



The Combined Effect of Subjective Body Image and Body Mass Index (Distorted Body Weight Perception) on Suicidal Ideation

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Objectives: Mental health disorders and suicide are an important and growing public health concern in Korea. Evidence has shown that both globally and in Korea, obesity is associated with an increased risk of developing some psychiatric disorders. Therefore, we examined the association between distorted body weight perception (BWP) and suicidal ideation.

Methods: Data were obtained from the 2007-2012 Korea National Health and Nutritional Evaluation Survey (KNHANES), an annual cross-sectional nationwide survey that included 14 276 men and 19 428 women. Multiple logistic regression analyses were conducted to investigate the associations between nine BWP categories, which combined body image (BI) and body mass index (BMI) categories, and suicidal ideation. Moreover, the fitness of our models was verified using the Akaike information criterion.

Results: Consistent with previous studies, suicidal ideation was associated with marital status, household income, education level, and perceived health status in both genders. Only women were significantly more likely to have distorted BWP; there was no relationship among men. In category B1 (low BMI and normal BI), women (odds ratio [OR], 2.25; 95% confidence interval [CI], 1.48 to 3.42) were more likely to express suicidal ideation than women in category B2 (normal BMI and normal BI) were. Women in overweight BWP category C2 (normal BMI and fat BI) also had an increased OR for suicidal ideation (OR, 2.25; 95% CI, 1.48 to 3.42). Those in normal BWP categories were not likely to have suicidal ideation. Among women in the underweight BWP categories, only the OR for those in category A2 (normal BMI and thin BI) was significant (OR, 1.34; 95% CI, 1.13 to 1.59).

Conclusions: Distorted BWP should be considered an important factor in the prevention of suicide and for the improvement of mental health among Korean adults, especially Korean women with distorted BWPs.

Key words: Body mass index, Weight perception, Body image, Obesity, Suicide, Suicidal ideation

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INTRODUCTION

Mental health disorders have been an important and growing public health concern in South Korea (hereafter Korea). Approximately 27.6% of the population had a lifetime history of mental disorders that met the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition for having at least one disorder [1]. Among women, 23.5% experienced at least one mental disorder in their lifetime, which included

12.0% who had an anxiety disorder and 9.1% who had major depressive disorder (MDD). Additionally, the annual suicide rate has steeply increased in Korea since 1997 [1]. According to the Organisation for Economic Co-operation and Development (OECD) health statistics data, the age-standardized suicide mortality rate in 2011 was 33.3 per 100 000 individuals, the highest among all OECD countries. Although the rate of increase suicidal mortality has remained constant since 2009 [2].

Evidence has shown that the increasing prevalence of obesity worldwide and in Korea [3-5] is associated with an increased risk of developing psychiatric disorders [6-9]. However, most prior research has failed to simultaneously evaluate the effects of obesity-related comorbidities, lifestyle factors (smoking, alcohol consumption, and physical activity), and/or other psychosocial factors (general health status, emotional support, and life satisfaction) on mental health, even though these factors are known to affect mental health status [10,11] and contribute to the development of mental disorders [12-14]. However, some studies have found no relationship [15] or an inverse relationship between overweight/obesity and mental disorders among men [16]. Thus, the relationship between mental disorders and body mass index (BMI) remains controversial.

In this study, we aimed to examine the association of BMI and body image (BI) with suicidal ideation. In doing so, we examined the effect of objective BMI measurements, reflecting true obesity, and subjective BI to yield what we refer to here as a distorted body weight perception (BWP). BWP was used since it is challenging to investigate the association between BMI and mental disorders. Several studies have previously investigated the association between the perception of being overweight and suicidal ideation among adolescents [17]. However, few studies have investigated this relationship in adults; therefore, we attempted to examine the impact of distorted BWP on suicidal ideation in a representative population of adult Koreans.

METHODS

Subjects

Data were obtained from the 2007-2012 Korea National Health and Nutritional Evaluation Survey (KNHANES), which is managed by the Korea Centers for Disease Control and Prevention and the Korean Ministry of Health and Welfare. The KNHANES is a cross-sectional nationwide survey that employs a stratified, multistage, clustered probability sampling method.

The survey is comprised of a health interview, nutritional sur-

vey, and health examination. For data collection purposes, household interviews and physical examinations were conducted. Informed consent was obtained from all participants. Since the KNHANES datasets are publicly available for research purposes, additional ethical approval by our institutional review board was not required for this study.

The total sample size from 2007 to 2012 was 50 405 participants. Of these, 12 801 participants were excluded because they were younger than 19 years of age. In addition, those with relevant missing data were also excluded, resulting in a final study sample that included 14 276 men and 19 428 women all 19 years and older.

Dependent Variable

Suicidal ideation was assessed by asking if participants had any suicidal ideation in the previous one year. Those who answered yes were considered to have suicidal ideation.

Primary Independent Variables

Nine BWP categories were made to classify participants according to their objective BMI subjective BI (Table 1). Subjective BI was assessed by asking, "In your opinion, how do you perceive your body?" Possible responses included thin, normal, or fat. BMI was classified into three categories as low (<18.5 kg/m²) normal (18.5-25 kg/m²), and high (≥25 kg/m²). The category combining normal weight perception and normal BMI was selected as the reference group.

Covariates

Socioeconomic and demographic factors included age, residential area, marital status, employment status, educational level, and household income. Participants were classified into six age categories: 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and ≥ 70 years. Residential area was categorized as urban or rural, and marital status was categorized as married or unmarried. The highest educational level attained was categorized as elementary school, middle school, high school, and

Table 1. The nine categories of body weight perception by the three body image (BI) categories and three body mass index (BMI) categories

Subjective BI	BMI < 18.5 (1)	18.5 ≤ BMI < 25 (2)	BMI ≥ 25 (3)
Thin (A)	Normal (A1)	Under (A2)	Under (A3)
Normal (B)	Over (B1)	Normal (B2)	Under (B3)
Fat (C)	Over (C1)	Over (C2)	Normal (C3)

The category B2 was selected as the control.

college or higher. Household income was included as quartiles based on monthly earnings. Employment status categories were unemployed and employed.

Health-related factors included sleep duration, perceived health status, BMI, and the presence of chronic diseases such as hypertension and diabetes, which were reported only if they had been diagnosed by a physician. Perceived health status was collected as extremely good, good, moderate, bad, and extremely bad. Stress was considered either mild or severe. In addition, mental health-related factors included perceived levels of stress relating to daily life and the presence of depressive symptoms that had been diagnosed by a physician within the previous one year. The influence of the study year for each of the six collection years (2007-2012) was also considered.

Statistical Analysis

Multiple logistic regression analyses were conducted to investigate the associations between the nine BWP categories and suicidal ideation. Our models were adjusted for age, the data collection year, residential area, marital status, employment status, household income, educational level, perceived health status, sleep duration, stress level, BMI, and the presence of hypertension, diabetes, and MDD.

Moreover, we used the Akaike information criterion to verify the adequacy of these models with BMI only, BI only, and the combined BWP as the independent variables. Odds ratios (OR) with a 95% confidence intervals (CI) were calculated. Statistical significance was set at $p < 0.05$. Statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Demographic Characteristics

Table 2 shows the demographic characteristics of the sample. A total of 1573 men (11.0%) and women (20.3%) reported having suicidal ideation during the twelve months prior to the survey, while 12 703 men and 15 481 women did not. Five men and four women matched the BWP category C1, which included those who were in the overweight BWP category but had a low BMI; none of these subjects expressed suicidal ideation.

Multiple Logistic Regression Analysis

The results of the multiple logistic regression analysis are presented in Tables 3 and 4. Table 3 depicts the ORs for suicidal ideation across age, the data collection year, residential area, mari-

tal status, employment status, household income, educational level, perceived health status, sleep duration, hypertension, diabetes, MDD, stress levels, and BMI. In Table 4, the nine BWP categories were rearranged as underweight BWP (A2, A3, and B3), normal BWP (A1, B2, and C3), and overweight BWP (B1, C1, and C2). Because none of the participants in C1 expressed suicidal ideation, it was not possible to calculate the OR for this group.

Married participants were more likely to express suicidal ideation than were unmarried participants for both men (OR, 1.84; 95% CI, 1.37 to 2.46) and women (OR, 1.42; 95% CI, 1.15 to 1.76). In addition, employed men were less likely to express suicidal ideation (OR, 0.71; 95% CI, 0.59 to 0.86) than were unemployed men.

In terms of household income, the ORs for suicidal ideation for both men and women were very similar. Relative to the lowest quartile group, the ORs for suicidal ideation were 0.88 (95% CI, 0.72 to 1.08) for men and 0.83 (95% CI, 0.73 to 0.96) for women in the second lowest quartile, 0.72 (95% CI, 0.58 to 0.90) for men and 0.85 (95% CI, 0.73 to 0.98) for women in the third lowest quartile, and 0.68 (95% CI, 0.54 to 0.87) for men and 0.63 (95% CI, 0.53 to 0.74) for women in the highest quartile.

Suicidal ideation was also influenced by education level in both genders. The likelihood of suicidal ideation decreased as the level of education increased; thus, men (OR, 0.73; 95% CI, 0.58 to 0.94) and women with a middle school education (OR, 0.76; 95% CI, 0.63 to 0.90) were less likely to express suicidal ideation than men and women with only an elementary school education were. Men (OR, 0.63; 95% CI, 0.51 to 0.78) and women with a high school education showed an even lower likelihood (OR, 0.60; 95% CI, 0.51 to 0.71) of suicidal ideation, followed by men (OR, 0.51; 95% CI, 0.40 to 0.65) and women with a college education or higher (OR, 0.43; 95% CI, 0.35 to 0.53).

Participants who reported being in excellent health (for men: OR, 0.18; 95% CI, 0.11 to 0.29, and women: OR, 0.26; 95% CI, 0.18 to 0.37) or very good health according to the self-rated survey questions (for men: OR, 0.21; 95% CI, 0.15 to 0.31, and women: OR, 0.28; 95% CI, 0.23 to 0.35) were less likely to express suicidal ideation. Furthermore, men (OR, 4.56; 95% CI, 3.91 to 5.32) and women (OR, 4.47; 95% CI, 4.06 to 4.93) with very high levels of stress were more likely to express suicidal ideation than those with mild stress were.

Among the prevalent diseases investigated, only MDD showed a strong positive association with suicidal ideation (men: OR, 5.11; 95% CI, 3.42 to 7.62, women: OR, 2.75; 95% CI, 2.30 to 3.29).

Table 2. Demographic characteristics and the presence of suicidal ideation by gender

	Women			<i>p</i> -value	Men			<i>p</i> -value
	Absence	Presence	Total		Absence	Presence	Total	
Age (y)				<0.001				<0.001
20-29	1817 (80.8)	433 (19.2)	2250		1508 (92.7)	119 (7.3)	1627	
30-39	3325 (85.2)	577 (14.8)	3902		2502 (91.9)	221 (8.1)	2723	
40-49	3045 (84.0)	581 (16.0)	3626		2518 (90.8)	255 (9.2)	2773	
50-59	2924 (82.1)	639 (17.9)	3563		2279 (88.3)	301 (11.7)	2580	
60-69	2391 (76.0)	753 (24.0)	3144		2180 (87.7)	305 (12.3)	2485	
≥70	1979 (67.2)	964 (32.8)	2943		1716 (82.2)	372 (17.8)	2088	
Residential area				<0.001				<0.001
Urban	12 023 (80.8)	2856 (19.2)	14 879		9700 (89.7)	1113 (10.3)	10 813	
Rural	6458 (85.5)	1091 (14.5)	7549		3003 (86.7)	460 (13.3)	3463	
Marital status				0.73				0.42
Married	13 812 (79.6)	3529 (20.4)	17 341		10 755 (88.9)	1344 (11.1)	12 099	
Single	1669 (80.0)	418 (20.0)	2087		1948 (89.5)	229 (10.5)	2177	
Job status				<0.001				<0.001
Unemployed	7955 (77.9)	2253 (22.1)	10 208		2972 (83.7)	579 (16.3)	3551	
Employed	7526 (81.6)	1694 (18.4)	9220		9731 (90.7)	994 (9.3)	10 725	
Sleep hours (h)				<0.001				<0.001
<6	2391 (70.9)	983 (29.1)	3374		1563 (82.7)	328 (17.3)	1891	
6-8	11 844 (82.1)	2580 (17.9)	14 424		10 257 (90.4)	1084 (9.6)	11 341	
≥8	1246 (76.4)	384 (23.6)	1630		883 (84.6)	161 (15.4)	1044	
House income				<0.001				<0.001
1Q (lowest)	2916 (68.8)	1323 (31.2)	4239		2140 (80.8)	510 (19.2)	2650	
2Q (second lowest)	3874 (78.7)	1051 (21.3)	4925		3183 (87.7)	446 (12.3)	3629	
3Q (third lowest)	4229 (82.5)	898 (17.5)	5127		3637 (91.8)	327 (8.2)	3964	
4Q (highest)	4462 (86.9)	675 (13.1)	5137		3743 (92.8)	290 (7.2)	4033	
Educational level				<0.001				<0.001
Elementary school	4579 (70.3)	1931 (29.7)	6510		2194 (80.2)	541 (19.8)	2735	
Middle school	1629 (81.0)	383 (19.0)	2012		1513 (87.2)	223 (12.8)	1736	
High school	5127 (83.7)	1000 (16.3)	6127		4609 (90.7)	473 (9.3)	5082	
College or over	4146 (86.8)	633 (13.2)	4779		4387 (92.9)	336 (7.1)	4723	
Perceived health status				<0.001				<0.001
Excellent	610 (89.6)	71 (10.4)	681		750 (93.8)	50 (6.3)	800	
Very good	4974 (86.9)	753 (13.1)	5727		4676 (93.1)	345 (6.9)	5021	
Good	6758 (83.8)	1308 (16.2)	8066		5386 (90.5)	566 (9.5)	5952	
Poor	2726 (67.5)	1312 (32.5)	4038		1677 (78.5)	460 (21.5)	2137	
Very poor	413 (45.1)	503 (54.9)	916		214 (58.5)	152 (41.5)	366	
The presence of hypertension				<0.001				<0.001
No	12 325 (81.3)	2832 (18.7)	15 157		9975 (89.7)	1141 (10.3)	11 116	
Yes	3156 (73.9)	1115 (26.1)	4271		2728 (86.3)	432 (13.7)	3160	
The presence of diabetes				<0.001				<0.001
No	14 468 (80.4)	3526 (19.6)	17 994		11 563 (89.4)	1367 (10.6)	12 930	
Yes	1013 (70.6)	421 (29.4)	1434		1140 (84.7)	206 (15.3)	1346	
The presence of major depressive disorder				<0.001				<0.001
No	14 873 (81.1)	3461 (18.9)	18 334		12 568 (89.5)	1471 (10.5)	14 039	
Yes	608 (55.6)	486 (44.4)	1094		135 (57.0)	102 (43.0)	237	
Level of stress				<0.001				<0.001
High	3481 (60.4)	2287 (39.6)	5768		2653 (76.5)	813 (23.5)	3466	
Low	12 000 (87.8)	1660 (12.2)	13 660		10 050 (93.0)	760 (7.0)	10 810	

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Table 2. Continued from the previous page

	Women			p-value	Men			p-value
	Absence	Presence	Total		Absence	Presence	Total	
The difference in BI				<0.001				<0.001
A1: low BMI and skinny BI (N)	652 (78.7)	176 (21.3)	828		359 (84.5)	66 (15.5)	425	
A2: middle BMI and skinny BI (U)	1330 (70.8)	549 (29.2)	1879		2284 (86.6)	354 (13.4)	2638	
A3: high BMI and skinny BI (U)	100 (62.9)	59 (37.1)	159		42 (82.4)	9 (17.6)	51	
B1: low BMI and normal BI (O)	172 (75.4)	56 (24.6)	228		22 (73.3)	8 (26.7)	30	
B2: normal BMI and normal BI (N)	5567 (83.4)	1112 (16.6)	6679		4362 (89.7)	499 (10.3)	4861	
B3: high BMI and normal BI (U)	678 (77.8)	193 (22.2)	871		895 (88.8)	113 (11.2)	1008	
C1: low BMI and fat BI (O)	4 (100.0)	(0.0)	4		5 (100.0)	(0.0)	5	
C2: normal BMI and fat BI (O)	3284 (81.3)	755 (18.7)	4039		1153 (88.7)	147 (11.3)	1300	
C3: high BMI and fat BI (N)	3694 (77.9)	1047 (22.1)	4741		3581 (90.5)	377 (9.5)	3958	
Total	15 481 (79.7)	3947 (20.3)	19 428		12 703 (89.0)	1573 (11.0)	14 276	

Values are presented as number (%).

Data were adjusted for study year and BMI.

BI, body image; BMI, body mass index; N, normal body weight perception; U, underweight body weight perception; O, overweight body weight perception.

Table 3. Multiple logistic regression analysis of suicidal ideation by gender

	Women	Men
Age (y)		
20-29	1.00	1.00
30-39	1.00 (0.80, 1.25)	1.80 (1.28, 2.53)***
40-49	1.06 (0.84, 1.35)	2.52 (1.72, 3.67)***
50-59	0.83 (0.64, 1.09)	2.82 (1.89, 4.21)***
60-69	0.89 (0.67, 1.19)	2.42 (1.58, 3.73)***
≥70	1.26 (0.93, 1.70)	2.67 (1.70, 4.20)***
Residential area		
Urban	1.00	1.00
Rural	0.92 (0.81, 1.04)	1.11 (0.93, 1.31)
Marital status		
Married	1.00	1.00
Single	1.42 (1.15, 1.76)*	1.84 (1.37, 2.46)***
Job status		
Unemployed	1.00	1.00
Employed	0.92 (0.83, 1.02)	0.71 (0.59, 0.86)***
Sleep hours (h)		
<6	1.09 (0.97, 1.24)	1.19 (0.98, 1.45)
6-8	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
≥8	1.14 (0.96, 1.35)	1.23 (0.95, 1.58)
House income		
1Q (lowest)	1.00	1.00
2Q (second lowest)	0.83 (0.73, 0.96)*	0.88 (0.72, 1.08)
3Q (third lowest)	0.85 (0.73, 0.98)*	0.72 (0.58, 0.90)*
4Q (highest)	0.63 (0.53, 0.74)***	0.68 (0.54, 0.87)*

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Table 3. Continued

	Women	Men
Educational level		
Elementary school	1.00	1.00
Middle school	0.76 (0.63, 0.90)***	0.73 (0.58, 0.94)*
High school	0.60 (0.51, 0.71)***	0.63 (0.51, 0.78)***
College or over	0.43 (0.35, 0.53)***	0.51 (0.40, 0.65)***
Perceived health status		
Excellent	0.26 (0.18, 0.37)***	0.18 (0.11, 0.29)***
Very good	0.28 (0.23, 0.35)***	0.21 (0.15, 0.31)***
Good	0.32 (0.26, 0.40)***	0.27 (0.19, 0.38)***
Poor	0.51 (0.42, 0.62)***	0.45 (0.32, 0.64)***
Very poor	1.00	1.00
The presence of hypertension		
No	1.00	1.00
Yes	0.90 (0.76, 1.07)	0.91 (0.71, 1.18)
The presence of diabetes		
No	1.00	1.00
Yes	0.93 (0.79, 1.11)	1.13 (0.90, 1.42)
The presence of major depressive disorder		
Absence	1.00	1.00
Presence	2.75 (2.30, 3.29)***	5.11 (3.42, 7.62)***
Level of stress		
High	4.47 (4.06, 4.93)***	4.56 (3.91, 5.32)***
Low	1.00	1.00

Values are presented as odds ratio (95% confidence interval).

These data were adjusted for study year, body mass index, and body weight perception.

*p<0.05, ***p<0.001.

Table 4. Multiple logistic regression analysis of suicidal ideation by gender according to BWP as determined by subjective BI and BMI measures

BWP	BI	BMI category	Category ¹	Women	Men
Underestimation	Thin	Middle	A2	1.34 (1.13, 1.59)***	1.05 (0.84, 1.31)
	Thin	High	A3	1.39 (0.79, 2.43)	1.64 (0.56, 4.8)
	Normal	High	B3	0.94 (0.71, 1.26)	0.98 (0.72, 1.33)
Normal	Thin	Low	A1	1.2 (0.93, 1.55)	1.3 (0.83, 2.03)
	Normal	Middle	B2	1.00	1.00
	Fat	High	C3	1.09 (0.89, 1.34)	0.84 (0.65, 1.09)
Overestimation	Normal	Low	B1	2.25 (1.48, 3.42)***	1.2 (0.49, 2.95)
	Fat	Middle	C2	1.28 (1.11, 1.48)***	1.14 (0.89, 1.47)
	Fat	Low	C1	-	-

Values are presented as odds ratio (95% confidence interval).

All the other variables including age, residential area, marital status, job status, sleep hours, house income, educational level, perceived health status, the presence of hypertension, the presence of diabetes, the presence of major depressive disorder, year, and level of stress are adjusted for the odds ratio for suicidal ideation.

BWP, body weight perception; BI, body image; BMI, body mass index.

¹These categories are reported in Table 1.

*** $p < 0.001$.

In the fully adjusted models, all women with an overweight BWP were significantly more likely to have suicidal ideation (Table 4 and Supplemental Table 1). In addition, women in category B1 (low BMI and normal BI) had a higher OR for suicidal ideation (OR, 2.25; 95% CI, 1.48 to 3.42) than the control category B2 (normal BMI and BI) did. However, no relationship was found in men (OR, 1.20; 95% CI, 0.49 to 2.95) ($p < 0.001$) in category BI. Women in category C2 (normal BMI and fat BI) were also more likely to express suicidal ideation (OR, 1.28; 95% CI, 1.11 to 1.48) than women in C1 were.

No significant differences were found for men or women with normal BWP. For women with underweight BWP, the OR in category A2 (normal BMI and thin BI) showed an increased likelihood of having suicidal ideation (OR, 1.34; 95% CI, 1.13 to 1.59). Thus, only three BWP categories were significantly related to suicidal ideation in women, and none were significantly related in men.

Model Fitness

The results of the Akaike information criterion analysis suggested that the model using both BMI and BI was superior to the one using only BMI and the one using only BI (Table 5). Although the fitness of these models was not significantly different, the difference between the model using both BMI and BI and only BMI was larger than that between both BMI and BI and only BWP.

Table 5. The fitness of models including both BMI and BWP, only BWP, and only BMI according to the AIC

Models	AIC		
	Total	Men	Women
BWP	24 755 172	9 704 093	14 882 892
BMI and BI	24 787 467	9 713 517	14 908 230
BI only	24 801 575	9 715 349	14 912 369
BMI only	24 799 963	9 713 597	14 926 893

AIC, Akaike information criterion; BMI, body mass index; BWP body weight perception; BI, body image.

DISCUSSION

Suicidal ideation was found to be associated with not only socioeconomic variables such as marital status, household income level, and educational level but also health-related variables such as the presence of MDD, routine stress, and perceived health status. Several other studies have also supported associations between socioeconomic and mental health-related factors with suicidal ideation [18-21]. Inder et al. [18] identified determinants of suicidal ideation and suicide attempts using data from the 2007 National Survey of Mental Health and Wellbeing (n=8463) in Australia [18]. According to their study, psychiatric disorders were the main determinant of 12-month and lifetime suicidal ideation as well as lifetime suicide attempts. Moreover, marital status, employment status, perceived financial adversity, and mental health service use were also important determinants; these findings were consistent with our results. Lee et al. [19] also studied differential associations of so-

cio-economic status with gender- and age-defined suicidal ideation among Korean adults and elderly using the KNHANES from 2007 to 2012. They found that household income was the main protective factor for women and those aged 25 to 44 years and that educational attainment was protective for individuals aged > 65 years. In another report from Korea, the relationship between sleep duration and suicidal ideation formed a U-shaped curve [22]. However, in the present study we did not find a statistically meaningful association between sleep duration and suicidal ideation, despite finding a similar U-shaped pattern in the ORs.

When investigating BWP, it was deemed necessary to examine suicidal ideation and its related factors by gender. Chin et al. [23] have suggested that the development of a suicide prevention program for Korean adults requires different approaches for each gender. For example, for working men aged 45 to 54 years, the focus should be on the management of work-related stress and depression, while community support programs might substantially help women who are less educated, are not formally employed, and/or experience a great deal of stress and depression. Although their study had a robust methodology, they did not consider the possibility that distorted BI might induce stress and/or even foster suicidal ideation.

Therefore, we examined BWP to understand the impact of BI on suicidal ideation. Several studies have examined the association between BWP and suicidal ideation [17,21,24-27]. Lee and Seo [28] studied the trajectory of suicidal ideation in relation to BWP from adolescence to young adulthood using representative data from four waves (1995-2008) of the National Longitudinal Study of Adolescent Health from the US. In general, they found that suicidal ideation tended to decrease with age. However, participants who perceived themselves as overweight were more likely to think about committing suicide than those who perceived themselves as normal weight were, and this was especially true among young girls, even after controlling for rigorously measured depressive symptoms. According to a study of Korean adolescents, a significantly higher proportion of girls reported suicidal ideation and suicide attempts than did boys. Factors associated with suicidal ideation were overestimating one's weight (vs. an accurate estimation) and reporting behaviors to lose or gain weight (vs. no weight control) among boys, and overestimating one's weight and attempting to lose weight were associated factors among girls [24]. Another study of elementary students between twelve to thirteen years old found that body image distortion may lead to stress, depression, and

undesirable dieting behavior [21]. Compared to participants without distorted BIs, the group that overestimated their weight demonstrated a greater interest in weight control, expressed dissatisfaction with body weight, presented unhealthy reasons to lose weight, and had higher scores for the survey items "feeling sad when comparing own body with others" and "easily getting annoyed and tired," even though these children had similar obesity indices as the children without distorted BIs did [21].

However, the majority of these studies targeted adolescents rather than adults. Thus, a study of the general population was needed. Kim et al. [26] studied the effect of weight perception on suicidal ideation among young Korean women using data from the 2001 and 2005 KNHANES. Overweight women were more likely to think about suicide than their normal-weight counterparts were in both study years. However, in both study years, the association between overweight and suicidal ideation was not significant when perceived weight was taken into account. Therefore, the difference between the results of the above study and the present study might be due to differences between the data collection years and the targeted age groups. In addition, Kim et al. [25] did not analyze the effect of BWP by combining the effect of BI and BMI as we have done. On the other hand, we divided each of the three BWP categories into three groups based on the actual BMI measurement anticipating that these differences may yield meaningful statistical outcomes in our study.

Another similar study examining the role of BWP in the general population was conducted in 2011 in Korea [26]. Kim et al. [25] examined the effects of actual and perceived body weight on unhealthy weight control behaviors and depressed mood. They found that women who perceived themselves to be heavier than their actual BMIs appeared more likely to engage in unhealthy weight control behaviors (OR, 1.44; 95% CI, 1.14 to 1.83). Furthermore, women with a distorted BWP, whether an underestimation (OR, 1.49; 95% CI, 1.09 to 2.03) or overestimation of their BMI (OR, 1.26; 95% CI, 1.05 to 1.52), tended to be more likely to report having depressed mood than those who had a realistic BWP did [26]. Interestingly, contrary to previous studies on adolescents, women with underweight BWPs also suffered from depressed mood.

Gaskin et al. [29] performed a study to determine if BWP mediates the association between measured weight and depression. They analyzed data on 13 548 adults aged 18 or older collected from the 2005-2008 National Health and Nutrition Ex-

amination Survey of the US. Among women, adjusting for BWP weakened the relationship between measured weight and depression. The ORs of depression for being obese and overweight were 2.26 (95% CI, 1.50 to 3.40) and 1.92 (95% CI, 1.29 to 2.85) before adjustment for BWP and 1.72 (95% CI, 1.01 to 2.92) and 1.62 (95% CI, 1.01 to 2.60) after adjustment. Independent from measured weight, women who perceived themselves as underweight (OR, 2.95; 95% CI, 1.47 to 5.14) or overweight (OR, 1.73; 95% CI, 1.14 to 2.61) had an increased odds of depression compared with women who perceived themselves as being at a normal weight. Among men, measured weight, but not overweight BWP nor underweight BWP, was associated with depression, and perceiving oneself as underweight (OR, 2.80; 95% CI, 1.42 to 5.54) was associated with depression. However, it is important to note that the authors of that study did not measure suicidal ideation as the dependent variable; rather, they measured whether increasing depressive symptoms were able to increase the probability of having suicidal ideation.

Considering the results of these previous studies as well as our own, distorted BWP as measured from objective BMI and subjective BWP seems to be related to suicidal ideation. Thus, those who suffer from distorted body image should be assessed not only objectively according to their BMI but also subjectively by asking about one's self-perception of body weight as possible indicators of suicidal ideation, and this kind of assessment might be especially beneficial for Korean women. Moreover, we believe that this simple measurement might help detect patients with suicidal ideation early to reduce the number of suicidal attempts and prevent the incidence of suicides in Korea.

This study has several important strengths. First, we assessed the presence of suicidal ideation, which is more indicative of suicide than measuring depressive mood is. Although there is an established association between depressive mood and suicidal ideation, the outcome can be more clearly defined by investigating the dependent variable firsthand. Second, we used nationally representative data, thus strengthening our study's reliability. In addition, these data were recently collected (2007-2012), permitting us to make relevant interpretations.

Nevertheless, our study has several limitations. First, due to its cross-sectional design, causal relationships cannot be determined. However, since we divided BMI into categories and examined BMI as an independent variable, it is extremely unlikely that reverse causation is valid. Second, we used suicidal ideation and not attempted suicide as the outcome, even though the association between suicidal ideation and attempts exists

[30-32]. Since suicidal ideation does not always directly result in a suicidal attempt or suicide, determining the strength of the connection between suicidal ideation and suicide without considering the role of mental illness may create some challenges.

In conclusion, this study supports the notion that distorted BWP and suicidal ideation are related. Women with overweight BWP in all BMI categories and underweight perception with normal BMI were more likely to express suicidal ideation than women with a normal BWP and normal BMI were. Therefore, BWP might be an important factor that could be employed to prevent suicidal ideation and improve the mental health of Korean adults, especially Korean women.

CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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Supplemental Table 1. The odds ratios for the nine categories of body weight perception by the three types of body image (BI) and three body mass index (BMI, kg/m²) categories

	BMI < 18.5 (1)	18.5 ≤ BMI < 25 (2)	BMI ≥ 25 (3)
Thin (A)	F: 1.20/M: 1.30	F: 1.34***/M: 1.05	F: 1.39/M: 1.64
Normal (B)	F: 2.25***/M: 1.20	F: 1.00/M: 1.00	F: 0.94/M: 0.98
Fat (C)	-	F: 1.28***/M: 1.14	F: 1.09/M: 0.84

F, female; M, male.

*** $p < 0.001$.