TJFM&PC Turkish Journal of Family Medicine and Primary Care

Original Research / Özgün Araştırma

The Comparison of Body Mass Index and Waist Circumference to Assess Health-Related Quality of Life

Sağlıkla İlgili Yaşam Kalitesini Değerlendirmek için Vücut Kitle İndeksi ve Bel Çevresinin Karşılaştırılması

İbrahim Başhan[1], Mustafa Bakman[2]*

ABSTRACT

Introduction: Health-related quality of life studies performed only based on body mass index does not provide clear results, especially in overweight individuals. The evaluation of body mass index and waist circumference measurements together can offer better insights in this area. **Methods:** The SF-36 Quality of Life Scale was applied to 398 women aged 18 years and over. The participants were grouped according to body mass index, and the overweight individuals were further divided into groups based on waist circumference measurements. To compare each sub-scale, the Kruskal-Wallis 1 - way ANOVA statistics were used. **Results:** From the normal weight to class III obesity, the scores in all physical and mental subscales tended to decline, except in the overweight group. Compared to the individuals with normal weight, the overweight participants' scores in the mental subscales were increased but this was not statistically significant, unlike the other findings. We examined the overweight group separately according to the waist circumference measurements and detected statistically significant differences between the risk groups. The mental scores were significantly decreased in the high-risk group compared to the normal risk group ($p<0.05$). **Conclusion:** The effect of obesity on quality of life can be complex if evaluated only by body mass index, and therefore studies evaluating waist circumference measurements together with body mass index can provide clearer results in this area.

Key words: Quality of life, questionnaire, anthropometric methods, obesity

ÖZET

Giriş: Yalnızca vücut kitle indeksine dayalı olarak yapılan sağlıkla ilgili yaşam kalitesi çalışmaları, özellikle fazla kilolu bireylerde net sonuçlar vermemektedir. Vücut kitle indeksi ve bel çevresi ölçümlerinin birlikte değerlendirilmesi, bu alanda daha iyi fikir verebilir. **Yöntem:** SF-36 Yaşam Kalitesi Ölçeği 18 yaş ve üstü 398 kadına uygulandı. Katılımcılar vücut kitle indekslerine göre gruplandırıldı ve fazla kilolu bireyler ayrıca bel çevresi ölçümlerine göre gruplara ayrıldı. Her bir alt ölçeği karşılaştırmak için Kruskal-Wallis One- way ANOVA istatistiksel analizleri kullanılmıştır. **Bulgular:** Normal ağırlıktan sınıf III obeziteye kadar tüm fiziksel ve mental alt ölçeklerdeki skorlar fazla kilolu grup dışında düşme eğilimindeydi. Normal kilolu bireylerle karşılaştırıldığında, fazla kilolu katılımcıların mental alt ölçeklerindeki skorların arttığı ancak bunun diğer bulgulardan farklı olarak istatistiksel olarak anlamlı olmadığı saptandı. Fazla kilolu grup bel çevresi ölçümlerine göre ayrı ayrı incelendiğinde; risk grupları arasında istatistiksel olarak anlamlı farklılıklar tespit edildi. Mental skorların yüksek riskli grupta normal risk grubuna göre anlamlı olarak azaldığı görüldü. ($p <0.05$) **Sonuç:** Obezitenin yaşam kalitesine etkisi sadece vücut kitle indeksi ile değerlendirilirse karmaşık olabilir ve bu nedenle bel çevresi ölçümlerini vücut kitle indeksi ile birlikte değerlendiren çalışmalar bu alanda daha net sonuçlar verebilir.

Anahtar kelimeler: Yaşam kalitesi, ölçek, antropometrik yöntemler, obezite

Received / Geliş tarihi: 14.11.2020, Accepted / Kabul tarihi: 02.01.2021

[1]Department of Medical Education, Mersin University, Faculty of Medicine Mersin, TURKEY.
[2]Toroslar Ay Isigi Primary Care Center, Mersin, TURKEY.
***Address for Correspondence / Yazışma Adresi:** Ibrahim Bashan, Department of Medical Education, Mersin University, Faculty of Medicine Mersin, TURKEY.
E-mail: ibashan@yahoo.com

Bashan I, Bakman M. The Comparison of Body Mass Index and Waist Circumference to Assess Health-Related Quality of Life. TJFMPC, 2021;15(2): 230-235.

DOI: 10.21763/tjfmpc.825838

INTRODUCTION

Obesity has a direct impact on the quality of life, leading to a decrease in physical, social, and psychological activities of daily routine. It negatively affects functional capacity and health-related quality of life (HRQoL).[1] In clinical practice, the most used obesity evaluation criterion is the measurement of body mass index (BMI). However, there are some limitations in the definition of obesity by BMI. In some physiological conditions, the sensitivity of BMI measurements changes. For instance, the BMI cut-off points used for women are the same as males, although the body fat ratios of the former are higher. Women and men are diagnosed as being overweight or obese based on the same BMI thresholds as men. [2,3]

The other important aspect of obesity is abdominal adiposity in the body and waist circumference measurement (WCM) can be used to evaluate abdominal fat, and therefore obesity. WCM has a correlation with the amount of intraabdominal adiposity and provides an advantage for the better determination of abdominal fat and cardiovascular risk. In addition, waist circumference values are not affected by confounding factors, such as age, gender, and muscle mass, and the cut-off points for being overweight and obese are calculated separately for women and men, which is a significant advantage over BMI. The knowledge about the WCM values of people especially with BMI values between 25-35 kg/m^2, is important to correctly diagnose obesity. [4,5]

HRQoL is a broad concept that covers many factors directly or indirectly related to health. Measurement of quality of life is becoming increasingly important in many areas of health research. Current research on nutrition and health is aimed at protecting and improving health status, as well as preventing or slowing down the emergence of diseases. [6,7] However, recent studies that investigate the relationship between BMI and HRQoL have not presented definitive results. [8,9] HRQoL consists of both physical and mental components and the differences in these studies may be caused by these components. [10]

Although it is known that overweight and obesity are associated with a reduction in the physical domains of HRQoL, [11,12] the results are different in the mental scores of HRQOL. Some studies suggest that obesity is negatively associated with mental scores while others do not support this association. [13-15] There are also studies revealing that being overweight is associated with better HRQoL scores. [16-19]

In our study, we aimed to investigate the effects of obesity on HRQoL in women classified according to BMI and WCM together using the SF-36 Quality of Life Scale that evaluates different health dimensions: physical functioning (PF), role physical (RP), role mental (RM), vitality (VT), mental health (MH), social functioning (SF), bodily pain (BP), and general health (GH).[20]

METHODS

Study Population

This prospective study was conducted with 398 female subjects aged over 18 years, who presented to the Family Medicine Clinic of Mersin University Medical Faculty between June 2015 and June 2016 to participate in a healthy nutrition program. Before initiating this program, SF-36 was applied to the individuals who gave consent for a face-to-face interview by an executive, and anthropometric measurements (height, weight, and WCM) were simultaneously performed. Individuals with a chronic disease, those that needed to take medicine continuously according to the International Statistical Classification of Diseases and Related Health Problems 10 (ICD 10) coding, pregnant women, individuals that were not able to verbally communicate or did not have the mental capacity to understand or respond to the questionnaire, and those that did not provide consent to participate in the research were excluded. The participants' signed informed consent was obtained individually. Mersin University Clinical Research Ethics Committee approved the study.

BMI Assessment

The BMI values of the participants were calculated using the formula, BMI = weight/height^2 [kg/m^2]; then, they were grouped according to the World Health Organization's protocol as normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese ≥30.0 kg/m^2. The obese group was further divided into class I (30.0-34.9 kg/m^2), class II (35.0-39.9 kg/m^2), and class III (≥40 kg/m^2). [21]

WCM Assessment

The participants were asked to stand up with their weight equally distributed on each foot and breathe normally. The waist circumference was measured at the mid-point between the iliac crest and the inferior costal margin. The measurement was taken from the nearest 0.1 cm after normal exhalation. A WCM of ≥ 80 cm in females was accepted as increased risk, whereas WCM ≥ 88 cm as abdominal obesity. [21]

HRQoL

HRQoL was evaluated using the Turkish version of the SF-36 Health Survey [20]. SF-36 consists of 36 items structured under the physical and mental domains with four subscales each: PF, RP, GH, and BP in the physical domain and SF, RM, MH, and VT in the mental domain. In this study, an algorithm was used to convert the sum of the SF-36 item scores within each subscale to a total score ranging from 0 (poor health) to 100 (good health).

Statistical Analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) v. 21. The quality-of-life perceptions of the individuals grouped by the BMI classification were compared using the eight subscales of SF-36. The Kolmogorov-Smirnov test was used to determine whether the data obtained was normally distributed. For the data that was not normally distributed, the Kruskal-Wallis one-way ANOVA (k-samples) test was used in the analysis of each subcategory of independent variables. A p value of less than 0.05 was statistically significant.

RESULTS

The subscales of SF-36 were examined according to the BMI classes, the scores in the physical HRQoL subscales (GH, PF, RP, and BP) statistically significantly differed. From normal weight to class III obesity, the scores in all physical HRQoL subscales tended to decline in all BMI categories (Table 1). However, the scores in the mental HRQoL subscales (RM, VT, MH, SF) tended to decline in all BMI classes from normal weight to class III obesity except for overweight participants, and they also statistically significantly between the obesity classes. When we compared the normal weight and overweight groups, the scores in the mental HRQoL subscales (RM, VT, MH, and SF) were increased, but this was not statistically significant.

Table 1. Distribution of SF-36 scores by BMI categories

		Physical Scores					Mental Scores			
BMI Groups		**Age, Years** Mean ± SD	**GH** Mean ± SD	**PF** Mean ± SD	**RP** Mean ± SD	**BP** Mean ± SD	**RM** Mean ± SD	**VT** Mean ± SD	**MH** Mean ± SD	**SF** Mean ± SD
Normal		37.3 ± 13.81	62.6 ± 16.08	86.6 ± 11.32	76.0 ± 11.86	68.9 ± 21.54	80.4 ± 32.52	66.7 ± 12.93	68.5 ± 15.77	80.6 ± 18.74
Overweight		36.1 ± 12.09	60.9 ± 17.94	81.1 ± 13.84	72.7 ± 30.01	68.1 ± 31.43	82.6 ± 26.34	68.0 ± 20.76	72.5 ± 13.1	85.5 ± 13.05
Class I		39.1 ± 11.91	53.9 ± 16.56$^{\delta}$	78.2 ± 11.98	71.5 ± 29.51	65.2 ± 22.11	76.5 ± 32.54	60.2 ± 20.36$^{\delta}$	67.4 ± 15.78	72.7 ± 18.67$^{\#\,\delta}$
Class II		42.1 ± 11.99	46.0 ± 16.83$^{\beta\gamma}$	56.2 ± 19.30$^{\alpha\,\beta\gamma}$	54.4 ± 34.80$^{\beta\gamma}$	53.7 ± 23.21$^{\alpha\,\beta\gamma}$	60.2 ± 43.19$^{\beta\gamma}$	46.0 ± 23.12$^{\alpha\,\beta\gamma}$	62.4 ± 17.06	68.3 ± 21.86$^{\beta\gamma}$
Class III		36.1 ± 10.67	43.0 ± 20.37$^{*+\&}$	38.2 ± 19.45$^{*+\&}$	41.3 ± 26.76$^{*+\&}$	46.9 ± 29.46$^{*\&}$	49.2 ± 40.03$^{*+\&}$	39.3 ± 15.24$^{*+\&}$	58.9 ± 11.26$^{+\&}$	53.2 ± 24.19$^{*+\&}$
Total		38.1 ± 12.19	55.0 ± 18.34	73.9 ± 19.43	67.7 ± 31.19	63.6 ± 23.12	74.1 ± 35.84	60.1 ± 22.38	65.7 ± 15.78	74.9 ± 20.73
KWH	**TS**	13.42	66.50	134.49	36.16	36.30	15.89	42.50	29.30	48.64
	p	0.010	< 0.001	< 0.001	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001

BMI: body mass index; **GH:** general health; **PF:** physical functioning; **RP**: role physical; **BP:** bodily pain; **RM:** role mental: **VT:** vitality; **MH:**mental health; **SF:** social functioning; **KWH:** Kruskal-Wallis one-way ANOVA (k-samples); **TS:** test statistics;
The p values belong to the overall comparison of the scores between the BMI categories using KWH
* $p < 0.05$ Class III vs. Class I, + $p < 0.05$ Class III vs. overweight, & $p < 0.05$ Class III vs. normal weight
α $p < 0.05$ Class II vs. Class I, β $p < 0.05$ Class II vs. overweight, γ $p < 0.05$ Class II vs. normal weight
# $p < 0.05$ Class I vs. overweight, δ $p < 0.05$ Class I vs. normal weight

Table 2. Distribution of waist circumference risk groups by BMI categories

BMI Groups	Waist Circumference Risk Groups			
	Normal Risk n (%)	Increased Risk n (%)	High Risk n (%)	Total n (%)
Normal	17 (73.9)	6 (26.1)	0	23 (5.8)
Overweight	18(11.1)	96 (59.3)	48 (29.6)	162 (40.7)
Class I	0	17 (13.9)	105 (86.1)	122 (30.7)
Class II	0	0	68 (100.0)	68 (17.0)
Class III	0	0	23 (100.0)	23 (5.8)
Total	35 (8.8)	119 (29.9)	244 (61.3)	398 (100.0)

BMI: body mass index

There was a decline in the physical HRQoL subscales scores from the normal to high-risk group, but this was not statistically significant (Table 3). When we compared the WCM groups according to the mental HRQoL subscale scores, we found significant differences between the risk groups according to WCM in overweight participants. The mental scores were significantly decreased in the high-risk group compared to the normal risk group for all subscales. However, there was no statistical significance between the normal and increased risk groups.

Table 3. Distribution of SF-36 subscales in overweight individuals according to the WCM groups

WCM Groups		Physical Scores				Mental Scores			
		GH Mean ± SD	PF Mean ± SD	RP Mean ± SD	BP Mean ± SD	RM Mean ± SD	VT Mean ± SD	MH Mean ± SD	SF Mean ± SD
Normal Risk		64.6 ± 15.12	85.8 ± 12.28	75.1 ± 10.98	72.8 ± 12.90	89.1 ± 10.57	73.3 ± 27.94	75.6 ± 26.78	87.3 ± 25.94
Increased Risk		61.2 ± 18.88	82.6 ± 26.88	73.5 ± 28.62	70.0 ± 08.25	84.6 ± 06.76	71.4 ± 24.96	73.6 ± 24.84	86.4 ± 26.96
High Risk		58.9 ± 16.56	78.7 ± 11.83	70.6 ± 33.92	66.2 ± 11.99	74.7 ± 9.83*	59.4 ± 42.90*	69.0 ± 38.68*	79.4 ± 40.0*
Total		60.9 ± 17.94	81.1 ± 13.84	72.7 ± 30.01	68.1 ± 31.43	82.6 ± 26.34	68.0 ± 20.76	72.5 ± 13.1	85.5 ± 13.05
KWH	**TS**	5.67	0.79	2.24	4.17	9.68	14.04	8.06	7.93
	P	0.058	0.673	0.326	0.231	0.008	0.000	0.018	0.019

WCM: waist circumference measurement; **GH:** general health; **PF:** physical functioning; **RP:** role physical; **BP:** bodily pain; **RM:** role mental: **VT:** vitality; **MH:** mental health; **SF:** social functioning; **KWH:** Kruskal-Wallis 1-way ANOVA (k samples); **TS:** test statistics
The p values belong to the overall comparison of the scores between the WCM groups by KWH.
* $p < 0.05$ high risk vs. normal risk

DISCUSSION

Most studies have shown that obesity impairs HRQoL depending on the degree of obesity. However, HRQoL contains different domains, namely mental and physical, and previous studies do not provide definitive findings for these two domains, and thus there is still a complex relationship between BMI and HRQoL. [8,9]

Some studies show that the total score of HRQoL is reduced linearly among obese people but increased among those that are overweight. [13, 16] In addition, recent publications presented different results for the physical and mental domains, with most researchers revealing a significant relationship between obesity and impairment in the physical domain without comprehensive quantitative analysis. Some studies report a significant linear relationship between obesity degree and reduced mental scores, [13-15] while

others have shown either a weak or no relationship. [22]

Our study supports recent studies in terms of the differences in the physical domain scores according to BMI classes. The physical scores of our participants were significantly decreased linearly according to the BMI degree. However, when we compared the mental scores of the individuals, we found that they were higher compared to the normal weight groups without statistically significant differences. In order to clarify this result, we thought that scoring according to BMI alone was not sufficient, and therefore we also reported the changes in the scores of quality-of-life subscales by further grouping overweight individuals based on their WCM values. Although BMI is the most used measure in the diagnosis of obesity, it only provides a rough estimate, and it does not fully show abdominal fat mass.

These results revealed that when the overweight participants were classified according to WCM as normal, increased, and high risk, significant differences were found in the SF36 mental scores. While all the mental scores were increased in the overweight participants with normal or increased risk, there was a significant decrease in the scores of the high-risk individuals compared to the normal risk group. These scores in the high-risk overweight group were also comparable to the group with class I obesity.

CONCLUSION

This study presented evidence of the need to evaluate BMI and waist circumference together in the assessment of the effect of obesity on HRQoL and recommended a solution to reduce complexity in this area. The limitations of the study include the sample consisting of only women and the groups not being similarly distributed.

REFERENCES

1. Mannucci E, Petroni ML, Villanova N, Rotella CM, Apolene G, Marchesini G. Clinical and psychological correlates of health-related quality of life in obese patients. Health Qual Life Outcomes 2010;8(1):90. doi: 10.1186/1477-7525-8-90
2. Wang Z, Ma J, Si D. Optimal cut-off values and population means of waist circumference in different populations. Nutr Res Rev 2010;23(2):191–199. doi: 10.1017/S0954422410000120
3. Moyer VA. Screening for and management of obesity in adults: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med 2012;57(5):373-378. doi: 10.7326/0003-4819-157-5-201209040-00475
4. Romero-Corral A, Somers VK, Sierra-Johnson J, Thomas RJ, Collazo-Clavell ML, Korinek J, et al. Accuracy of body mass index in diagnosing obesity in the adult general population. Int J Obes (Lond) 2008;32(6):959-966. doi: 10.1038/ijo.2008.11
5. Schneider HJ, Glaesmer H, Klotsche J, Böhler S, Lehnert H, Zeiher AM, et al. Accuracy of anthropometric indicators of obesity to predict cardiovascular risk. J Clin Endocrinol Metab 2007; 92(2):589-594. doi: 10.1210/jc.2006-0254
6. Afman L, Müler M. Nutrigenomics: From molecular nutrition to prevention of disease. J Am Diet Assoc 2006;106(4):569-576. doi: 10.1016/j.jada.2006.01.001
7. Kussmann M, Affolter M. Proteomics at the center of nutrigenomics: Comprehensive molecular understanding of dietary health effects. Nutrition 2009;25(11-12):1085-1093. doi: 10.1016/j.nut.2009.05.022
8. Friedman MA, Brownell KD. Psychological correlates of obesity: moving to the next research generation. Psychol Bull 1995;117(1):3-20. doi: 10.1037/0033-2909.117.1.3
9. Fontaine KR, Barofsky I. Obesity and health-related quality of life. Obes Rev 2001;2(3):173-182. doi: 10.1046/j.1467-789x.2001.00032.x
10. Apple R, Samuels LR, Fonnesbeck C, Schlundt D, Mulvaney S, Hargreaves M, et al. Body mass index and health-related quality of life. Obes Sci Pract 2018;4(5):417-426. doi: 10.1002/osp4.292
11. Fontaine KR, Barofsky I, Cheskin LJ. Predictors of quality of life for obese persons. J Nerv Ment Dis 1997;185(2):120–122. doi: 10.1097/00005053-199702000-00011.
12. Larsson U, Karlsson J, Sullivan M. Impact of overweight and obesity on health-related quality of life – a Swedish population study. Int J Obes Relat Metab Disord 2002;26(3):417–424. doi: 10.1038/sj.ijo.0801919.
13. Ul-Haq Z, Mackay DF, Fenwick E, Pell JP. Impact of metabolic comorbidity on the association between body mass index and health-related quality of life: A Scotland-wide cross-sectional study of 5,608 participants. BMC Public Health 2012;12:143. doi: 10.1186/1471-2458-12-143.
14. de Zwaan M, Petersen I, Kaerber M, Burgmer R, Nolting B, Legenbauer T, et al. Obesity and quality of life: A controlled study of normal-weight and obese individuals. Psychosomatics 2009;50(5):474–482. doi: 10.1176/appi.psy.50.5.474

15. Fontaine KR, Bartlett SJ, Barofsky I. Health-related quality of life among obese persons seeking and not currently seeking treatment. Int J Eat Disorder 2000;27(1):101–105. doi: 10.1002/(sici)1098-108x(200001)27:1<101::aid-eat12>3.0.co;2-d
16. Bentley TG, Palta M, Paulsen AJ, Cherepanov D, Dunham NC, Feeny D, et al. Race and gender associations between obesity and nine health-related quality-of-life measures. Qual Life Res 2011;20(5):665–674. doi: 10.1007/s11136-011-9878-7
17. Wang R, Wu MJ, Ma XQ, Zhao YF, Yan XY, Gao QB, et al. Body mass index and health-related quality of life in adults: A population based study in five cities of China. Eur J Public Health 2012;22(4):497–502. doi: 10.1093/eurpub/ckr080
18. Kearns B, Ara R, Young T, Relton C. Association between body mass index and health-related quality of life, and the impact of self-reported long-term conditions – cross-sectional study from the south Yorkshire cohort dataset. BMC Public Health 2013;13:1009. doi: 10.1186/1471-2458-13-1009
19. Milder IE, de Hollander EL, Picavet HS, Verschuren WM, de Groot LC, Bemelmans WJ. Changes in weight and health-related quality of life. The Doetinchem cohort study. J Epidemiol Community Health 2014;68(5):471–477. doi: 10.1136/jech-2013-203127
20. Kocyigit H, Gülseren S, Erol A, Hizli N, Memis A. The reliability and validity of the Turkish version of Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO). Clin Rheumatol 2003;22(1):18–23. doi: 10.1007/s10067-002-0653-6
21. World Health Organization. WHO fact sheet on overweight and obesity. Updated on March 3, 2020. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight. Accessed April 22, 2020.
22. Hopman WM, Berger C, Joseph L, Barr SI, Gao Y, Prior JC, et al. The association between body mass index and health-related quality of life: Data from CaMos, a stratified population study. Qual Life Res 2007;16(10):1595-1603. doi: 10.1007/s11136-007-9273-6.