based on the data from 2020, statistics regarding the cause of death and related data were constructed and disclosed to researchers. Data obtained by linking the 2007 to 2015 KNHANES data with the 2007 to 2019 Cause of Death Statistics are currently available (dataset version 1.2).[18,19]

Of the 53,101 individuals 19 years of age or older who participated in the 2007 to 2015 KNHANES health examination survey, 51,575 who agreed to link their data and had valid registration numbers were included in the linked dataset. However, 3,426 of the 51,575 individuals comprising the linked dataset died between 2007 and 2019 during an average follow-up of 8.4 years according to the cutoff date of December 31, 2019.[19]

Among them, those who died within 1 year of the follow-up period (n = 93), those with a history of cancer (stomach cancer, liver cancer, colon cancer, breast cancer, cervical cancer, lung cancer, or thyroid cancer; n = 823), those with cardiovascular diseases (stroke or ischemic heart disease; n = 556), those who did not have BMI data (n = 218), and those who did not have self-perceived body shape data (n = 1,854) were excluded from this study. Therefore, 42,453 participants (17,056 male; 25,397 female) were included in the study after the exclusion criteria were applied.

The KNHANES is in agreement with the guidelines of the Declaration of Helsinki. The Institutional Review Board of the Korean

Centers for Disease Control and Prevention approved all procedures involving human subjects. All participants provided written informed consent. The Institutional Review Board of Busan Paik Hospital Inje University approved the study protocol (No. 2022-04-045).

Weight-related parameters

Trained study assistants performed weight and height measurements. BMI was computed by dividing the weight in kilograms by the height in meters squared. According to the 2018 Korean Society for the Study of Obesity Guideline for Management of Obesity, BMI was classified as follows: underweight, 18.5 kg/m^2; normal weight, 18.5 to < 23.0 kg/m^2; overweight, 23.0 to < 25.0 kg/m^2; and obesity, ≥ 25.0 kg/m^2.[20] During the self-administered surveys, five categories of self-perceived weight were evaluated. Participants were asked the following: "What do you think about your current body shape?"; the five options for answering this question were "very thin," "thin," "just right," "slightly fat," and "very fat."[21]

Subsequently, the BMI-based weight categorization and self-perceived weight classification were compared, and weight perception was categorized. Self-perceived "very thin" was regarded as underweight because the prevalence of underweight according to BMI and that of self-perceived "very thin" were comparable (4.5% and 4.6%, respectively). Therefore, these five self-perceived weights were reclassified as "very thin" (underweight), "thin," "just right" (normal weight), "slightly fat" (overweight), and "very fat" (obesity) to denote weight perception. If the BMI-based and self-perceived weight classifications coincided, then the perception was considered accurate. If the self-perceived weight category was lower than the BMI-based weight category, then the perception was defined as an underestimation. Overestimation was defined as a self-perceived weight category exceeding the BMI-based weight category.[1-4]

Cause of death statistics

The causes of death comprising the linked data were based on the subcategories of the Korean Standard Classification of Diseases (7th revision). The cause of death and the year and month when death occurred were related to the death statistics.[19] All-cause mortality, cardiovascular disease mortality (I05-I99), and cancer mortality (C02-D47) were the endpoints of the analyses.

Covariates

The following factors were investigated using questionnaires and interviews: economic status; educational background; marital status; presence of chronic diseases (yes or no for hypertension, dyslipidemia, diabetes mellitus, pulmonary tuberculosis, renal failure, depression, and liver cirrhosis); self-rated health status; depressive mood (yes or no for depression for ≥ 2 consecutive weeks); and health-related behaviors. Health-related behaviors included monthly drinking (yes or no for ≥ 1 drink/mo over the course of the past year), smoking status (current, former, or non-smoker), physical activity (yes or no for aerobic physical activity, which comprised ≥ 2 hours and 30 minutes of moderate-intensity exercise, ≥ 1 hour and 15 minutes of high-intensity exercise, a combination of high-intensity and moderate-intensity physical activity [1 minute of high-intensity exercise corresponds to 2 minutes of moderate-intensity exercise], or walking [≥ 30 min/session and ≥ 5 day/wk]).

Waist circumference was measured to the nearest 0.1 cm at the end of normal expiration at the midpoint between the lowest rib and iliac crest. Blood pressure was measured three times using a standard manual sphygmomanometer while the participants were seated. The average of the second and third blood pressure measurements was used for the analyses. Antecubital venous blood samples were collected from each subject after a 12-hour overnight fast. An automatic analyzer (Automatic Chemistry Analyzer 7600; Hitachi, Tokyo, Japan) was used to measure high-density lipoprotein cholesterol and triglyceride levels using an enzyme method and glucose levels using calorimetry. Metabolic syndrome was defined when at least three of the following characteristics were present: waist circumference ≥ 90 cm (for male) or 85 cm (for female);[19,21,22] blood pressure ≥ 130/85 mmHg or a history of hypertension; fasting plasma glucose level ≥ 5.6 mmol/L or a history of diabetes mellitus; high-density lipoprotein cholesterol level < 1.03 mmol/L for male or 1.29 mmol/L for female; and triglyceride level ≥ 1.7 mmol/L.[23] Using a standardized questionnaire, an individual was defined as having a history of hypertension or diabetes mellitus based on the diagnosis determined by a physician or the current use of treatment for these illnesses.[24]

Statistical analysis

Sampling weights and a complex survey design (clusters and strata) were considered during all analyses.[17,25] The Rao-Scott modified chi-square test was used to determine the relationships of weight-related indicators and confounding factors for survival and death. Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for all-cause mortality, cancer mortality, and cardiovascular mortality according to self-perceived weight, weight perception, and combinations of BMI categories and weight perception. The follow-up durations for all participants were computed using the time from their participation year and month to their death year and month in the case of the deceased; in the case of survivors, they were computed using the time from their participation year and month to December 2019. During cancer or cardiovascular mortality analyses, those who died from other causes were censored along with the survivors, and only death attributable to the cause was considered an outcome event, assuming that those who were censored had the same disease-specific mortality. A test of the proportional hazards assumption was performed to compare the fitted model to an alternative model that included time-dependent predictors for each predictor using the Kaplan-Meier time function. When $P < 0.05$ was observed during the test for model assumptions, HRs and 95% CIs using an alternative model were adopted.

Sociodemographic characteristics, health-related behaviors, self-rated health, depression, and chronic disease status were adjusted in the analyses using Cox proportional hazards models. The BMI (only for analysis of self-perceived weight) and metabolic syndrome were further adjusted. In these models, the interactions between sex and self-perceived weight-related indicators were analyzed; then, sex-specific HRs and 95% CIs for all-cause mortality according to self-perceived weight-related indicators were assessed. Data were analyzed using the IBM SPSS software ver. 28 (IBM Corp., Armonk, NY, USA).

RESULTS

Baseline characteristics

The mean age of the participants was 44.6 years (95% CI, 44.3–44.8 years), and the mean follow-up duration was 7.85 years (95% CI, 7.78–7.93 years). There were 2,492 deaths (3.8% of all participants; 4.5% of male; 3.1% of female). Cancer mortality comprised 31.9% of all deaths, whereas cardiovascular mortality comprised 21.7%. All-cause mortality increased with lower BMI category, lower self-perceived weight, and underestimated weight. All-cause mortality was higher among participants with lower level of educa-

Table 1. Comparison of characteristics between survivors and deceased (n = 42,453)

Variable	Deceased (n)	W%*	Survivor (n)	W%*	Chi^{2†}	*P*
Number	2,492	3.8	39,961	96.2		-
Weighted N*	1,425,037		36,381,187			-
Cause of mortality						-
Cancer	814	31.9	-			
Cardiovascular disease	566	21.7	-			
Others	1,112	46.4	-			
BMI category (kg/m^2)					11.7	<0.001
<18.5	194	5.9	1,706	94.1		
18.5–<22.9	1,066	4.0	15,937	96.0		
23.0–<24.9	577	3.8	9,458	96.2		
≥25.0	655	3.2	12,860	96.8		
Self-perceived weight					131	0.000
Very thin	352	12.7	1,606	87.3		
Thin	497	5.4	4,845	94.6		
Just right	1,059	4.0	16,351	96.0		
Slightly fat	493	2.4	13,889	97.6		
Very fat	91	1.5	3,270	98.5		

(*Continued to the next page*)

Table 1. Continued

Variable	Deceased (n)	W%*	Survivor (n)	W%*	Chi^{2†}	*P*
Weight perception					41.9	0.000
Underestimation	1,227	4.8	15,906	95.2		
Accurate estimation	1,128	3.3	20,392	96.7		
Overestimation	137	2.2	3,663	97.8		
Sex					48.5	<0.001
Male	1,401	4.5	15,655	95.5		
Female	1,091	3.1	24,306	96.9		
Age (yr)					1,222	0.000
19–39	53	0.4	12,994	99.6		
40–59	295	1.9	15,697	98.1		
60–80	2,144	15.6	11,270	84.4		
Education					666	0.000
< High school	1,908	10.2	13,610	89.8		
High school	380	1.8	13,829	98.2		
≥ College	175	1.0	11,973	99.0		
Household income					347	0.000
1st quartile	1,264	11.6	7,068	88.4		
2nd quartile	582	3.6	10,030	96.4		
3rd quartile	319	1.8	11,103	98.2		
4th quartile	255	1.7	11,298	98.3		
Spouse					5.1	0.024
Yes	1,628	3.6	29,225	96.4		
No	864	4.1	10,736	95.9		
Smoker					75.9	0.000
Current	1,033	5.4	9,829	94.6		
Former	379	4.1	5,143	95.9		
Non	1,076	2.7	24,967	97.3		
Alcohol drink (per month)					162	0.000
No	1,546	5.3	18,988	94.7		
Yes	941	2.7	20,898	97.3		
Physical activity					139	0.000
Regular	239	1.7	8,755	98.3		
Irregular	2,231	4.5	30,653	95.5		
Depression					32.7	<0.001
No	1,949	3.8	30,988	96.2		
Yes	435	5.5	4,885	94.5		
Chronic diseases					264	0.000
No	105	0.8	7,923	99.2		
Yes	2,387	4.7	32,038	95.3		
Metabolic syndrome					263	0.000
No	1,146	2.5	27,024	97.5		
Yes	898	6.2	9,814	93.8		
Self-rated health					269	0.000
Very good/good	671	2.8	14,000	97.2		
Fair	757	2.7	17,766	97.3		
Poor/very poor	1,039	8.7	7,687	91.3		

*Weighted percentage (W%) and weighted N were estimated by accounting for complex sampling design (strata, cluster, and sampling weight); *P*-value was based on †Rao-Scott modified chi-square values.

tion or family income; those without spouses; smokers (current or former); those who did not consume alcohol; those who performed less physical activity; and those with depression, chronic illnesses, metabolic syndrome, or worse self-rated health (Table 1).

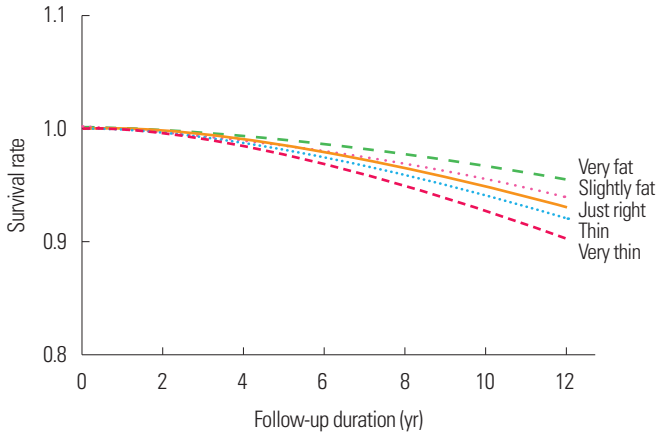

Figure 1. Survival curve for all-cause mortality by self-perceived weight.

Self-perceived weight and all-cause mortality

The survival curve demonstrated that all-cause mortality varied during the follow-up period according to self-perceived weight. There was a tendency for the survival rate to decline when self-perceived weight decreased (Fig. 1). Table 2 shows the HRs of all-cause mortality according to self-perceived weight, weight perception, and the combinations of BMI categories and weight perception after adjusting for confounding factors. Compared to participants who self-perceived their weight to be just right, those who considered themselves very thin or thin had 1.68-fold and 1.43-fold greater all-cause mortality risks, respectively, even after adjusting for confounding variables, BMI category, and metabolic syndrome status. Compared with participants who accurately estimated their weight, those who underestimated their weight had a 27% lower all-cause

Table 2. Hazard ratios and 95% confidence intervals for the associations between self-perceived weight-related indicators and all-cause mortality

Weight indicator	Death/person-year	Adjusted HR (95% CI)		
		MV*	MV+BMI†	MV+BMI+MetS‡
Self-perceived weight				
Very thin	352/16,860	2.20 (1.68–2.89)	1.92 (1.36–2.69)	1.68 (1.15–2.46)
Thin	497/48,468	1.68 (1.28–2.23)	1.57 (1.16–2.12)	1.43 (1.04–1.99)
Just right	1,059/156,845	1.00	1.00	1.00
Slightly fat	493/131,050	0.89 (0.68–1.17)	1.05 (0.76–1.43)	1.16 (0.84–1.63)
Very fat	91/30,812	0.91 (0.57–1.46)	1.17 (0.70–1.93)	1.38 (0.80–2.36)
Weight perception				
Underestimation	1,227/154,985	0.84 (0.70–1.02)		0.73 (0.58–0.90)
Accurate estimation	1,128/193,612	1.00		1.00
Overestimation	137/34,102	1.67 (1.07–2.61)		1.51 (0.90–2.48)
Combination of BMI category and weight perception				
UW/accurate	101/5,906	2.18 (1.49–3.19)		2.14 (1.36–3.32)
UW/overestimation	93/10,826	1.93 (1.05–3.60)		1.57 (0.79–3.16)
NW/underestimation	214/9,364	1.70 (1.21–2.39)		1.45 (0.96–2.18)
NW/accurate	813/12,796	1.00		1.00
NW/overestimation	39/21,061	1.72 (0.92–3.19)		1.86 (0.98–3.53)
OW/underestimation	441/50,323	0.94 (0.70–1.25)		0.79 (0.57–1.07)
OW/accurate	131/38,049	0.94 (0.59–1.49)		0.94 (0.58–1.54)
OW/overestimation	<10/2,215§	0.62 (0.15–2.53)		0.30 (0.07–1.25)
Obesity/underestimation	572/95,298	0.66 (0.51–0.86)		0.53 (0.39–0.73)
Obesity/accurate	83/27,861	0.75 (0.45–1.23)		0.68 (0.40–1.17)

All models accounted for complex sampling design (sampling weight, cluster, and strata). All HRs and 95% CIs were estimated by alternative models according to test for proportional hazard model assumptions.
*MV-adjusted model included age, sex, marital status, education, household income, smoking status, physical activity, alcohol drinking, self-rated health, depression, and chronic diseases status; †Additionally adjusted for BMI category; ‡Additionally adjusted for BMI category and MetS; §If there were <10 deaths, the exact number was not given.
HR, hazard ratio; CI, confidence interval; MV, multivariable; BMI, body mass index; MetS, metabolic syndrome; UW, underweight; NW, normal weight; OW, overweight.

mortality risk. After adjusting for confounding variables except for metabolic syndrome, all-cause mortality was higher among those who correctly recognized their underweight status, overestimated their underweight status, and underestimated their normal weight status than among those who accurately perceived their normal weight status (reference group). After further adjustment for metabolic syndrome, the risk of all-cause death was 2.14-times higher among those who accurately perceived themselves as underweight compared to the reference group; however, it was 47% lower among those who underestimated their obesity.

Self-perceived weight and cause-specific mortality

Associations between self-perceived weight-related indicators and mortality attributable to either cancer (Table 3) or cardiovascular disease (Table 4) were determined. Self-perceived weight was not associated with the risk of cancer mortality, whereas overestimation of weight was associated with a 2.89-fold higher risk of cancer death than appropriate estimation of weight. In particular, the risk of cancer mortality for participants who overestimated their underweight status was 3.94-times greater than that of the reference group (Table 3). Participants who perceived themselves as very thin had a 2.48-times higher risk of cardiovascular mortality than those who perceived their body shape as just right. In comparison to the reference group, the cardiovascular mortality risks were 2.32-times and 2.23-times higher among those who accurately estimated their underweight status and those who underestimated their normal weight, respectively (Table 4).

Self-perceived weight and all-cause mortality according to sex

Sex had a significant interaction with weight misperception among the self-perceived weight-related indicators of the total mortality

Table 3. Hazard ratios and 95% confidence intervals for the associations between self-perceived weight-related indicators and cancer mortality

Weight indicator	Death/person-year	Adjusted HR (95% CI)		
		MV*	MV+BMI†	MV+BMI+MetS‡
Self-perceived weight				
Very thin	86/16,860	1.07 (0.79–1.44)*	1.14 (0.82–1.57)*	0.69 (0.36–1.31)
Thin	160/48,468	1.23 (0.94–1.62)*	1.28 (0.96–1.71)*	1.40 (0.82–2.44)
Just right	344/156,845	1.00	1.00	1.00
Slightly fat	188/131,050	1.26 (0.98–1.61)*	1.29 (0.99–1.67)*	1.26 (0.75–2.12)
Very fat	36/30,812	1.77 (1.14–2.75)*	1.90 (1.18–3.06)*	2.03 (0.87–4.81)
Weight perception				
Underestimation	400/154,985	1.06 (0.76–1.48)		1.04 (0.72–1.51)
Accurate estimation	374/193,612	1.00		1.00
Overestimation	40/34,102	2.44 (1.32–4.53)		2.89 (1.49–5.58)
Combination of BMI category and weight perception				
UW/accurate	23/5,906	0.63 (0.22–1.79)		0.79 (0.25–2.48)
UW/overestimation	23/10,826	3.22 (1.65–6.30)		3.94 (1.93–8.08)
NW/underestimation	56/9,364	0.95 (0.47–1.93)		0.79 (0.36–1.70)
NW/accurate	266/12,796	1.00		1.00
NW/overestimation	17/21,061	1.68 (0.57–5.00)		2.08 (0.64–6.69)
OW/underestimation	150/50,323	1.26 (0.79–1.99)		1.21 (0.73–2.01)
OW/accurate	50/38,049	0.68 (0.36–1.28)		0.73 (0.38–1.43)
OW/overestimation	< 10/2,215§	-		-
Obesity/underestimation	194/95,298	0.90 (0.58–1.38)		0.99 (0.61–1.62)
Obesity/accurate	35/27,861	1.92 (0.93–3.94)		1.88 (0.84–4.18)

All models accounted for complex sampling design (sampling weight, cluster, and strata). HRs and 95% CIs were estimated by *fitted Cox regression model or alternative models according to test for proportional hazard model assumptions.
*MV-adjusted model included age, sex, marital status, education, household income, smoking status, physical activity, alcohol drinking, self-rated health, depression, and chronic diseases status; †Additionally adjusted for BMI category; ‡Additionally adjusted for BMI category and MetS; §If there were < 10 deaths, the exact number was not given.
HR, hazard ratio; CI, confidence interval; MV, multivariable; BMI, body mass index; MetS, metabolic syndrome; UW, underweight; NW, normal weight; OW, overweight.

Table 4. Hazard ratios and 95% confidence intervals for the associations between self-perceived weight-related indicators and cardiovascular mortality

Weight indicator	Death/person-year	Adjusted HR (95% CI)		
		MV*	MV+BMI†	MV+BMI+MetS‡
Self-perceived weight				
Very thin	81/16,860	1.90 (1.23–2.92)	2.03 (1.28–3.19)	2.48 (1.45–4.26)
Thin	106/48,468	1.15 (0.61–2.16)	1.22 (0.64–2.36)	1.54 (0.70–3.35)
Just right	243/156,845	1.00	1.00	1.00
Slightly fat	117/131,050	1.17 (0.70–1.93)	1.16 (0.64–2.12)	1.52 (0.81–2.86)
Very fat	19/30,812	0.89 (0.35–2.23)	0.91 (0.36–2.34)	1.15 (0.42–3.13)
Weight perception				
Underestimation	296/154,985	1.11 (0.77–1.58)		1.15 (0.76–1.73)
Accurate estimation	244/193,612	1.00		1.00
Overestimation	26/34,102	0.86 (0.44–1.68)		0.84 (0.40–1.75)
Combination of BMI category and weight perception				
UW/accurate	25/5,906	2.23 (1.25–4.01)		2.32 (1.21–4.48)
UW/overestimation	15/10,826	0.74 (0.29–1.92)		0.60 (0.17–1.93)
NW/underestimation	44/9,364	1.97 (1.08–3.60)		2.23 (1.13–4.44)
NW/accurate	174/12,796	1.00		1.00
NW/overestimation	<10/21,061§	1.32 (0.52–3.35)		1.57 (0.60–4.06)
OW/underestimation	101/50,323	1.30 (0.76–2.23)		1.26 (0.68–2.34)
OW/accurate	29/38,049	1.48 (0.51–4.31)		1.63 (0.55–4.85)
OW/overestimation	<10/2,215§	0.71 (0.13–3.94)		1.28 (0.24–6.69)
Obesity/underestimation	151/95,298	1.11 (0.70–1.73)		1.13 (0.66–1.90)
Obesity/accurate	16/27,861	0.93 (0.35–2.51)		1.01 (0.35–2.89)

All models accounted for complex sampling design (sampling weight, cluster, and strata). All HRs and 95% CIs were estimated by alternative models according to test for proportional hazard model assumptions.
*MV-adjusted model included age, sex, marital status, education, household income, smoking status, physical activity, alcohol drinking, self-rated health, depression, and chronic diseases status; †Additionally adjusted for BMI category; ‡Additionally adjusted for BMI category and metabolic syndrome; §If there were <10 deaths, the exact number was not given.
HR, hazard ratio; CI, confidence interval; MV, multivariable; BMI, body mass index; MetS, metabolic syndrome; UW, underweight; NW, normal weight; OW, overweight.

risk. During the sex-specific analysis, among female, those who perceived themselves as very thin had a risk of all-cause mortality that was 1.87-times higher than that of those who perceived themselves as just right. Male who underestimated obesity had a 55% lower risk of all-cause mortality than those who accurately estimated their normal weight. In comparison to female who accurately estimated their normal weight status, the risk of all-cause mortality was 1.92-times higher among female who underestimated their normal weight. However, it was 28% lower among those who underestimated their obesity and 39% lower among those who correctly estimated their obesity (Table 5).

DISCUSSION

Using the linked dataset of the KNHANES and Causes of Death Statistics of Korean adults, this study suggested that even after adjusting for sociodemographic characteristics, health-related behaviors, underlying health status, BMI, and metabolic syndrome, self-perceived thinness was associated with a 43% to 68% increased risk of all-cause mortality during an average follow-up duration of 7.8 years. Compared to the normal weight group with accurate weight estimation, the risk of all-cause mortality was 2.14-times higher for the underweight group with accurate weight estimation. After controlling for the confounding factors, those who underestimated their weight had a 27% reduced risk of all-cause mortality compared to those who correctly estimated their weight. Additionally, compared with the group with normal weight who accurately perceived their weight, those with obesity who underestimated their weight had a 47% decreased risk of all-cause mortality. These results support the hypothesis that self-perceived weight is associated with mortality risk, regardless of whether it is considered independent of actual weight or along with actual weight.

Table 5. Hazard ratios and 95% confidence intervals for the associations between self-perceived weight-related indicators and all-cause mortality by sex

Weight indicator	Male	Female	*P* for interaction
Death/person-year	1,401/166,537	1,091/228,383	-
Self-perceived weight			0.115
Very thin	1.09 (0.66–1.84)	1.87 (1.35–2.60)*	
Thin	1.42 (0.94–2.14)	1.19 (0.90–1.57)*	
Just right	1.00	1.00	
Slightly fat	1.39 (0.84–2.32)	0.80 (0.62–1.04)*	
Very fat	1.35 (0.46–3.97)	0.74 (0.50–1.10)*	
Weight perception			0.038
Underestimation	0.61 (0.45–1.22)	1.05 (0.86–1.28)*	
Accurate estimation	1.00	1.00	
Overestimation		1.29 (0.84–1.99)*	
Combination of BMI category and weight perception	1.65 (0.92–2.94)		0.121
UW/accurate	1.58 (0.93–2.66)	1.54 (0.88–2.70)*	
UW/overestimation	1.90 (0.97–3.71)	1.83 (0.96–3.48)*	
NW/underestimation	0.93 (0.55–1.57)	1.92 (1.30–2.83)*	
NW/accurate	1.00	1.00	
NW/overestimation	1.77 (0.71–4.35)	0.93 (0.51–1.69)*	
OW/underestimation	0.73 (0.49–1.09)	0.94 (0.71–1.24)*	
OW/accurate	1.19 (0.66–2.14)	0.62 (0.42–0.90)*	
OW/overestimation	0.02 (0.00–0.10)	0.53 (0.17–1.62)*	
Obesity/underestimation	0.45 (0.29–0.68)	0.72 (0.56–0.93)*	
Obesity/accurate	0.46 (0.16–1.36)	0.61 (0.42–0.89)*	

All models were accounted for complex sampling design (sampling weight, cluster, and strata). HRs and 95% CIs were estimated by *fitted model of Cox regression model or alternative models according to test for proportional hazard model assumptions after adjusting for age, sex, marital status, education, household income, smoking status, physical activity, alcohol drinking, self-rated health, depression, chronic diseases status, BMI category (for the analysis of perceived body shape), and metabolic syndrome status. BMI, body mass index; UW, underweight; NW, normal weight; OW, overweight.

These findings are significant because there have not been sufficient investigations of the relationship between subjective weight assessment and mortality risk. This study demonstrated that subjectively assessed weight remained an independent factor for predicting the risk of all-cause mortality despite the adjustment of factors that could have affected self-perceived weight.

During this study, the finding that a lower risk of all-cause mortality among those with obesity who underestimated their weight was partially consistent with the findings of a previous study.[4] Using the KNHANES data, the odds ratio for worse self-rated health was lower for individuals who underestimated their weight and were overweight or obese.[4] Additionally, a previous study demonstrated that individuals who underestimated their weight had a better quality of life.[26] Furthermore, there is evidence that failing to recognize one's own overweight status is associated with better health outcomes than correctly recognizing it.[27] These findings might counter the idea that accurately identifying obesity is the first step in the process of helping individuals with obesity to manage their weight. In a meta-analysis, all-cause mortality was lowest with a BMI of 20 to 25 kg/m^2, and it increased both immediately below this range and across the overweight and obesity ranges.[15] Therefore, it is possible that those who are obese but underestimate their weight have a lower BMI in the category of obesity. Because there is a tendency for decreased risks of all-cause mortality and cardiovascular mortality, even for those who accurately perceived obesity, these findings may be related to inadequate adjustment of confounding factors.

The mechanisms underlying the increased all-cause mortality risk among participants who considered themselves to be thin, underestimated their weight, or accurately perceived their underweight status are unclear. This association remained consistent even after considering sociodemographic characteristics, underlying diseases, and health-related behaviors, which could influence how individuals perceives their own weight.[1,28] The current findings may be explained by weak muscle strength because of the evidence that those who perceived themselves to be thin or underestimated their weight were more likely to have a lower grip strength[29] and because of the evidence of the association between weak grip strength and increased mortality risk.[30,31] The results of this study, which showed that self-perceived thinness was more strongly associated with cardiovascular mortality than cancer mortality, were also comparable to those of a previous study that showed that grip strength was more strongly related to cardiovascular mortality than to cancer mortality.[32] An increased risk of cardiovascular mortality for participants who underestimated their normal weight or an increased risk of all-cause mortality for female who underestimated their normal weight may also be attributed to low muscle strength and its associated mechanisms.

The relationship between self-perception of thinness and a high risk of mortality may be related to the underlying reason for weight loss. This is because weight loss might be associated with being thin. Individuals who lose weight as a result of a condition that increases their mortality risk and who perceive themselves to be very thin are more likely to have the ability to accurately assess their weight status.

Body image disturbances may have contributed to an increased risk of cancer mortality among those who overestimated their weight (compared to those who accurately perceived their weight) and those who overestimated their underweight status (compared to those who accurately perceived their normal weight status). Overestimating body weight may result in inadequate eating behaviors and inappropriate weight management, which could increase the risk of mortality. Overestimating weight may be linked to dangerous weight loss approaches, such as vomiting and laxative use, as well as use of unhealthy coping strategies, such as stress-induced eating. Such behaviors can compromise health and cause eating disorders.[11]

No relevant studies have compared the findings of this study with those of others; therefore, future research is necessary. Additionally, because the types of cancer or cardiovascular diseases related to mortality may vary depending on self-perceived weight, additional research of the differences in the types of cancer or cardiovascular diseases as the cause of death and their associations with self-perceived thinness, accurately perceived underweight status, and overestimation of weight may be required.

It is well-established that underweight status increases the mortality risk. Individuals who are underweight and perceive themselves as thin can be categorized as a group at high risk for mortality if the findings of this study are practically implemented. Therefore, it will be useful to identify groups at high risk for mortality by considering the subjective perception of underweight status among those who are underweight. Additionally, the results of this study do not provide sufficient support to advise underestimating obesity, even though the mortality risk was lower among those who did. It would be preferable to investigate the characteristics of those who subjectively perceived their body shape as just right or slightly fat among those with a BMI ≥ 25 kg/m^2 to determine whether the findings of this study are applicable.

This study had several limitations that should be considered. Although a 1-year time lag was introduced to exclude deaths at the beginning of follow-up, reverse causation in the relationship between self-perceived weight and risk of mortality may have been possible. Other limitations were that it did not analyze only nonsmokers and did not exclude those with self-perceived very poor health, even after adjusting for smoking status and self-rated health. Because there may be more smokers or individuals with self-perceived very poor health among individuals who consider themselves to be very thin, additional research that specifically includes nonsmokers or individuals with health conditions is necessary.

Additionally, this association could have been affected by confounding factors such as nutritional status, environmental factors, occupation, medication, sleep, and other mental health issues that were not considered. Another significant limitation was that the classification of weight perception differed based on the reference values for defining the BMI categories. Although the current study did not assess the relationship between self-perceived weight and mortality risk according to BMI-based weight categories, it is crucial to establish this relationship for this cohort if the follow-up period is extended.

In conclusion, this study demonstrates that self-perceived low body weight and accurately perceived underweight status among Korean adults are independent risk factors for increased risks of all-cause mortality and cardiovascular mortality. Instead of showing a greater risk of all-cause mortality for those with self-perceived obesity, the underestimation of obesity was associated with a lower risk of all-cause mortality. Long-term investigations that can establish the mechanism of this association and that consider factors that may affect causality are required.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

ACKNOWLEDGMENTS

This study was supported by the 2022 JOMES Research Grant (Grant No. KSSO-J-2022004) of the Korean Society for the Study of Obesity. Data in this study were obtained from the Korea National Health and Nutrition Examination Survey, the Korea Disease Control and Prevention Agency, and the Cause of Death Statistics, Statistics Korea.

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