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Do Comorbidities and Body Mass Index Influence Shoulder Pain, Disability and Joint Range of Motion?

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Abstract

Aim: Shoulder diseases are believed to be associated with metabolic factors including diabetes and obesity. Our research aimed to determine how age-related comorbidities and rising body mass index (BMI) affected shoulder pain, disability, and joint range of motion (ROM).

Methods: The study included 137 individuals aged 20–80 who sought treatment for chronic shoulder pain at the physical medicine and rehabilitation outpatient clinic and, they were recorded for their demographics, BMI, comorbidities, pain duration, dominant shoulder, affected shoulder, history of treatment, joint ROM, visual analogue scale pain score, and shoulder pain and disability index score.

Results: The study found that the obese group had a high mean age (p=0.047) and substantially more common thyroid dysfunction (p=0.031). When individuals with and without diabetes mellitus (DM) were compared, it was observed that the DM group had significantly less ROM. Similarly, ROM was found to be considerably lower in the group with hypertension (HT) when a comparison was made for having or not having HT. In comparison of patients with or without hyperlipidemia (HL), the group with HL had significantly lower BMI compared to the group without HL (p=0.047). Upon comparing the groups with and without thyroid disease, it was discovered that the former had a considerably higher BMI (p=0.012).

Conclusion: We found that the two most prevalent disorders associated with shoulder pain, DM and HT, have a particularly positive influence on joint range of motion. We also observed a connection between thyroid problems and BMI. In the management of shoulder discomfort, managing comorbidities and BMI are crucial.

Keywords: diabetes; hypertension; joint range; obesity; shoulder pain.

Introduction

After knee pathology and spine pathology, shoulder pain stands as the third most prevalent musculoskeletal complaint [1].

Comorbidities of individuals with adhesive shoulder capsulitis had a substantial impact on pain and functioning [2].

According to epidemiological research, having a high body mass index (BMI) puts one at a considerable risk for developing a number of chronic diseases, including metabolic and musculoskeletal disorders [3,4].

Studies suggest that there is a relationship between shoulder disorders and metabolic factors such as obesity [5,6] and diabetes [6].

The release of leptin and other adiponectin from the shoulder joint has been reported in obese patients with shoulder pain, and the pro-inflammatory qualities of adiponectin have been proposed as a possible explanation for the association [7].

Shoulder disorders have been associated with interleukin (IL) -1 [13,14,15] and IL-6 and tumor necrosis factor (TNF) α [8-10].

Obesity promotes C-Reactive protein (CRP) production, mostly through circulating IL-6 levels [11].

There is research in the literature on the effect of obesity on patients undergoing shoulder arthroplasty [12,13], but only few investigations on patients with persistent shoulder pain who did not have surgery.

The research we conducted sought to investigate the effects of increased BMI and comorbidities, which are the problems of our age, on shoulder pain, disability and range of motion (ROM).

Materials and methods

The ethical committee of the local institute approved this study protocol through the institutional review board (date: 24.04.24 Decision no:AESH-BADEK-2024-318). The study also conforms to the principles set forth in the declaration of Helsinki. The study procedure was clarified to those who participated, and their written informed consent was collected in the manner mandated by the local institute's ethical committee.

This cross-sectional study included 137 patients aged 20-80 years who applied to the physical medicine and rehabilitation (PMR) outpatient clinic with chronic shoulder pain (pain duration of more than three months) [14].

History of trauma or surgery on the shoulder, pregnancy, malignancy, rheumatic diseases, cervical radiculopathy, brachial neuritis, complex regional pain syndrome and immunodeficiency were the exclusion criteria.

Demographic characteristics of the patients, BMI (kg/m2), comorbidities (diabetes mellitus (DM), hypertension (HT), hyperlipidemia (HL), thyroid dysfunction, renal disease, valvular heart disease, arrhythmia, coronary heart disease, chronic obstructive pulmonary disease (COPD), asthma), pain duration, dominant shoulder and affected shoulder, previous treatment for shoulder pain, joint ROM, visual analogue scale (VAS) pain score and shoulder pain and disability index (SPADI) score were recorded.

A conventional 10-cm VAS was used to measure pain intensity; 0 represented "no pain," and 10 represented "unbearable pain" [15].

The SPADI, which consists of 5 items to assess pain and 8 items to assess disability, was used to assess the shoulder functional status (pain and disability). Higher scores indicate greater pain and disability. The score runs from 0% to 100% [16].

SPADI comprises a total score as well as subparameters for pain and activity limitation. There are five questions in the pain subparameter about shoulder pain in daily activities, and there are eight questions in the activity limitation subparameter about difficulty carrying out daily tasks. Patients rate their responses on a scale of 0 to 10, and the total of all response scores is divided by the total number of questions in each subparameter to obtain the value of that subparameter. Two subparameter scores are averaged to determine the total SPADI score. A high score denotes worsening shoulder function and more pain [17,18].

BMI was computed as body weight divided by height squared (kg/m2). There are three weight categories for participants: normal (18.5-24.9 kg/m2), overweight (25.0-29.9 kg/m2), and obese (>= 30.0 kg/m2) as defined by the World Health Organization (WHO) [19].

Statistical analysis

The SPSS for Windows 22.0 package was used for data analysis. The Shapiro Wilks test was utilized to determine whether continuous variables demonstrated a normal distribution. For continuous variables, descriptive statistics were shown as mean ± standard deviation; for nominal variables, they were shown as number of observations and (%). Using the Mann Whitney U test, the significance of the difference between the paired groups was examined with regard to all parameters and continuous variables. The Kruskal Wallis or Pearson's Chi-Square tests were used to assess nominal variables. When the Kruskal Wallis test was used, the results were given as median (min-max). When $p<0.05$, the results were deemed significant.

Results

The samples' mean age was 54.44 (SD 10.86). 68.4% were women and 30.8% were men. 16.5% were those who had jobs above shoulder level. 48.1% were primary school graduates. Demographic data are presented in Table 1.

Table 1 Demographic data

Variables		N=137
Age mean (SD)		54.20(10.72)
Gender n (%)	Female	95(69.3)
	Male	42 (30.7)
BMI mean (SD)		29.17 (4.82)
Symptom duration n (%)	3-6 months	57(41.6)
	6-12 months	26(19.0)
	>12 months	54(39.4)
Affected shoulder n (%)	Right	82(59.9)
	Left	55(40.1)
Dominant side n (%)	Right	131(95.6)
	Left	6(4.4)
Education level n(%)	Illiterate	15(10.9)
	Primary school	68(49.6)
	Middle school	7(5.1)
	High school	27(19.7)
	College	3(2.2)
	University	17(12.4)
Occupation n (%)	Heavy work above shoulder level	24 (17.5)
	No heavy work above shoulder level	113 (82.5)
Previous treatment received n (%)	Analgesic/NSAID	137(100)
	Injection	17(12.4)
	PMR	16(11.7)
Comorbidity n (%)	DM	28(20.4)
	HT	24(17.5)
	HL	18(13.1)
	Thyroid function disorder	16(11.7)
	Renal disease	3(2.2)
	Heart valve disease	3(2.2)
	Arrhythmia	1(0.7)
	COPD	1(0.7)
	Asthma	1(0.7)
VAS mean (SD)		6.99(1.6)
SPADI mean (SD)		66.09(16.94)
Abduction mean (SD)		157.66(26.43)
Adduction mean (SD)		35.25(10.27)
Internal rotation mean (SD)		67.62(24.18)
External rotation mean (SD)		71.67(23.05)
Flexion mean (SD)		159.56(24.55)
Extension mean (SD)		36.24(9.88)

BMI: Body mass index; NSAID: Nonsteroidal anti-inflammatory drugs; PMR: Physical medicine and rehabilitation; DM: Diabetes mellitus; HT: Hypertension; HL: Hyperlipidemia; COPD: Chronic obstructive pulmonary disease; VAS: Visual analogue scale; SPADI: Shoulder pain and disability index

The top 3 most common comorbidities were DM, HT and HL. Thyroid dysfunction was in the 4th place.

Patients were grouped according to BMI. They were divided into 3 groups: normal, overweight and obese. It was observed that the mean age of the obese group was high (p = 0.047). It was also seen that thyroid dysfunction was substantially greater in the obese group (p = 0.031). No significant difference was found between groups based on BMI in terms of symptom duration, abduction, adduction, internal rotation, external rotation, flexion and extension, VAS and SPADI (p values were 0.169, 0.581, 0.407, 0.358, 0.322, 0.696, 0.228, 0.832, 0.765 respectively). The results according to BMI are shown in Table 2.

Abduction, adduction, internal rotation, external rotation, flexion, and extension have been shown to be considerably lower in the DM group (p values were 0.000, 0.049, 0.000, 0.001, 0.001, 0.037, respectively) when the groups were split into those with and without DM. (Table 3).

Table 2 Comparison of groups according to BMI

Variables		Normal	Overweight	Obese	p
Age median (min-max)	52.5(28-74)	52.5(24-79)	57(39-75)	0.047#	
Gender n (%)	Female	19(63.3)	33(61.1)	43(81.1)	0.058*
	Male	11(36.7)	21(38.9)	10(18.9)	
Symptom duration n (%)	3-6 months	17 (56.7)	24 (44.4)	16 (30.2)	0.169*
	6-12 months	3(10)	11(20.4)	12(22.6)	
	>12 months	10(33.3)	19(35.2)	25(47.2)	
Affected shoulder n(%)	Right	20(66.7)	36(66.7)	26(49.1)	0.123*
	Left	10(33.3)	18(33.3)	27(50.9)	
Dominant side n(%)	Right	29(96.7)	50(92.6)	52(98.1)	0.359*
	Left	1(3.3)	4(7.4)	1(1.9)	
Education level n(%)	Illiterate	0(0)	5(9.3)	10(18.9)	0.423*
	Primary school	16(53.3)	26(48.1)	26(49.1)	
	Middle school	1(3.3)	3(5.6)	3(5.7)	
	High school	8(26.7)	11(20.4)	8(15.1)	
	College	0(0)	2(3.7)	1(1.9)	
	University	5(16.7)	7(13)	5(9.4)	
Occupation n(%)	Heavy work above shoulder level	8(26.7)	11(20.4)	5(9.4)	0.109*
	No heavy work above shoulder level	22 (73.3)	43 (79.6)	48(90.6)	
Previous treatment received n(%)	Analgesic	6(20)	9(16.7)	10(18.9)	0.920*
	NSAID	8 (26.7)	12 (22.2)	17 (32.1)	0.517*
	Injection	6(20)	7(13)	4(7.5)	0.252*
	PMR	5(16.7)	4(7.4)	7(13.2)	0.407*
Comorbidity n(%)	DM	5(16.7)	8(14.8)	15(28.3)	0.189*
	HT	4(13.3)	11(20.4)	9(17.0)	0.712*
	HL	7(23.3)	8(14.8)	3(5.7)	0.065*
	Thyroid function disorder	2(6.7)	3(5.6)	11(20.8)	0.031*
	Renal disease	0(0)	1(1.9)	2(3.8)	0.517*
	Heart valve disease	0(0)	0(0)	3(5.7)	0.088*
	Arrhythmia	0(0)	0(0)	1(1.9)	0.450*
	COPD	0(0)	0(0)	1(1.9)	0.450*
	Asthma	0(0)	0(0)	1(1.9)	0.450*
VAS median (min-max)		7.5(3-9)	7.5(2-10)	7(3-9)	0.832#
SPADI median (min-max)		69.2(26.9-100)	66.1(30-100)	71.5(37.6-90.7)	0.765#
Abduction median (min-max)		170(90-180)	160(60-180)	170(90-180)	0.581#
Adduction median (min-max)		45(20-45)	40(10-45)	30(10-45)	0.407#
Internal rotation median (min-max)		90(20-90)	70(10-90)	70(10-90)	0.358#
External rotation median (min-max)		90(20-90)	75(20-90)	80(20-90)	0.322#
Flexion median (min-max)		175(90-180)	160(90-180)	170(90-180)	0.696#
Extension median (min-max)		42.5(10-45)	40(10-45)	40(10-45)	0.228#

*:Pearson Chi-kare test #:Kruskal Wallis test

BMI: Body mass index; NSAID: Nonsteroidal anti-inflammatory drugs; PMR: Physical medicine and rehabilitation; DM: Diabetes mellitus; HT: Hypertension; HL: Hyperlipidemia; COPD: Chronic obstructive pulmonary disease; VAS: Visual analogue scale; SPADI: Shoulder pain and disability index

BMI, symptom duration, VAS, and SPADI did not significantly differ between individuals with and without DM (p values were 0.099, 0.186, 0.461, and 0.586, respectively) (Table 3).

The HT group showed considerably less abduction, adduction, flexion, extension, internal rotation, and exterior rotation (p values were 0.049, 0.015, 0.030, 0.011, 0.020,0.012 respectively) (Table 3).

When we compared those with and without HT, no significant difference was found in terms of BMI, symptom duration, VAS and SPADI (p values were 0.700, 0.703, 0.422, 0.251 respectively) (Table 3).

When we grouped them as those with or without HL, BMI was found to be significantly lower in the group with HL than in the group without HL (p =0.047) (Table 4).

No significant difference was found in the groups with and without HL in terms of symptom duration, abduction, adduction, internal rotation, external rotation, flexion and extension, VAS and SPADI (p values were 0.501,0.272,0.732, 0.816, 0.683, 0.668, 0.649, 0.580, 0.105 respectively) (Table 4).

When the groups with and without thyroid dysfunction were compared, BMI was found to be significantly higher in those with thyroid dysfunction (p=0.012) (Table 4).

No significant difference was found in the groups with and without thyroid dysfunction in terms of symptom duration, abduction, adduction, internal rotation, external rotation, flexion and extension, VAS and SPADI. (p values, 0.699, 0.580, 0.997, 0.881, 0.694, 0.576, 0.384, 0.388, 0.320, respectively) (Table 4).

Table 3 Comparison of groups according to DM and HT

Variables	w/ DM	w/o DM	p&	w/ HT	w/o HT	p&
BMI mean (SD)	30.35(4.53)	28.8(4.85)	0.099	29.95(5.19)	29.02(4.73)	0.700
Symptom duration n (%)						
3-6 months	8(28.6)	49(45)	0.186	9(37.5)	48(42.5)	0.703
6-12 months	7(25)	19(17.4)		5(20.8)	21(18.6)	
>12 months	13(46.4)	41(37.6)		10(41.7)	44(38.9)	
VAS mean (SD)	7.21(1.34)	6.9(1.65)	0.461	7.16(1.16)	6.92(1.59)	0.422
SPADI mean (SD)	67.7(15.8)	65.6(17.2)	0.586	69.6(16.8)	65.3(16.9)	0.251
Abduction mean (SD)	143.9(22.1)	161.1(26.3)	0.000	146.6(30.8)	160(24.9)	0.049
Adduction mean (SD)	31.78(10.5)	36.1(10.06)	0.049	30.2(11.3)	36.3(9.75)	0.015
Internal rotation mean (SD)	51.4(25.1)	71.8(22.19)	0.000	56.45(27.6)	70(22.8)	0.030
External rotation mean (SD)	58.75(24.6)	75(21.5)	0.001	60(24.8)	74.1(21.9)	0.011
Flexion mean (SD)	147.5(23.6)	162.6(23.9)	0.001	147.08(30.57)	162.2(22.3)	0.020
Extension mean (SD)	33.03(10.39)	37.06(9.62)	0.037	31.04(10.9)	37.3(9.3)	0.012

& :Mann Whitney u test
BMI: Body mass index; DM: Diabetes mellitus; HT: Hypertension; VAS: Visual analogue scale; SPADI: Shoulder pain and disability index

Table 4 Comparison of groups according to HL and thyroid dysfunction

Variables	w/ HL	w/o HL	p&	w/ TFT dysfunction	w/o TFT dysfunction	p&
BMI mean (SD)	27.4((3.7)	29.4(4.9)	0.047	32.1(5.35)	28.78(4.6)	0.012
Symptom duration n (%)						
3-6 months	6(33.3)	51(42.9)	0.501	7(43.8)	50(41.3)	0.699
6-12 months	4(22.2)	22(18.5)		1(6.3)	25(20.7)	
>12 months	8(44.4)	46(38.7)		8(50)	46(38)	
VAS mean (SD)	6.77(1.69)	7(1.59)	0.580	7.25(1.65)	6.93(1.59	0.388
SPADI mean (SD)	72.4(16.8)	65.1(16.8)	0.105	69.4(18.5)	65.6(16.7)	0.320
Abduction mean (SD)	155(22.8)	158(27)	0.272	161.8(21.36)	157.1(27.06)	0.580
Adduction mean (SD)	36.1(9.16)	35.1(10.4)	0.732	35.3(10.7)	35.2(10.2)	0.997
Internal mean (SD)rotation	66.1(24.9)	67.8(24.1)	0.816	67.5(23.7)	67.6(24.3)	0.881
External rotation mean (SD)	69.1(23.7)	72(23.03)	0.683	75.3(20.7)	71.1(23.3)	0.694
Flexion mean (SD)	161.6(23.070	159.2(24.8)	0.668	163.12(21.8)	159(24.9)	0.576
Extension mean (SD)	36.9(9.8)	159.2(24.8)	0.649	34.6(9.56)	36.4(9.9)	0.384

& :Mann Whitney u test
BMI: Body mass index; HL: Hyperlipidemia; TFT: Thyroid function tests; VAS: Visual analogue scale; SPADI: Shoulder pain and disability index

Discussion

We revealed that DM and HT, which are the two most common diseases accompanying shoulder pain, are especially effective on joint range of motion.

We found that the average age of our patients with chronic shoulder pain was 54.2 years. In one study, the median age of the patient group who received tipped shoulder injection for chronic shoulder pain was found to be 57. Again, in the same study, the number of women was found to be higher, as in ours. It seems that right shoulder involvement is more common, which is in line with our study [20].

In a study where HILT (high intensity laser therapy) was applied for chronic shoulder pain, unlike ours, the male rate was found to be higher. In the same study, the average BMI was found to be 24.55 and this value is within normal limits. In our study, we determined that the average BMI was above the ideal weight [21].

In the study by Cuce et al., BMI was determined as 29.3 in patients diagnosed with rotator cuff tear and they found the most common comorbidity to be HT. These results are similar to ours in terms of BMI, but we found the most common comorbidity to be DM [22].

In a study, they found that the most common disease accompanying chronic shoulder pain was HT. DM ranked 2nd. In our study, DM was ranked first, and HT was ranked second. In the same study, it was determined that a total of 37.8% had received physical therapy before and 8.5% had a history of surgery. We found that 10.9% of them received PMR and 12.9% had a history of injection. We accepted those with a surgical history as an exclusion criterion [23].

A statistically significant relationship was observed in one study between the increase in BMI and the pain intensity, SPADI scores and erythrocyte sedimentation rate (ESR) values. A statistically significant difference was observed between the obese group and the other groups, despite the fact that there was no statistically significant difference in any of the measures between the normal weight and overweight groups [24].

ESR and CRP values of our patients were within normal limits, but they were not evaluated as numerical values.

Weight-related variables, especially abdominal obesity, were linked to shoulder pain in either gender, according to research by Rechardt et al. Additionally, it has been demonstrated that persistent rotator cuff tendinitis is connected to abdominal obesity [14].

In type 1 diabetes, metabolic byproducts of non-enzymatic glycation accumulate in tendons [25].

Men's rotator cuff tendinitis and type 1 diabetes have been linked [14].

Men with type 2 diabetes were also shown to have a higher prevalence of rotator cuff tendinitis [14].

Buyuksireci et al. demonstrated in their study that being female and over 50 years old and having HbA1c levels between 5.7 and 6.4 increased the development of tendinosis susceptibility [26].

DM was shown to be the most common comorbid disease overall, despite the fact that our research was conducted without respect to gender.

In the study by Reid et al., in which they evaluated before and after arthroplasty, preoperative and postoperative pain was found to be worse in obese patients, but the magnitude of the change in pain scores after anatomical or reverse total shoulder arthroplasty was found to be similar to that in non-obese patients [27].

One study found no association of BMI with nonspecific shoulder pain [28].

Gandhi et al. examined levels of leptin, adiponectin, and resisting in synovial fluid (SF) samples. It was discovered that higher levels of SF leptin and adiponectin were correlated with greater pain. Functional outcome scores were not correlated with adipokine levels [7].

In the study evaluating shoulder arthroplasty patients, preoperative functional scores and quality of life of morbidly obese patients were found to be worse compared to other groups [29].

A correlation has been found between impaired shoulder function, obesity and high cholesterol [30].

We did not find a relationship between ROM, VAS, SPADI and HL or obesity.

Both preoperative and postoperative BMI have been reported to be inversely related to internal rotation in shoulder arthroplasty patients [31].

In individuals with breast cancer, lymphedema, postoperative immobility, and obesity have been shown to contribute to the development of adhesive capsulitis [32].

We did not detect any difference between groups based on BMI in terms of ROM.

One study suggested that thyroid autoimmunity in Hashimoto's disease may lead to an increase in thickness of shoulder tendons [33].

No significant difference was found in the groups with and without thyroid dysfunction in terms of symptom duration, ROM, VAS and SPADI in our study.

Conclusion

We found that DM and HT, which are the two most common diseases accompanying shoulder pain, are especially effective on joint range of motion. In addition, the group with obesity had a considerably greater mean age and thyroid dysfunction than the other groups. We conclude that weight control and treatment of comorbidities are important in patients experiencing pain in the shoulders. The significance of lifestyle and metabolic variables in shoulder disorders requires prospective investigations.

Pros and cons of research: The fact that this research examined a small number of patients cross-sectionally may be considered a limitation, but we strongly believe it is important in terms of drawing attention to the problem of our age, obesity and comorbidities, through shoulder pain.

Author Contributions: This research was conducted by Yasemin Tombak hence, conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, critical revising and final approval were all carried out by the same author. The author has read and agreed to the published version of the manuscript.

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Statement of Ethics: The research was approved by the ethics committee of the local institute, Ankara Etlik City Hospital, Ankara, Turkey (date: 24.04.24 Decision no:AESH-BADEK-2024-318) and was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: The procedure of the study was explained to the participants and their written consent was obtained in the format required by the ethics committee of the aforementioned local institute.

Data Availability Statement: The author confirms that the data supporting the findings of this study are available within the article. The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

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