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Clinical demonstration of the relationship between cervical subcutaneous fat tissue thickness and obesity

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Abstract

Aim: Neck pain is an important complaint in neurosurgery practice and is observed with a frequency of 30-50% throughout life. The most common complaint of working women who apply to the doctor is neck pain. Obesity is known as a common disease in recent years and traditional measurements are used in its evaluation in practice. In this research, we aimed to show the relationship between obesity in patients with neck pain that may accompany cervical disc herniation. We examined the usability of neck circumference measurement in indicating obesity.

Materials and Methods: This study was made on 100 patients aged between 20 and 70, after determining the Sample Size with Power Analysis. The presence of cervical disc herniation and the thickness of the cervical subcutaneous adipose tissue were measured and recorded on Magnetic Resonance Imaging. Neck circumference measurements of the patients were compared with waist circumference measurements. The data collected for the study were recorded using the SPSS 22 program and analysed in the same program.

Results: 55% of the patients had disc herniation and 38% had an additional chronic disease. Individuals with a cervical herniated disc had higher waist circumference and subcutaneous asymptote tissue values than those without ($p<0.01$). BMI values of individuals with a cervical herniated disc were found to be higher than those without (respectively, 30.47 ± 4.93, 27.77 ± 4.60, $p=0.023$). A positive linear correlation was found between the BMI values of the patients, neck circumference, waist circumference and subcutaneous adipose tissue ($p<0.05$ core coefficient 0.676&0.750&0.463, respectively).

Conclusion: Neck circumference measurement, which is a simple and fast method, we can diagnose obesity. We saw that in our study, as in many cases, obesity was observed more frequently with cervical disc herniation, especially in women.

Introduction

Obesity continues to increase its severity as one of the important health problems of recent years. Obesity negatively affects the social lives of individuals in many ways, it also has countless negative effects on their health [1]. According to research data of the World Health Organization, 1.9 billion adults live overweight or obese in the world [2]. It is known that obesity is a risk factor for many metabolic disorders, hemodynamic, endothelial, inflammatory, and physiological diseases [3,4]. Many surgical and medical treatment methods, especially diet programs, are used to improve obesity [5]. However, we can prevent complications from occurring by monitoring obesity and diagnosing it early. Many indices have been proposed to predict central or visceral obesity. In particular, measurements such as waist circumference (WC), waist-hip ratio (WHR) and waist-to-height ratio (WHRt) have been the most frequently used measurements for years [6,7]. However, body mass index (BMI) mainly reflects general obesity and is the most used parameter in practice [8].

Fat tissue measurement in the upper body can also be shown by the fat tissue thickness around the neck. Measurement of neck circumference (NC) is a marker used to determine upper body subcutaneous fat distribution [9]. Neck circumference is easily measurable, reliable, non-invasive and reproducible, does not require cost. Waist circumference can be affected by respiratory or gastric filling, but NC is not affected. When we examine the literature, there are studies stating that neck circumference measurement can be used as a predictor of obesity [10,11]. Waist circumference measurement is used as the standard method to define central obesity, but WC measurement can vary and has certain limitations as it is affected by res-

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piratory or gastric fullness as we mentioned before. Therefore, there was a need for a new, better method that could be used to monitor and diagnose obesity. Neck circumference has been a good alternative method instead of WC measurement [12].

Obesity and vertebral diseases have been discussed together in different previous studies [13-15]. Sheng et al. In 2017, obesity was compared with conditions such as low back pain, degenerative spine diseases and intervertebral disc disorders [16].

Neck pain that persists for more than 12 weeks is considered chronic. It is the second most common chronic pain after low back pain. Various reasons play a role in the ethology of neck pain. There may be psychosocial and personal factors, as well as the occupations of the people [17]. Although the relationship between obesity and low back pain has been observed in formerly studies [18, 19], studies showing the relationship between neck pain and cervical disc herniation are insufficient. In our study, patients with chronic neck pain; demographic data, education level, economic status, occupation, severity of neck pain, coexistence with obesity and presence of cervical disc herniation were investigated.

Materials and Methods

Study design

The sample of the study was obtained using literature information (20) and Number Cruncher Statistical System (NCSS) 2007 & Power Analysis and Sample Size (PASS) 2008 Statistical Software (Utah, USA). Two independent groups (non-parametric) test with α:0.01, β:0.95, effect size (01.0), and the total sample size was calculated at least 76 consisting of 38 from each group. Since there may be data loss, it was planned to include more people from the sample account. This study was made with 100 patients, aged 20 to 70 years, who applied to University of Health Sciences, Kayseri City Hospital Neurosurgery outpatient clinic. The study was carried out with the 76397871 numbered and 28.10.2022 dated permission of Kayseri City Hospital approval of the ethics committee. The study was conducted in accordance with the Declaration of Helsinki with the informed consent of the patients. The selection of the cases was made by questioning, examination, laboratory, and radiological examinations. In the examination; inspection and neurological examination; done.

Criteria for patient selection

Patients with a diagnosis of chronic neck pain or with cervical disc herniation, those were between the ages of 20-70, included in the study. History of trauma to the cervical spine, inflammatory arthritis, cervical region tumours, infections, congenital anomalies, neurological diseases (multiple sclerosis, parkinsonian disease, syringomyelia), shoulder pathologies were excluded.

Anthropometric measurements

Body weight (kg) and height (cm) were measured with bare feet and light clothing, using a calibrated digital scale (Seca 707R, Germany) and a portable stadiometer (Seca 707R, Germany) respectively. When calculating BMI, weight (kg) is divided by the square of height (m). In the definition of BMI, people below 18.5 are underweight, people between 18.5 and 24.9 are normal weight, people between 25-29.9 are overweight and people over 30 are obese [20]. Waist circumference (cm) was measured from the midpoint between the lower rib and the iliac crest, using a non-stretchable tape while standing, to the nearest 0.1 cm. Neck circumference (cm) was measured at the level just below the laryngeal prominence perpendicular to the long axis of the neck, to within 1 mm, using no stretchable plastic tape with the subjects standing upright.

Examinations

Neck pain; evaluated by visual pain score (VAS). No pain was described as 0 and unbearable as 10, and patients were asked to mark the value that best represented their bees on the line. In the study pain score was categorized into 3 groups as 0-4 a little bit, 5-6 more, 7-10 very unbearable. In radiological evaluation, cervical subcutaneous fat tissue thickness was measured from cervical MRI (Magnetic Resonance Imaging) images and cervical disc herniation was observed (Figure 1).

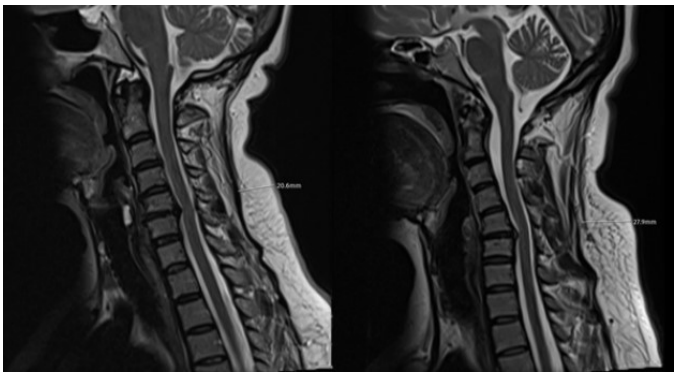

Figure 1. Cervical disc herniation at C5-C6 distance on T2 sagittal section on cervical MRI and demonstration of subcutaneous fat tissue measurement.

Demographic characteristics

The Patient's population information was included in the study by creating a questionnaire administered personally by the physician. Education level was evaluated in 3 groups: secondary school and below, high school and university. Economic situation of patients was questioned; the minimum wage was evaluated as those who earn less than (below minimum wage) or above (above minimum wage). Working status, evaluated as working or not working. Additional other chronic diseases (comorbidity); diabetes mellitus, hypertension, coronary artery disease, chronic lung disease was investigated. For habits, smoking use were questioned.

Statistical analysis

The data was analyzed with the Statistical Package for Social Sciences for Windows (SPSS 22.0) statistical package program. Shapiro Wilk test was used to check the conformity of the data to the normal distribution. Quantitative

data were expressed as median and interquartile range, and qualitative data were expressed as absolute frequency and percentage. Pearson Chi-square test was used for statistical analysis of categorical data. The Kruskall-Wallis test (post hoc Dunn's) was used to compare neck circumference, waist circumference and subcutaneous fat tissue values according to BMI and pain groups, since they did not comply with normal distribution. A value of $p<0.05$ was considered as statistically significant.

Results

Some sociodemographic and anthropometric data of the patients and their relationship with disc herniation are given in Table 1. 100 patients were included in the study. 90 (90%) of the patients were women, and the average age of all patients was 44.18±10.69 (min-max: 18-68) years. Disc herniation was present in 55% of the patients. The average age of individuals with a herniated disc was higher than those without (p=0.003). Eleven of the patients were working, 77% had an income at or below the minimum wage, and 71% had secondary school education or below. When we questioned the patients, it was found that 38% had an additional chronic disease. The BMI value of all patients was calculated as 29.24±4.91 (min-max: 18.83-43.43). Looking at the BMI groups, 43% were obese and 36% were overweight, while only 21% were of normal weight. BMI values of individuals with a herniated disc were found to be higher than those without (respectively, 30.47±4.93, 27.77±4.60, p=0.023) (Table 1).

No significant relationship was detected between herniated disc, gender, income level, employment status, and smoking but the frequency of disc herniation was significantly higher in group with secondary school education and below, in group with an additional disease and those who were obese ($p<0.05$). In terms of pain, all patients in Group 1 had disc herniation, but the frequency of disc herniation in Group 3 patients was higher than Group 2 (Table 1).

There was no significant relationship between the patients' gender, employment and income status, comorbidity, smoking and pain groups. While most of the high school and secondary school graduates defined their pain as very severe with an excruciating pain score of 7-10, university graduates defined their pain as severe, that is, a score of 5-6 ($p<0.05$). The pain score was slightly higher in the obese BMI group, but it could be considered statistically significant (p:0.055) (Table 2).

In terms of BMI groups, neck circumference and waist circumference were lower in patients with normal BMI and higher in slightly overweight and obese patients and there were significantly different, and measurement of subcutaneous adipose tissue was significantly higher in the obese group (Table 3). There was no significant relationship between the patients' neck, waist and subcutaneous fat tissue and pain scores ($p>0.05$). A positive linear correlation was found between the BMI values of the patients, neck circumference, waist circumference and subcutaneous adipose tissue ($p<0.05$ core coefficient 0.676&0.750&0.463, respectively, not shown in the table).

Discussion

No significant relationship was found between patients with and without a herniated disc with gender, employment status, income level, educational status, and smoking (Table 1). The highlight of our study, 90% of the gender was women and most of them were housewives. In this case, we should aim to reduce pain by encouraging housewives to exercise and move.

When old studies are examined, it is reported that the majority of pain originating from various structures of the spine occurs in individuals with chronic pain disorders, and the lifetime prevalence of spine pain varies between 54% and 80% [21]. In our study, disc herniation was present in 55% of the patients. Disc herniation was significantly higher in the group with secondary school education and below, the group with additional chronic diseases, the obese group, and the group with high neck pain scores (Table 1). Whereas, in previous studies; any significant relationship wasn't found between obesity and cervical diseases [22,23]. In a study of 23,048 individuals, compared to normal or underweight individuals, overweight and obese individuals had a 0.218, 0.395 times increased risk of developing back problems and 0.441, 0.528 times higher risks of developing IDD, respectively. However, no significant relationship was found between other cervical disorders and body weight [16]. In a cross-sectional study conducted in China on 2596 people, overweight and obesity significantly increased the likelihood of having lumbar disc herniation, its global severity, and the risk of developing sciatica [24]. A study conducted in adolescents showed that obesity may increase lumbar disc burden and accelerate degeneration [25]. This situation is clarified by the fact that the cervical segment does not need to carry as much body weight as the lower segments, such as the lumbar segments. However, it can be said that obesity can also cause serious postural changes that affect the load on the joints and therefore cause long-term negative effects on bones and joints.

Adipokines secreted from adipose tissue are considered key players of the innate and adaptive immune system and active modulators of the acute and chronic inflammatory response. Low-grade inflammation, which begins with an increase in adipokines with obesity, can accelerate disc degeneration and increase neck pain [26]. Additionally, obesity can cause changes in body biomechanics, which can contribute to neck pain [27]. In our study, the pain score was slightly higher in the obese BMI group, but it could be considered statistically significant (p:0.055) (Table 2). Obesity can also trigger other mechanical-structural changes, including joint misalignment. In one research, significant postural changes were seen in individuals with morbid obesity. In obese people, it can cause serious sagittal balance disorders, especially in the spine, knees, and feet [28]. For clinical practice, it is important to consider obesity in the evaluation of patients with neck pain. Avoiding heavy physical activity and maintaining a stable mood may be an effective approach to preventing neck pain in obese individuals [29].

Neck circumference has been a good alternative method instead of WC measurement. Many studies have proven the relationship between WC and obesity. In this case, neck circumference measurement offers an easy-to-apply and

Table 1. Some sociodemographic data of the patients and their relationship with disc herniation.

Variables		All Patients	Disc herniation				p*
			Yes (n:55)		No (n:45)		
		n	n	%	n	%	
Gender	Female	90	52	57.8	38	42.2	0.094
	Male	10	3	30.0	7	70.0	
Working status	Not working	89	52	58.4	37	41.6	0.061
	Working	11	3	27.3	8	72.7	
Income	Below minimum wage	30	19	63.3	11	36.7	0.501
	Minimum wage	47	25	53.2	22	46.8	
	Above minimum wage	23	11	47.8	12	52.2	
Education	Secondary school and below	71	44	62.0	27	38.0	**0.034**
	High school	19	9	47.4	10	52.6	
	University	10	2	20.0	8	80.0	
Additional disease	Yes	38	28	73.7	10	26.3	**0.003**
	No	62	27	43.5	35	56.5	
Cigarette	Yes	34	22	64.7	12	35.3	0.161
	No	66	33	50.0	33	50.0	
Pain score	Group 1	7	7	100.0	-	-	**0.003**
	Group 2	34	12	35.3	22	64.7	
	Group 3	59	36	61.0	23	39.0	
BMI group	Normal	21	7	33.3	14	66.7	**0.034**
	Slightly fat	36	19	52.8	17	47.2	
	Obese	43	29	67.4	14	32.6	

* chi-square test. BMI: Body mass index.

Table 2. The relationship between BMI groups, gender, working status, income, education, additional disease, cigarette and pain score.

Variables		Pain score						p*
		Group 1		Group 2		Group 3		
		n	%	n	%	n	%	
Gender	Female	6	6.7	28	31.1	56	62.2	0.094
	Male	1	10.0	6	60.0	3	30.0	
Working status	Not working	7	7.9	28	31.5	54	60.7	0.322
	Working	-	-	6	54.5	5	45.5	
Income	Below minimum wage	2	6.7	11	36.7	17	56.7	0.472
	Minimum wage	4	8.5	12	25.5	31	66.0	
	Above minimum wage	1	4.3	11	47.8	11	47.8	
Education	Secondary school and below	5	7.0	21	29.6	45	63.4	**0.035**
	High school	2	10.5	5	26.3	12	63.2	
	University	-	-	8	80.0	2	20.0	
Additional disease	Yes	2	5.3	13	34.2	23	60.5	0.949
	No	5	8.1	21	33.9	36	58.1	
Cigarette	Yes	2	5.9	13	38.2	19	55.9	0.843
	No	5	7.6	21	31.8	40	60.6	
BMI group	Normal	-	-	9	42.9	12	57.1	**0.055**
	Slightly fat	6	16.7	13	36.1	17	47.2	
	Obese overweight	1	2.3	12	27.9	30	69.8	

* chi-square test. BMI: Body mass index.

Table 3. Neck circumference, waist circumference, subcutaneous adipose tissue values were compared with BMI group and pain scores.

BMI and pain groups		Measured values					
		Neck circumference		Waist circumference		Subcutaneous adipose tissue	
		Median	Q1-Q3	Median	Q1-Q3	Median	Q1-Q3
BMI group	Normal	32[a]	30-34	90.0[a]	83-92.5	15.3[a]	13.9-19.4
	Slightly fat	36[b]	34-36	99.0[b]	92-103	19.0$_a$	17-24.2
	Obese	38[c]	35-40	108[c]	104-116	23.9[b]	19.3-27.6
	p*	**<0.001**		**<0.001**		**<0.001**	
Pain score	Group1	39	36-41	104	94-110	25.6	17-27.9
	Group2	35	33-37	101	90-107	19.3	16.1-23.3
	Group3	36	33-38	101	93-111	21.4	17-26.3
	p*	0.098		0.448		0.398	

*Kruskal Wallis test (post hoc Dunn's test), Q1: first quartile, Q3: third quartile, Values with different letters (a-c) are statistically significantly different (p<0.05).

inexpensive evaluation. In a study conducted by Thunyarat et al in 2019 on prediabetic and obese patients, it was shown that NC was significantly associated with WC [22]. In our study a positive correlation was found between the BMI values of the patients, neck circumference, waist circumference and subcutaneous adipose tissue ($p<0.05$ core coefficient 0.676&0.750&0.463, respectively). Subcutaneous fat tissue was found to be significantly higher in the patients examined in the obese group in our study (Table 3).

We showed the relationship between subcutaneous fat tissue thickness, neck circumference measurement and waist circumference measurements measured in cervical MRI with obesity and the presence of cervical disc herniation. One-third of the general population may develop neck pain due to various reasons. Similar examples in the literature have said that body mass index (BMI: 30 kg/m^2) correlates with the development of low back pain [30]. Also, when we search the literature, there are not enough studies in which chronic neck pain and obesity coexist, and neck circumference measurement is also eliminated, with our research, we showed that there was a positive correlation between the BMI values of the patients, neck circumference, waist circumference and subcutaneous adipose tissue. A study examining the effect of a healthy lifestyle behavior consisting of physical activity, alcohol intake, smoking and dietary changes on neck pain found that women with three or four healthy lifestyles had a reducing effect on neck pain, compared to women with none or one (risk ratio 0.52) [31].

We wanted to examine the effects of obesity on the musculoskeletal system as well as on all other systems of the body. And again, our study has shown us that the frequency of disc herniation is significantly higher in those who have an additional disease and are obese. In addition, the obese patient had a slightly higher pain score.

Conclusion

Our study showed that in terms of BMI groups, neck circumference and waist circumference were lower in patients with normal BMI and higher in slightly overweight and obese patients. By detecting obesity with simpler methods such as early and neck stage measurement, we can get rid of its chronic effects by getting help from the necessary experts. It is obvious that increasing exercise and physical activity has a positive effect on this.

Conflict of interest

The authors have no conflict of interest regarding this study.

Financial disclosure

No financial support has been received for this study.

Ethical approval

This study was carried out with the 76397871 numbered and 28.10.2022 dated permission of Kayseri City Hospital approval of the ethics committee.

Author contributions

Detailing the work; Project preparation, data collection, data analysis and statistics, preparing tables, writing scientific papers, Op.Dr. Ş.G. has contributions. Dr.Y.G. and Dr. E. B. contributed to statistical analyses and writing the scientific paper in the project.

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