

Health-Related Quality of Life, Depression and BMI in Korean adults

Myoung-Hee Kim

*Department of Nursing, Semyung University, 65 Semyung-ro, Chechon, Chungbuk, 27136,
Republic of KOREA*

Abstract

The purpose of this study was to analyze correlation among HR-QoL, depression, and BMI; and ultimately to investigate if BMI could be a variable for determining HR-QoL and depression. This study performed a secondary analysis of the KNHANES data for 2016 and 2018. This study was designed to analyze for correlations among HR-QoL, depression and BMI. A complex sample Chi-square test and complex sample general linear model (CSGLM) were conducted using SPSS program. There was no difference for male and female in the correlation between BMI and HR-QoL. However, there was a statistically significant difference in their depression by BMI (Men: Wald $F=3.22$, $p=0.023$; Women: Wald $F=3.30$, $p=0.021$). Among demographic and health-related characteristics, the variables that affected Korean men's depression were age ($p=0.021$), marital status ($p<0.001$), perceived health status ($p<0.001$), perceived usual stress ($p<0.001$), and their HR-QoL ($p<0.001$). This study showed that variables affecting the depression for Korean women were age ($p<0.001$), residential area ($p=0.008$), household income ($p=0.013$), occupation ($p=0.001$), perceived health status ($p<0.001$), perceived usual stress ($p<0.001$), perceived body image ($p=0.039$), BMI ($p=0.014$), and HR-QoL ($p<0.001$). The increase in correlational variables among Korean women is indicative of more potential depression triggers compared to Korean men. This study found that BMI was not the sole variable that affected HR-QoL but demonstrated that BMI was related to depression for both men and women.

Keywords:HR-QoL; Depression; BMI; KNHANE.

*Corresponding Author :

Name :Myoung-Hee Kim

Email :mh1352@semyung.ac.kr

Contact :+82-10-4049-3964

Fax :+82-43-649-7051

Date of Submission :2020. 10. 5

INTRODUCTION

Obesity is an increasing public health concern as it increases the risk of diabetes, cardiovascular disease, musculoskeletal disorders, and cancer (Bastien M et al., 2014). In addition, it is well-known that obesity and being overweight affect people's quality of life, as obese and

overweight adults frequently indicate a lower quality of life compared to adults who are in normal weight group (McLaughlin L et al., 2014). The World Health Organization warned that “obesity is an illness that requires treatment” and there were no arguments that obesity causes various physical illnesses around the world (WHO., 1996). In addition, many researchers have been investigating the correlation between obesity, physical illness and psychological depression (Scott K M et al., 2008).

Recently, research has begun looking at the effects of low BMI in addition to obesity. Low-weight is associated with poor physical health as many studies have confirmed that low BMI increases the death rate among the elderly population. In addition, it has been confirmed that the death rates among older adults with a pre-existing cardiovascular disorder in both the obese group and low weight group were significantly higher (Roh L et al., 2014). Many studies confirm that women with a low weight have more illnesses (including anemia, irregular period, infertility, and miscarriage) and are at increased risk of depression compared to those falling within normal BMI limits or overweight women (Helgstrand S et al., 2005). The study on the correlation between BMI and depression showed U-shaped association and it showed that subjects in the high BMI group and low BMI group had higher rates of depression compared to regular BMI group (de Wit L M et al., 2009). However, some studies (Lee J et al., 2016) have not found any correlations between low BMI and illness among Koreans so we cannot definitively conclude that there were correlations between BMI and physical and psychological health.

Therefore, this study investigated the correlations among HR-QoL, depression, and BMI.

METHODS

Research design

This study performed a secondary analysis of the 7th Korean National Health and Nutritional Examination Survey (KNHANES) data from 2016 and 2018. This study was designed to investigate the correlations among HR-QoL, depression, and BMI.

Research population

This complex sampling study used the 7th KNHANES data from 2016 and 2018 that included a depression screening survey. The subjects of this study were adults who were above 20 years of age except the subjects with illness and who were answered to all of the questions related to the study variables. The final study was made up of 5,879 subjects, including 2,735 men and 3,144 women.

Study variables

This study used health related survey data from the KNHANES. Socio-demographic characteristics including sex, age group, residential area, education level, marital status, household composition, household income, and occupation were used. Health related variables including perceived health status, perceived usual stress, perceived body image, BMI, HR-QoL, and depression were used.

BMI was categorized into four groups according to the Asian-Pacific cutoff points; underweight ($< 18.5 \text{ kg/m}^2$), normal weight ($18.5 \sim < 23 \text{ kg/m}^2$), overweight ($23 \sim < 25 \text{ kg/m}^2$), and obese ($\geq 25 \text{ kg/m}^2$) (Seo M H et al., 2019).

The EQ-5D was used to measure HR-QoL. The EQ-5D is a standardized instrument that measures HR-QoL and it is composed of 5 areas including activity ability, self-managing ability, activities of daily living, pain/discomfort level, and depression/anxiety level. Each question can be answered and scored as follows: 1 point (no problem), 2 points (some problem), and 3 points (serious problem). The EQ-5D index was obtained by applying a weighted value to the measured score for each question. The score variation was -0.717 through 1, and higher scores were indicative of a better quality of life (Lee Y J et al., 2017).

This study used the PHQ-9, a depression screening tool created specifically for Koreans, to measure the study participants' level of depression (Han C et al., 2008). The PHQ-9 is a self-reporting questionnaire that uses 9 questions to assess the level of depression, with higher scores signifying a higher level of depression.

Statistical analysis

The study analysis was conducted by following usage guidelines of the KNHANES suggested by KNHANES. The raw materials of KNHANES were used for complex sample design. The complex sample Chi-square test and the complex sample general linear model (CSGLM) were used to study the difference between male and female subjects in socio-demographic and health-related variables. The complex sample general linear model (CSGLM) was used to investigate the difference both male and female subjects in how BMI affected their HR-QoL and Depression levels and to analyze sociodemographic and health-related factors that cause depression among both genders. SPSS version 19.0 (Chicago, IL, USA) was used to measure the data and significance level was determined to be below 0.05.

RESULTS AND DISCUSSION

The socio-demographic characteristics of subjects

The study indicated a difference between male and female subjects in relation to socio-

demographic characteristics including level of education, marital status, household composition, and occupation.

The male subjects' education level was as follows: 5.6% below elementary school; 5.4% middle school; 38.5% high school; and 50.5% with a college education. The female subjects' education level was as follows: 6.9% below elementary school; 6.6% middle school; 38.8% high school; and 47.7% with a college education. The male subjects generally had a higher education level compared to the female subjects ($\chi^2=2.84$, $p=0.037$).

The male subjects' marital status was as follows: unmarried/single (33.3%); married/cohabited (62.7%); and etc. (4.0%); and the female subjects' marital status was as follows: unmarried/single (22.9%); married/cohabited (68.8%); and etc. (8.3%). This study noted significant differences between the male and female subjects in their marital status rates ($\chi^2=46.08$, $p<0.001$).

The number of people residing in the male subjects' household were as follows: 1-person (9.5%); 2-4 persons (80.6%); and over 5 persons (9.9%). The number of people residing in the female subjects' household were as follows: 1 person (6.7%); 2-4 persons (81.9%); and over 5 persons (11.4%). The male subjects had a significantly higher rate of 1-person households and a lower rate in over 5 person households, thus indicating a significant difference in the number of people residing in the subjects' household between male and female subjects ($\chi^2=8.20$, $p<0.001$).

The male and female subjects' occupation was as follows respectively: employed (79.7%, 59.1%); and unemployed (20.3%, 40.9%); which showed significant differences ($\chi^2=201.75$, $p<0.001$). There were no significant differences among the male and female study subjects' with regard to socio-demographic characteristics such as age, residential area, and household income. The male and female subjects' age group was as follows respectively: 20s (22.5%, 21.3%); 30s (24.0%, 23.6%); 40s (24.2%, 27.2%); 50s (18.0%, 18.5%); 60s (7.6%, 6.5%); and over 70s (3.7%, 2.9%). The male and female subjects' residential area was as follows respectively: Seoul (19.1%, 21.2%); urban/metropolitan area (28.5%, 26.9%); and countryside (52.4%, 51.9%). The male and female subjects' household income was as follows respectively: lower class (10.0%, 9.7%); lower-middle class (23.2%, 23.1%); upper-middle class (32.9%, 32.4%); and upper class (33.9%, 34.9%).

Health related factors of study participants

There were significant differences between male and female subjects in health related factors such as perceived usual stress, perceived body image, BMI, EQ-5D index, and level of

depression except as a perceived health status.

The level of the male subjects' perceived usual stress was indicated as: often (3.7%); frequently (22.3%); somewhat (59.5%); and rarely (14.4%); compared to the female subjects, who reported stress often (6.0%), frequently (22.4%), somewhat (58.6%), and rarely (13.0%). In this section, the female subjects indicated significantly higher rates in stress level compared to their male counterparts ($\chi^2=4.31$, $p=0.006$).

The male and female subjects' body image perceptions were as follows respectively: thin (20.1%, 12.6%); fit (38.2%, 42.8%); and obese (41.7%, 44.7%). The female subjects were significantly more likely to view themselves in the obese category than as thin compared to the male subjects ($\chi^2=20.47$, $p<0.001$).

The male subjects' BMI was as follows respectively: 2.8% were underweight (<18.5); 32.3% were within normal weight limits ($18.5 \sim <23$); 24.4% were overweight ($\geq 23 \sim < 25$); and 40.5% were obese (≥ 25); while the BMI of female subjects' was as follows: 6.8% were underweight (<18.5); 52.8% were within normal weight limits ($18.5 \sim <23$); 17.7% were overweight ($\geq 23 \sim < 25$); and 22.7% were obese (≥ 25). The female subjects were more likely to have their BMI falling within the underweight and normal weight categories compared to male subjects and the differences in BMI between the male and female subjects was found to be significant ($\chi^2=85.93$, $p<0.001$).

This study noted that while the female subjects were more likely to be underweight and normal weight in BMI, their perceived body image was more likely to fall in the overweight and obese categories. It was determined that it is the reflection of the social perception that thinner is better.

The HR-QoL was analyzed by using the EQ-5D index. The male subjects' EQ-5D index was 0.98 and the female subjects' EQ-5D index was 0.97, indicating that women had a lower HR-QoL than men (Wald $F= 17.10$, $p<0.001$). Depression was measured by using the PHQ-9 created for Koreans. The depression score for the male subjects was 1.82 and the female was 2.55 which indicated that the female subjects had higher depression scores (Wald $F= 54.17$, $p<0.001$). There were no significant differences between men and women in perceived health status among health-related characteristics. The male and female subjects' reported about perceived health status as follows respectively: Good (37.8%, 36.8%); Moderate (51.3%, 52.6%); and Bad (10.8%, 10.6%).

Many other studies confirmed that women have a lower quality of life and experience more depression compared to men in Korea (Lee S H., 2013). Therefore, it is important to consider

gender when dealing Koreans' quality of life and depression.

HR-QoL related to BMI

This study examined whether BMI is a factor affecting HR-QoL. Neither the male nor the female subjects showed any significant differences in HR-QoL related to BMI (Table 1 and Table 2).

The male subjects' HR-QoL related to BMI was as follows: underweight 0.97 (95% CI: 0.96-0.99); normal weight 0.98 (95% CI: 0.97-0.98); overweight 0.98 (95% CI: 0.98-0.98); and obese 0.98 (95% CI: 0.97-0.98); and there were no significant differences among each group (Wald F=0.43, p=0.726).

The female subjects' HR-QoL related to BMI was as follows: underweight 0.97 (95% CI: 0.97-0.98); normal weight 0.97 (95% CI: 0.97-0.98); overweight 0.97 (95% CI: 0.97-0.98); and obese 0.97 (95% CI: 0.96-0.97); with no significant differences among each group (Wald F= 1.60, p=0.189).

This study's results were different from previous research which had found a partial correlation between BMI and HR-QoL among Koreans. According to Lee et al. obese or underweight subjects showed decreased activity ability of HR-QoL, with underweight women being particularly prone to suffer with anxiety and depression (Lee Y J et al., 2017). Therefore, it is necessary to have additional research to examine the correlation between BMI and HR-QoL.

Table 1: HR-QoL by BMI among Korean men (N=2735)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	0.97	0.002	0.97	0.98	<0.001	206378.46	<0.001
BMI						0.43	0.726
<18.5	0.97	0.008	0.96	0.99	0.331		
18.5 ~<23	0.98	0.002	0.97	0.98	0.933		
≥23 ~<25	0.98	0.002	0.98	0.98	0.761		
≥25 ^a	0.98	0.002	0.97	0.98	-		

Model summary: R²=0.001, Wald F= 0.43, p= 0.726, a =Reference category

Table 2: HR-QoL by BMI among Korean women (N=3144)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	0.96	0.003	0.96	0.97	<0.001	425803.68	<0.001
BMI						1.60	0.189
<18.5	0.97	0.004	0.97	0.98	0.142		
18.5 ~<23	0.97	0.002	0.97	0.98	0.066		
≥23 ~<25	0.97	0.003	0.97	0.98	0.048		
≥25 ^a	0.97	0.003	0.96	0.97	-		

Model summary: R²=0.002, Wald F= 1.60, p= 0.189, a =Reference category

Depression by BMI

This study confirmed that BMI was one of the factors of depression among both male and female subjects, as indicated by the significant differences depending on BMI (Table 3 and Table 4).

The male subjects' depression score related to BMI was as follows: underweight 2.80 (95% CI: 1.99-3.61); normal weight 1.70 (95% CI: 1.49-1.91); overweight 1.70 (95% CI: 1.46-1.94); and obese 1.92 (95% CI: 1.73-2.10). Significant differences were seen between each group (Wald F=3.22, p=0.023); that is, the male subjects who were underweight showed a higher rate of depression compared to their obese counterparts.

The female subjects' score of depression related to BMI was as follows: underweight 3.04 (95% CI: 2.47-3.61); normal weight 2.59 (95% CI: 2.38-2.79); overweight 2.14 (95% CI: 1.84-2.45); and obese 2.66 (95% CI: 2.30-3.01); with significant differences found between each group (Wald F=3.30, p=0.021). The subjects who were in the overweight group showed the lowest depression score, whereas those who were obese or underweight exhibited a higher depression score.

This result indicated that the BMI index has more significance than simply as a tool to determine obesity and its' co-occurring physical illnesses. It is important to use the BMI index as a way of maintaining a healthy weight, but a poor BMI index score could be indicative of the potentially cyclical relationship of depression and malnutrition. This was suggested in previous studies (de Wit L M et al., 2009) and the correlation between depression and being underweight has been corroborated by this study.

Table 3: Depression by BMI among Korean men (N=2735)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	1.91	0.096	1.72	2.10	<0.001	344.56	<0.001
BMI						3.22	0.023
<18.5	2.80	0.411	1.99	3.61	0.043		
18.5 ~<23	1.70	0.107	1.49	1.91	0.156		
≥23 ~<25	1.70	0.122	1.46	1.94	0.162		
≥25 ^a	1.92	0.096	1.73	2.10	-		

Model summary: R²=0.005, Wald F= 3.22, p= 0.023, ^a=Reference category

Table 4: Depression by BMI among Korean women (N=3144)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	2.65	0.179	2.30	3.01	<0.001	592.11	<0.001

BMI						3.30	0.021
<18.5	3.04	0.291	2.47	3.61	0.225		
18.5 ~<23	2.59	0.104	2.38	2.79	0.716		
≥23 ~<25	2.14	0.154	1.84	2.45	0.023		
≥25 ^a	2.66	0.179	2.30	3.01	-		

Model summary: R²=0.004, Wald F= 3.30, p= 0.021, ^a=Reference category

Korean men’s depression by socio-demographic and health-related variables

The Korean men’s depression level by socio-demographic and health-related variables is indicated in Table 5. The variables among socio-demographic and health-related characteristics that affect Korean men’s depression were age (p=0.021), marital status (p<0.001), perceived health status (p<0.001), perceived usual stress (p<0.001), and HR-QoL (p<0.001).

The male subjects’ depression levels by age, using those over 70 as the reference, showed that subjects in their 30s and 40s had higher rates of depression compared to the subjects in their 70s. The male subjects’ depression levels by the marital status and putting the “etc.” category as reference indicated that married men showed lower depression levels. The male subjects’ depression levels by perceived health status and putting “poor perceived health status” as the reference showed that subjects who reported moderate and good in the perceived health status were less depressed than their poor health counterparts. The male subjects’ depression levels by perceived usual stress indicated that the subjects who indicated higher stress were more likely to be depressed compared to those who rarely recognized the perceived usual stress.

Regarding the male subjects’ HR-QoL, when the EQ-5D score was increased by 1 point, the depression rate decreased by 11.08 (Wald F =81.47, p<0.001). This result indicated an emphasis on managing both physical health and psychological well-being should be used when treating depression.

For the male subjects, residential area, education, household composition, household income, occupation, perceived body image, and BMI were not considered as factors triggering depression. This differs from the above finding that BMI was correlated to depression, and accordingly, it requires additional study on it.

In the study by Fowler-Brown A G et al. (2012), obesity and depression did not show any correlation, but the obese subjects who belonged to a higher socio-economic group were two times more likely to be suffering from depression than people in the normal weight group. That is, when examining the correlation between obesity and depression, socio-demographic variables play important roles, so when analyzing BMI and depression, it is necessary to consider socio-demographic variables that affect depression. The explanation power of socio-

demographic and health related variables regarding Korean men's depression was 33.3% (Wald F=21.76, $p<0.001$).

Table 5: Factors affecting depression among Korean men (N=2735)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	14.19	1.460	11.32	17.06	<0.001	130.42	<0.001
Age						2.69	0.021
20~29 years	3.07	0.268	2.55	3.60	0.633		
30~39 years	3.49	0.246	3.01	3.98	0.048		
40~49 years	3.62	0.248	3.13	4.11	0.010		
50~59 years	3.32	0.226	2.88	3.77	0.122		
60~69 years	3.30	0.241	2.83	3.78	0.145		
≥70 years ^a	2.92	0.291	2.35	3.49	-		
Residential area						2.08	0.126
Seoul	3.14	0.236	2.67	3.60	0.267		
Urban area	3.44	0.218	3.01	3.87	0.170		
Countryside area ^a	3.29	0.212	2.87	3.71	-		
Education						0.70	0.553
≤Elementary	3.56	0.309	2.95	4.17	0.232		
Middle	3.16	0.284	2.60	3.72	0.778		
High	3.20	0.220	2.77	3.63	0.802		
≥University ^a	3.23	0.222	2.80	3.67	-		
Marital status						11.21	<0.001
Single	3.50	0.222	3.06	3.94	0.605		
Married	2.68	0.202	2.28	3.07	0.004		
Others ^a	3.69	0.375	2.96	4.43	-		
Household composition						0.34	0.707
1	3.26	0.252	2.76	3.75	0.669		
2~4	3.24	0.214	2.81	3.66	0.410		
≥5 ^a	3.37	0.262	2.86	3.89	-		
Household income						1.85	0.138
Lower	3.41	0.267	2.88	3.93	0.147		
Lower-Middle	3.39	0.225	2.94	3.83	0.033		
Upper-Middle	3.27	0.229	2.82	3.72	0.130		
Upper class ^a	3.09	0.221	2.66	3.53	-		
Occupation						2.29	0.131
Employed	3.17	0.207	2.76	3.58	0.131		
Unemployed ^a	3.41	0.237	2.94	3.87	-		
Perceived health status						23.97	<0.001
Good	2.64	0.196	2.26	3.03	0.001		
Moderate	3.11	0.198	2.72	3.50	0.001		
Poor ^a	4.11	0.319	3.48	4.74	-		

Perceived usual stress						86.94	<0.001
Often	6.10	0.559	5.00	7.20	0.001		
Frequently	3.63	0.197	3.24	4.02	0.001		
Somewhat	2.02	0.154	1.71	2.32	0.001		
Rarely ^a	1.41	0.151	1.11	1.71	-		
Perceived body image						2.16	0.116
Thin	3.15	0.239	2.68	3.62	0.114		
Fit	3.21	0.219	2.78	3.64	0.038		
Obesity ^a	3.51	0.237	3.04	3.97	-		
BMI	-0.03	0.025	-0.08	0.01	0.141	2.17	0.141
HR-QoL (EQ-5D index score)	-11.08	1.228	-13.49	-8.66	0.001	81.47	<0.001

Model summary: $R^2=0.333$, Wald $F= 21.76$, $p<0.001$

Covariate: BMI value=24.41; EQ-5D index = 0.98,^a=Reference category

Korean women's depression by socio-demographic and health-related variables

The Korean women's depression by socio-demographic and health-related variables is indicated in Table 6. The variables among socio-demographic and health-related characteristics that affected Korean women's depression were age ($p<0.001$), residential area ($p=0.008$), household income ($p=0.013$), occupation ($p=0.001$), perceived health status ($p<0.001$), perceived usual stress ($p<0.001$), perceived body image ($p=0.039$), BMI ($p=0.014$), and HR-QoL ($p<0.001$).

More variables triggered depression among the female subjects compared to the male subjects, including residential area, household income, occupation, and perceived body image, and BMI. Marital status was one of variables affecting depression for the male subjects, but it was not the factor for the female subjects. The female subjects' depression levels by age, using those over 70 as the reference, showed that the female subjects had higher depression levels in all age groups. This result is different from the male subjects who only showed an elevated depression levels in their 30s and 40s. Among the female subjects, the depression levels was much higher in their 20s and 30s. Accordingly, it is necessary to start depression screenings and counseling for women beginning in their 20s as this study suggests this is when women are at high risk of depression.

Unlike the male subjects, the female subjects showed a significant difference in depression by residential area. The female subjects who lived in Seoul indicated a lower level of depression than those who lived in the countryside. It is assumed that the female subjects who lived in Seoul had more opportunity to access various cultural complexes where they can vent their stress, which could reduce their stress. In discerning the female subjects' depression levels by household income, it is one of factors that affects depression. It was determined that the female subjects were more affected by the household income compared the male subjects. By using the

poor perceived health status as the reference for determining female subjects' depression level by perceived health status, the subjects who reported moderate and good in their perceived health status showed lower depression level. The female subjects' depression level by perceived usual stress indicated that the subjects who showed higher stress level were more likely to be depressed compared to those who rarely recognized the perceived usual stress. For the female subjects, perceived body image and BMI were factors that cause depression. When putting obese subjects as the reference for measuring depression amongst the female subjects, those who had normal weight had lower depression rates compared to those who were obese. However, the depression ratings for obese and underweight subjects did not show any statistically significant differences.

Regarding the female subjects' HR-QoL, when the EQ-5D score was increased by 1 point, the depression rate decreased by 12.81 (Wald F =64.40, p<0.001). The explanation power of the socio-demographic and health related variables for Korean women's depression was 38.5% (Wald F=28.82, p<0.001).

The female subjects showed higher explanation power of socio-demographic and health related variables compared the male subjects and more variables actually caused depression. In order to successfully manage women's depression, it is necessary to have insight into various socio-demographic factors.

Table 6: Factors affecting depression among Korean women (N=3144)

Categories	Value	SE	95% CI Lower	95% CI Upper	<i>p</i>	Wald F	<i>p</i>
(constant)	15.53	1.460	12.65	18.40	<0.001	128.80	<0.001
Age						5.95	<0.001
20~29 years	4.48	0.253	3.98	4.98	<0.001		
30~39 years	4.13	0.226	3.69	4.57	<0.001		
40~49 years	3.69	0.227	3.24	4.13	0.002		
50~59 years	3.65	0.214	3.23	4.07	0.002		
60~69 years	3.21	0.246	2.73	3.70	0.045		
≥70 years ^a	2.41	0.380	1.66	3.16	-		
Residential area						4.88	0.008
Seoul	3.32	0.181	2.97	3.68	0.020		
Urban area	3.82	0.219	3.39	4.25	0.291		
Countryside area ^a	3.64	0.182	3.29	4.00	-		
Education						0.11	0.952
≤Elementary	3.63	0.307	3.02	4.23	0.951		
Middle	3.50	0.276	2.96	4.05	0.603		
High	3.60	0.201	3.21	4.00	0.723		
≥University ^a	3.65	0.188	3.28	4.02	-		

Marital status						1.42	0.243
Single	3.72	0.270	3.19	4.25	0.919		
Married	3.39	0.188	3.02	3.76	0.239		
Others ^a	3.68	0.241	3.21	4.16	-		
Household composition						0.68	0.500
1	3.75	0.262	3.24	4.27	0.493		
2~4	3.47	0.176	3.13	3.82	0.581		
≥5 ^a	3.56	0.218	3.13	3.99	-		
Household income						3.66	0.013
Lower	3.77	0.260	3.26	4.28	0.062		
Lower-Middle	3.71	0.213	3.29	4.12	0.008		
Upper-Middle	3.59	0.186	3.22	3.95	0.021		
Upper class ^a	3.31	0.186	2.95	3.68	-		
Occupation						12.03	0.001
Employed	3.40	0.174	3.06	3.74	0.001		
Unemployed ^a	3.79	0.188	3.42	4.16	-		
Perceived health status						27.71	<0.001
Good	2.81	0.190	2.44	3.18	<0.001		
Moderate	3.40	0.167	3.07	3.73	<0.001		
Poor ^a	4.58	0.297	4.00	5.16	-		
Perceived usual stress						93.32	<0.001
Often	6.73	0.435	5.88	7.59	<0.001		
Frequently	3.93	0.201	3.53	4.33	<0.001		
Somewhat	2.13	0.153	1.83	2.43	<0.001		
Rarely ^a	1.59	0.156	1.28	1.90	-		
Perceived body image						3.26	0.039
Thin	3.45	0.235	2.99	3.91	0.102		
Fit	3.48	0.178	3.13	3.83	0.011		
Obesity ^a	3.85	0.202	3.46	4.25	-		
BMI	-0.06	0.024	-0.10	-0.01	0.014	6.12	0.014
HR-QoL (EQ-5D index score)	-12.81	1.597	-15.96	-9.67	<0.001	64.40	<0.001

Model summary: $R^2=0.385$, Wald $F= 28.82$, $p<0.001$

Covariate: BMI value= 22.83; EQ-5D index = 0.97, ^a=Reference category

CONCLUSION

BMI can be used to determine an individuals' nutritional condition and as a psychological index that can evaluate depression. This study did not confirm that BMI is the sole variable that affects HR-QoL; however, it found that BMI is one of the variables related to depression for both male and female subjects.

This was especially true among the underweight study participants, where the male and female subjects showed higher levels of depression. Obesity is a cause of illness so it is important to emphasize that people need to maintain a healthy weight to have good health. However, the

issues related to being underweight have not been raised as much. This study learned that the depression rate was as high in the subjects who were underweight as those who are obese. Accordingly, the BMI should be considered as an index not only to determine physical health, but also to screen for psychological depression.

This study indicates that there are gender-related differences to consider in the various factors affecting depression. A limitation of this study was it was a cross-sectional study, so there are challenges in explaining the correlation among HR-QoL, depression, and BMI. However, it is significant that this study used survey materials that were designed specifically for the Korean culture. In addition, this study also determined the importance of using BMI as a tool when assessing not only issues with obesity and being underweight, but also how BMI correlates to psychological health issues such as depression.

ACKNOWLEDGEMENT

This paper was supported by the Semyung University Research Grant of 2020.

REFERENCES

1. Bastien M., Poirier P., Lemieux I., and Després J. P., 2014. Overview of epidemiology and contribution of obesity to cardiovascular disease. *Progress in cardiovascular diseases*, 56(4), pp. 369–381. DOI:10.1016/j.pcad.2013.10.016
2. de Wit L. M., van Straten A., van Herten M., Penninx B. W., and Cuijpers P., 2009. Depression and body mass index, a u-shaped association. *BMC public health*, 9, p.14. DOI:10.1186/1471-2458-9-14
3. Fowler-Brown A. G., Ngo L. H., and Wee C. C., 2012. The relationship between symptoms of depression and body weight in younger adults. *Obesity*, 20(9), pp. 1922–1928. DOI:10.1038/oby.2011.311
4. Han C., Jo S. A., Kwak J. H., Pae C. U., Steffens D., Jo I., and Park M. H., 2008. Validation of the Patient Health Questionnaire-9 Korean version in the elderly population: the Ansan Geriatric study. *Comprehensive psychiatry*, 49(2), pp. 218–223. DOI:10.1016/j.comppsy.2007.08.006.
5. Helgstrand S., and Andersen A. M., 2005. Maternal underweight and the risk of spontaneous abortion. *Acta obstetrica et gynecologica Scandinavica*, 84(12), pp.1197–1201. DOI:10.1111/j.0001-6349.2005.00706.x
6. Lee J., Kim H., Kim C., Park K., Ahn S., Kang D., . . . Suh I., 2016. Underweight and mortality

- ty. *Public Health Nutrition*, 19(10), pp. 1751-1756. DOI:10.1017/S136898001500302X
7. Lee S. H., 2013. Gender difference in influencing factors on health related quality of life among the elderly in community. *Journal of Digital Convergence*, 11(12), pp. 523-535. DOI:10.14400/JDPM.2013.11.12.523
 8. Lee Y. J., Lee J. A., Kim S. H., Lim J. S., and Park H. S., 2017. The Relationship between body mass index and health-related quality of life in Korean. *Korean Journal of Family Practice*, 7(5), pp. 794-798. DOI:10.21215/kjfp.2017.7.5.794
 9. McLaughlin L., and Hinyard L. J., 2014. The Relationship Between Health-Related Quality of Life and Body Mass Index. *Western journal of nursing research*, 36(8), pp. 989–1001. DOI: 10.1177/0193945913520415
 10. Roh L., Braun J., Chiolero A., Bopp M., Rohrmann S., Faeh D., and Swiss National Cohort Study Group, 2014. Mortality risk associated with underweight: a census-linked cohort of 31,578 individuals with up to 32 years of follow-up. *BMC public health*, 14, p. 371. DOI:10.1186/1471-2458-14-371
 11. Scott K. M., McGee M. A., Wells J. E., and Oakley Browne M. A., 2008. Obesity and mental disorders in the adult general population. *Journal of psychosomatic research*, 64(1), pp. 97–105. DOI:/10.1016/j.jpsychores.2007.09.006
 12. Seo M. H., Lee W. Y., Kim S. S., Kang J. H., Kang J. H., Kim K. K., ... Committee of Clinical Practice Guidelines, Korean Society for the Study of Obesity, 2019. 2018 Korean Society for the Study of Obesity Guideline for the Management of Obesity in Korea. *Journal of obesity & metabolic syndrome*, 28(1), pp. 40–45. DOI:10.7570/jomes.2019.28.1.40
 13. WHO, 1996. The world health report 1996 - Fighting disease, fostering development. Geneva : World Health Organization. viewed 30 July 2020, <https://www.who.int/whr/1996/en/>