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Scapular Muscles Strength of Different Age Groups in the Indian Population

Shivani Bisht[1], Sharmila Chaudhuri[2], M. Thangaraj[3], Shubhralata[4], Tamanna[5]

[1]MPT, Department of Physiotherapy, I.T.S Institute of Health and Allied Sciences, Ghaziabad, Uttar Pradesh, India.
[2]Associate professor, Department of Physiotherapy, School of Allied Health Sciences, Galgotias University, Greater Noida, Uttar Pradesh, India.
[3]Head of department (HOD), Department of Physiotherapy, I.T.S Institute of Health and Allied Sciences, Ghaziabad, Uttar Pradesh, India.
[4,5]MPT 1st semester, Department of Physiotherapy, I.T.S Institute of Health and Allied Sciences, Ghaziabad, Uttar Pradesh, India.

Corresponding Author: Sharmila Chaudhuri

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ABSTRACT

Background: Poor scapular muscular strength and scapular dyskinesis are the causes of scapular discomfort.
Objective: The aim of this study was to assess the normative values of isometric scapular muscle strength and examine the impact of body mass index (BMI), age, weight, height, and gender on scapular strength.
Method and Materials: A portable dynamometer was used to test the isometric scapular muscular strength of the adult volunteers. A multivariate analysis was conducted to examine the impact of age, weight, height, gender, and BMI on scapular muscular strength, and normative strength values were determined.
Results: For both genders, normative ranges were discovered, which would serve as a guide in the risk assessments of muscle weakness and strength. Compared to females, men are less likely to experience strength and weakness. Scapular muscular strength was favorably correlated with both age and weight. Muscle strength is not influenced by height or BMI.
Conclusions: This study will offer the basic framework for the normative ranges of scapular muscle strength in the adult population, assisting in the prevention, maintenance, and treatment of scapular muscle weakness. The clinician will be able to compare the muscle strength of various age groups using this standard.

Keywords: Scapular pain, muscle strength, scapular dyskinesis, isometric strength, normative ranges, handheld dynamometer.

INTRODUCTION

Scapular pain is a complicated significant musculoskeletal disorder that impairs a person's daily activities and general health. Around the world, 61% of people suffer from this illness.[1] It is the second known health problem among adults, and the prevalence of it is steadily rising these days. It is primarily brought on by scapular dyskinesis (SD), weak scapular muscle strength, acute discomfort, chronic musculoskeletal conditions, and poor posture.[2,3] In addition to supporting the neck and shoulder biomechanically and physiologically, scapular musculature has a special role in stabilizing and regulating scapular function.

These muscles are responsible for a variety of scapular movements and are linked to the biomechanical, morphological, and physiological functions of the neck, scapular, and shoulder.[4,5] Shoulder pain, scapular pain, neck pain, impaired physical performance, loss of muscle mass, and a decline in regenerative qualities are among the musculoskeletal and physiological diseases that are more likely to occur when scapular muscular strength is diminished or activated abnormally. In order to treat SD, lower the risk of discomfort, correct posture, and treat other musculoskeletal disorders, it is beneficial to strengthen these muscles.[2-6] The biomechanical, morphological, and physiological functions of the scapular, neck, and shoulder depend on the strength of the scapular muscles.[7] In order to assess progress, design exercise regimens, assess pain risk, treat musculoskeletal disorders, and compare muscular strength across age and gender groups, strength is a crucial factor in rehabilitation.[8] Previous studies have demonstrated normative values for scapular muscular strength, but they were limited to particular age groups and sample sizes.[9,10] A small number of them have not demonstrated how weight and BMI, two significant factors that may influence muscle strength, affect it.[11] The testing location and procedures can have an impact on variations in strength values. disparity in strength.

Few studies have measured the strength of a small number of muscles and restricted anatomical scapular movements.[8,11,12] Using a handheld dynamometer (HHD), an expensive device (Figure 1) that gives the clinician a basis to evaluate muscle force generation (as a measure of strength), many authors have tabulated scapular muscle strength ranges. This has demonstrated that HDD is a valid and reliable tool for measuring scapular muscle strength.[9,10,12,13]

(Figure 1: Handheld dynamometer HHD)

Purpose of the study

The purpose of this study was to determine the normative values of isometric scapular muscle strength in the adult population (across various age decades) using HHD.

Aims and objectives of study

1. To provide the fundamental framework for the normative ranges of scapular muscle strength in the adult population, which is necessary to prevent, maintain, and cure scapular muscular weakness.
2. It will provide a baseline against which the physician can compare the muscle strength of different age groups. Future research efforts and theoretical and clinical investigations will be able to refer to this research.
3. To examine the effects of age, weight, gender, and BMI on scapular muscle strength.

Significance of the study

The economic burden of scapular pain is remarkable and includes treatment costs,

reduced productivity and problems in activities of daily living. Prolonged duration of scapular pain affects the scapular region and hence causes scapular dyskinesia and chronic scapular pain. They lead to poor body posture as a result of which the scapular and upper thoracic spine lose their naturally occurring curvatures. Excessive upper thoracic and scapular postural imbalance causes weak muscle strength, disability and functional limitations.

With the help of this study, we will be able to know the normal reference ranges of scapular muscle strength that will help to diagnose, prevent and cure various musculoskeletal conditions associated with the scapula.

METHODS AND MATERIALS

In this observational research study, a total of 1,200 subjects were collected from September 23, 2023, to February 24,2024 through camps which were conducted at the Physiotherapy Department of the I.T.S. Institute of Health and Allied Sciences, Ghaziabad. The approval ID number approved by the local ethical committee, I.T.S. Institute of Health and Allied Sciences, Ghaziabad, India was IIEC/2021-2023/PHYSIO/031. Inclusion criteria gender, age, and pain-free scapula region were followed for the subject's selection.[4,7–10,12,13] And exclusion criteria related to disc pathology, pregnancy, cancer, spinal and cervical surgery, Pott's spine, any scapula pathology, inflammatory and rheumatoid conditions, muscular and connective tissue disorders was considered.[7, 9,10,13,14,15] The subject were explained about the testing postures, duration to complete the procedure (30 minutes), and procedures to ensure a smooth completion of this study. Age groups (as 21–30, 31–40, and 41–50 years old) were used to categorize the subjects, and each one completed an informed consent form before the procedure began.[13–15] Weight and height was measured with the help of a weighing machine and a stadiometer. Additionally the anthropometric parameters were recorded which included the name, age, gender, dominant hand, occupation, phone number, residence, history of pain, difficulty with activities of daily living, medical and surgical history. Two non-elastic straps were used to keep the subjects stable and to prevent any compensating movements by their other body parts while they were positioned on the treatment table and performing the test.[13-16] A calibrated Micro FET HDD device was used to measure the maximum isometric contraction of the scapular muscles (rhomboids, serratus anterior, middle trapezius, and lower trapezius) in various directions.[5,17–21]

The mean of the three consecutive values was used to determine the subject's scapular muscular isometric strength, which was then used for normative data and analysis. A few studies that show the effects of normalizing muscle strength using anthropometric parameters have found that body weight was an effective parameter for muscle strength.[17,22,23] Comparisons of muscle strength within and between genders were normalized to kilogrammes of body weight (Newton of force/kg of body weight) and further the relationship between scapular muscle strength and BMI, weight, age, height, and gender was analysed.

Position used to measure the strength of each scapular muscle:

Upper Trapezius: The subject was seated in a chair with the testing shoulder girdle in the middle of the elevation range, both hands resting on the thighs and upright spine. The subject was instructed to perform a shoulder shrug superiorly for three seconds while maintaining an elbow extension against resistance (Figure 2). The therapist stood at the testing side, placed the HDD on the acromion process, and applied force directed inferiorly.[7,9–13,15,21,24,25]

(Figure 2: Testing position for upper trapezius muscle)

Middle Trapezius: The subject was positioned prone on the examination table, with the humerus laterally rotated and the testing shoulder abducted to a 90° angle. The patient's face was turned to the opposite side. To stop any compensating body movement, a Velcro strap was fastened to the trunk and elbow of the non-testing arm. Placing HHD on the scapular spine, the therapist stands on the same side as the subject's testing arm. This distance represents around two-thirds of the distance between the posterolateral angle of the acromion process and the root of the spine. The subject was instructed to apply an isometric force against the HDD for three seconds while the therapist maintained the contralateral hip and provided anterolateral force in line with the humerus (Figure 3).[6,7–13,15,21–24,25]

(Figure 3: Testing position for middle trapezius muscle)

Lower Trapezius: The subject was lying prone on the examination table, with the non-testing arm to the side and the face turned to the opposite side, and the testing arm between 120° and 140° of flexion with the thumb up. To stop any compensating body movement, a Velcro strap was fastened to the trunk and elbow of the non-testing arm. The subject was asked to perform an isometric force against HDD for three seconds (Figure 4) while the therapist stood at the same side of the testing arm of the subject, placing HHD on the posterolateral corner of the acromion process with one hand and stabilising the contralateral hip at the same time with the other hand.[6,7,9-13,15,21,24,25]

(Figure 4: Testing position for lower trapezius muscle)

Rhomboids muscle: The subject was in a prone position, laying on the examination table with his face turned to the other side and the testing hand on the small of his back and the non-testing arm on the side. To stop any compensating body movement, a Velcro strap was fastened to the trunk and elbow of the non-testing arm. The subject was asked to perform an isometric force against the HDD for three seconds (Figure 5) while the therapist stood at the testing side, placing the HDD over the humerus halfway between the lateral epicondyle and the acromion process with one hand and stabilising the contralateral scapula with the other.[11–13,21,25]

(Figure 5: Testing position for rhomboids muscle)

Serratus anterior: The patient was lying supine on the examination table, with the non-testing arm at the side and the testing arm in a 90° forward flexion with the palm facing the ceiling. To stop any compensating body movement, a Velcro strap was fastened to the trunk and elbow of the non-testing arm. The subject is asked to perform an isometric force against the HDD by protecting movement with extended elbow (Figure 6). The therapist stands at the testing side and places the HDD on the subject's palm of hand. The therapist then applies force towards the table.[8,9,11,13,15,20-22,24]

(Figure 6: Testing position for serratus anterior muscle)

STATISTICAL ANALYSIS

SPSS software was used to analyze the results along with the 95% confidence interval (CI) system which was further used to determine the mean and standard deviation (SD) for the anthropometric parameters. The strength normalization method was then applied to each muscle group, considering age (21–30, 31–40, 41–50 years), gender, BMI, height, and weight and hence categorizes strength by body weight (N/kg). The relationship between age, gender, BMI, height, weight, and muscle strength was evaluated by Pearson's correlation method whereas comparison of muscle strength between age groups and genders was determined by using the t test.

RESULT

The mean and SD of the subject's demographic along with the normalized muscle strength stratified by age (Table 1), BMI (Table 2), height (Table 3), weight (Table 4) for both genders. Each table shows as the age increases the scapular muscle strength decreases in both genders. But males (M) always have higher strength than females (F) in each age decade. Furthermore, Table 5 demonstrates the correlation between the all parameters and hence proved that there is a significant correlation between

muscle strength, age, gender and weight, which implies that as weight and age increases so the muscle strength changes And poor correlation between BMI, height and scapular muscle strength which shows there is no impact of BMI and height on strength.

Table 1. Mean and SD for Normalized muscle strength (N/kg) and demographic data based onage groups along with gender

		Overall Sample				**21-30 years**		**31-40 years**		**41-50 years**		
		Total n=1200	F (n=600)	M (n=600)	p value	F (n=200)	M (n=200)	F (n=200)	M (n=200)	F (n=200)	M (n=200)	p value
Age	Mean	35.55	35.68	35.41	0.58	25.85	25.25	35.91	35.79	45.29	45.21	<0.001
	SD	8.55	8.45	8.65		2.95	2.74	2.80	2.90	2.86	3.00	
Height (cm)	Mean	163.60	157.76	169.44	<0.001	157.35	169.15	157.90	170.04	158.03	169.11	0.49
	SD	8.64	6.46	6.28		5.82	6.86	7.55	5.80	5.89	6.12	
Weight (kg)	Mean	71.52	70.75	72.30	<0.001	68.47	71.44	71.15	73.42	72.63	72.03	<0.001
	SD	6.35	6.85	5.71		7.27	5.09	6.63	6.34	5.93	5.46	
BMI	Mean	26.86	28.49	25.23	<0.001	27.68	25.03	28.66	25.44	29.13	25.21	<0.001
	SD	3.04	2.95	2.10		2.87	2.03	3.26	2.40	2.49	1.83	
RUT	Mean	1.58	1.54	1.62	<0.001	1.88	1.92	1.53	1.61	1.20	1.34	<0.001
	SD	0.30	0.32	0.27		0.20	0.14	0.15	0.14	0.10	0.10	
LUT	Mean	1.53	1.48	1.58	<0.001	1.82	1.87	1.47	1.56	1.15	1.30	<0.001
	SD	0.29	0.31	0.26		0.19	0.14	0.14	0.13	0.10	0.10	
RMT	Mean	1.15	1.10	1.20	<0.001	1.29	1.35	1.09	1.19	0.91	1.06	<0.001
	SD	0.18	0.19	0.15		0.14	0.10	0.10	0.10	0.08	0.08	
LMT	Mean	1.12	1.06	1.17	<0.001	1.23	1.31	1.06	1.15	0.91	1.05	<0.001
	SD	0.17	0.17	0.14		0.13	0.09	0.11	0.10	0.08	0.08	
RLT	Mean	1.01	0.96	1.06	<0.001	1.14	1.22	0.93	1.05	0.79	0.92	<0.001
	SD	0.17	0.17	0.15		0.12	0.09	0.09	0.09	0.07	0.07	
LLT	Mean	0.98	0.93	1.03	<0.001	1.09	1.18	0.93	1.01	0.78	0.91	<0.001
	SD	0.16	0.16	0.14		0.12	0.09	0.09	0.09	0.07	0.07	
RS	Mean	1.73	1.67	1.79	<0.001	2.02	2.13	1.66	1.75	1.33	1.49	<0.001
	SD	0.32	0.33	0.30		0.22	0.18	0.16	0.15	0.12	0.11	
LS	Mean	1.69	1.63	1.74	<0.001	1.98	2.08	1.61	1.70	1.31	1.45	<0.001
	SD	0.31	0.32	0.30		0.21	0.17	0.15	0.15	0.11	0.11	
RR	Mean	1.15	1.09	1.21	<0.001	1.28	1.36	1.07	1.19	0.91	1.06	<0.001
	SD	0.18	0.19	0.16		0.14	0.10	0.11	0.10	0.08	0.08	
LR	Mean	1.12	1.07	1.16	<0.001	1.24	1.32	1.07	1.14	0.91	1.04	<0.001

RUT-right upper trapezius, LUT-left upper trapezius, RMT-right middle trapezius, LMT-left middle trapezius, RLT-right lower trapezius, LLT-left lower trapezius, RS-right serratus anterior, LS-left serratus anterior, RR-right rhomboids, LR-left rhomboids, SD-standard deviation. P values show the strength comparison between both male and female. *Statistically significant difference p<0.001

Table 2. Mean and SD for Normalized muscle strength (N/kg) and demographic data based on BMI along with gender

		Overall Sample				**15-20 kg/m^2**	**20-25 kg/m^2**		**25-30 kg/m^2**		**30-35 kg/m^2**		
		Total n=1200	**F (n=600)**	**M (n=600)**	**p value**	**M (n=1)**	**F (n=77)**	**M (n=300)**	**F (n=346)**	**M (n=283)**	**F (n=177)**	**M (n=16)**	**p value**
Age	Mean	35.55	35.68	35.41	0.58	31.00	32.81	35.27	35.25	35.67	37.79	33.75	<0.005
	SD	8.55	8.45	8.65			8.03	8.89	8.39	8.59	8.29	4.43	
Height (cm)	Mean	163.60	157.76	169.44	<0.001	179.80	162.72	171.88	158.38	167.16	154.38	163.31	<0.001
	SD	8.64	6.46	6.28			6.52	5.37	6.29	6.14	4.84	5.22	
Weight (kg)	Mean	71.52	70.75	72.30	<0.001	61.35	63.26	69.69	69.62	74.54	76.21	82.10	<0.001
	SD	6.35	6.85	5.71			5.06	4.47	5.82	5.35	4.98	4.69	
BMI	Mean	26.84	28.46	25.23	<0.001	18.98	23.86	23.59	27.74	26.67	31.87	30.77	<0.001
	SD	2.98	2.85	2.10			0.79	1.00	1.37	1.21	1.35	0.64	
RUT	Mean	1.58	1.54	1.62	<0.001	1.89	1.82	1.69	1.56	1.57	1.36	1.48	<0.001
	SD	0.30	0.32	0.27			0.33	0.26	0.30	0.26	0.23	0.20	
LUT	Mean	1.53	1.48	1.58	<0.001	1.86	1.75	1.64	1.51	1.52	1.31	1.44	<0.001
	SD	0.29	0.31	0.26			0.33	0.26	0.29	0.25	0.23	0.19	
RMT	Mean	1.15	1.10	1.20	<0.001	1.41	1.28	1.24	1.11	1.16	0.98	1.08	<0.001
												0.12	
LMT	Mean	1.12	1.06	1.17	<0.001	1.37	1.23	1.21	1.08	1.13	0.96	1.05	<0.001
	SD	0.17	0.17	0.14			0.18	0.13	0.15	0.14	0.12	0.11	
RLT	Mean	1.01	0.96	1.06	<0.001	1.22	1.12	1.10	0.97	1.02	0.86	0.96	<0.001
	SD	0.17	0.17	0.15			0.19	0.15	0.16	0.14	0.12	0.11	
LLT	Mean	0.98	0.93	1.03	<0.001	1.23	1.09	1.07	0.95	1.00	0.84	0.93	<0.001
	SD	0.16	0.16	0.14			0.16	0.13	0.15	0.13	0.11	0.11	
RS	Mean	1.73	1.67	1.79	<0.001	2.10	1.97	1.86	1.70	1.73	1.48	1.62	<0.001
	SD	0.32	0.33	0.30			0.35	0.30	0.31	0.29	0.24	0.23	
LS	Mean	1.69	1.63	1.74	<0.001	2.07	1.91	1.81	1.66	1.68	1.45	1.58	<0.001
	SD	0.31	0.32	0.30			0.33	0.30	0.30	0.29	0.23	0.23	
RR	Mean	1.15	1.09	1.21	<0.001	1.42	1.27	1.25	1.11	1.17	0.97	1.09	<0.001
	SD	0.18	0.19	0.16			0.20	0.15	0.17	0.15	0.13	0.12	
LR	Mean	1.12	1.07	1.16	<0.001	1.38	1.24	1.21	1.09	1.12	0.96	1.04	<0.001
	SD	0.17	0.17	0.15			0.18	0.14	0.16	0.14	0.12	0.11	

RUT-right upper trapezius, LUT-left upper trapezius, RMT-right middle trapezius, LMT-left middle trapezius, RLT-right lower trapezius, LLT-left lower trapezius, RS-right serratus anterior, LS-left serratus anterior, RR-right rhomboids, LR-left rhomboids, SD-standard deviation. P values show the strength comparison between both male and female. *Statistically significant difference p<0.001

Table 3. Mean and SD for Normalized muscle strength (N/kg) and demographic data based on height along with gender

		Overall Sample				**140 - 150 cm**	**150-160 cm**		**160-170 cm**		**170-180 cm**		**180 - 190 cm**	
		Total (n=1200)	**F (n=600)**	**M (n=600)**	**p value**	**F (n=72)**	**F (n=327)**	**M (n=46)**	**F (n=174)**	**M (n=285)**	**F (n=27)**	**M (n=245)**	**M (n=24)**	**p value**
Age	Mean	35.55	35.68	35.41	0.58	34.85	35.81	34.98	35.38	35.76	38.30	35.39	32.25	0.37
	SD	8.55	8.45	8.65		7.14	8.99	9.06	7.99	8.78	7.54	8.42	8.54	
Height (cm)	Mean	163.60	157.76	169.44	0.00	147.71	155.59	156.66	163.61	166.52	173.06	174.01	181.83	<0.001
	SD	8.64	6.46	6.28		2.31	2.62	2.48	2.60	2.67	2.46	3.20	1.86	
Weight (kg)	Mean	71.52	70.75	72.30	0.00	66.42	70.31	67.95	72.55	70.51	76.01	74.63	78.09	<0.001
	SD	6.35	6.85	5.71		7.71	6.31	4.51	6.44	5.02	6.12	5.28	5.64	
BMI	Mean	26.86	28.49	25.23	0.00	30.46	29.05	27.71	27.11	25.44	25.39	24.67	23.63	<0.001
	SD	3.04	2.95	2.10		3.63	2.57	2.05	2.45	1.93	2.13	1.92	1.79	
RUT	Mean	1.58	1.54	1.62	0.00	1.68	1.53	1.74	1.51	1.65	1.36	1.57	1.61	0.009
	SD	0.30	0.32	0.27		0.34	0.32	0.30	0.30	0.27	0.20	0.25	0.25	
LUT	Mean	1.53	1.48	1.58	0.00	1.62	1.48	1.69	1.45	1.60	1.30	1.53	1.57	0.014
	SD	0.29	0.31	0.26		0.33	0.31	0.29	0.29	0.27	0.20	0.25	0.25	
RMT	Mean	1.15	1.10	1.20	0.00	1.19	1.10	1.29	1.08	1.22	0.98	1.16	1.17	<0.001
	SD	0.18	0.19	0.15		0.21	0.19	0.16	0.18	0.15	0.12	0.14	0.14	
LMT	Mean	1.12	1.06	1.17	0.00	1.16	1.07	1.24	1.04	1.19	0.96	1.13	1.13	<0.001
	SD	0.17	0.17	0.14		0.19	0.17	0.16	0.16	0.14	0.10	0.13	0.13	
RLT	Mean	1.01	0.96	1.06	0.00	1.04	0.96	1.13	0.94	1.08	0.85	1.03	1.04	<0.001
	SD	0.17	0.17	0.15		0.19	0.17	0.17	0.16	0.15	0.10	0.14	0.14	
LLT	Mean	0.98	0.93	1.03	0.00	1.02	0.94	1.11	0.91	1.05	0.85	1.00	1.00	<0.001
	SD	0.16	0.16	0.14		0.17	0.16	0.15	0.15	0.14	0.11	0.13	0.13	
RS	Mean	1.73	1.67	1.79	0.00	1.82	1.67	1.93	1.64	1.82	1.48	1.74	1.77	0.018
	SD	0.32	0.33	0.30		0.36	0.33	0.33	0.31	0.30	0.21	0.28	0.29	
LS	Mean	1.69	1.63	1.74	0.00	1.78	1.63	1.88	1.59	1.77	1.45	1.69	1.73	0.025
	SD	0.31	0.32	0.30		0.34	0.32	0.33	0.30	0.30	0.20	0.28	0.28	
RR	Mean	1.15	1.09	1.21	0.00	1.18	1.09	1.30	1.06	1.23	0.97	1.17	1.17	<0.005
	SD	0.18	0.19	0.16		0.21	0.19	0.16	0.18	0.15	0.11	0.14	0.14	
LR	Mean	1.12	1.07	1.16	0.00	1.16	1.07	1.25	1.05	1.19	0.96	1.13	1.12	<0.005
	SD	0.17	0.17	0.15		0.19	0.17	0.16	0.16	0.15	0.11	0.14	0.14	

RUT-right upper trapezius, LUT-left upper trapezius, RMT-right middle trapezius, LMT-left middle trapezius, RLT-right lower trapezius, LLT-left lower trapezius, RS-right serratus anterior, LS-left serratus anterior, RR-right rhomboids, LR-left rhomboids, SD-standard deviation. P values show the strength comparison between both male and female. *Statistically significant difference p<0.001

Table 4. Mean and SD for Normalized muscle strength (N/kg) and demographic data based on weight along with gender

		Overall Sample				**50-60 kg**		**60-70 kg**		**70-80 kg**		**80-90 kg**		
		Total (n=1200)	**F (n=600)**	**M (n=600)**	**p value**	**F (n=35)**	**M (n=2)**	**F (n=237)**	**M (n=255)**	**F (n=278)**	**M (n=284)**	**F (n=50)**	**M (n=59)**	**p value**
Age	Mean	35.55	35.68	35.41	0.58	29.63	31.50	34.09	35.35	37.72	35.05	36.16	37.53	<0.001
	SD	8.55	8.45	8.65		7.54	10.61	8.36	9.07	8.08	8.64	8.07	6.47	
Height (cm)	Mean	163.60	157.76	169.44	<0.001	153.36	161.30	156.23	167.12	158.94	170.75	161.52	173.38	<0.001
	SD	8.64	6.46	6.28		5.12	5.80	6.25	5.95	6.00	5.96	7.33	5.28	
Weight (kg)	Mean	71.52	70.75	72.30	<0.001	57.55	56.80	65.58	67.17	74.64	74.73	82.87	83.29	<0.001
	SD	6.35	6.85	5.71		2.22	1.91	2.61	2.10	2.73	2.70	2.16	2.40	
BMI	Mean	26.86	28.49	25.23	<0.001	24.53	21.85	26.97	24.13	29.66	25.71	31.95	27.78	<0.001
	SD	3.04	2.95	2.10		1.64	0.84	2.14	1.72	2.36	1.80	2.95	1.82	
RUT	Mean	1.58	1.54	1.62	<0.001	2.10	2.24	1.68	1.74	1.38	1.57	1.29	1.36	<0.001
	SD	0.30	0.32	0.27		0.25	0.31	0.26	0.27	0.23	0.22	0.20	0.16	
LUT	Mean	1.53	1.48	1.58	<0.001	2.02	2.19	1.62	1.69	1.33	1.52	1.24	1.32	<0.001
	SD	0.29	0.31	0.26		0.25	0.33	0.26	0.26	0.22	0.22	0.20	0.15	
RMT	Mean	1.15	1.10	1.20	<0.001	1.46	1.61	1.20	1.29	1.00	1.16	0.92	1.02	<0.001
	SD	0.18	0.19	0.15		0.15	0.17	0.15	0.14	0.13	0.12	0.11	0.08	
LMT	Mean	1.12	1.06	1.17	<0.001	1.39	1.60	1.16	1.25	0.98	1.13	0.90	0.99	<0.001
	SD	0.17	0.17	0.14		0.13	0.09	0.12	0.13	0.11	0.11	0.09	0.08	
RLT	Mean	1.01	0.96	1.06	<0.001	1.29	1.44	1.04	1.14	0.87	1.03	0.81	0.89	<0.001
	SD	0.17	0.17	0.15		0.14	0.15	0.14	0.14	0.11	0.12	0.10	0.08	
LLT	Mean	0.98	0.93	1.03	<0.001	1.24	1.40	1.02	1.11	0.85	1.00	0.78	0.87	<0.001
	SD	0.16	0.16	0.14		0.13	0.15	0.12	0.13	0.11	0.10	0.08	0.08	
RS	Mean	1.73	1.67	1.79	<0.001	2.27	2.41	1.83	1.93	1.51	1.73	1.40	1.49	<0.001
	SD	0.32	0.33	0.30		0.27	0.32	0.26	0.30	0.23	0.25	0.20	0.16	
LS	Mean	1.69	1.63	1.74	<0.001	2.20	2.33	1.79	1.88	1.47	1.68	1.37	1.45	<0.001
	SD	0.31	0.32	0.30		0.24	0.29	0.26	0.30	0.23	0.25	0.19	0.16	
RR	Mean	1.15	1.09	1.21	<0.001	1.46	1.64	1.19	1.29	0.99	1.16	0.92	1.03	<0.001
	SD	0.18	0.19	0.16		0.15	0.20	0.14	0.14	0.12	0.12	0.11	0.09	

LR	Mean	1.12	1.07	1.16	<0.001	1.40	1.56	1.17	1.25	0.98	1.12	0.90	0.98	<0.001
	SD	0.17	0.17	0.15		0.13	0.22	0.13	0.13	0.11	0.11	0.09	0.08	

RUT-right upper trapezius, LUT-left upper trapezius, RMT-right middle trapezius, LMT-left middle trapezius, RLT-right lower trapezius, LLT-left lower trapezius, RS-right serratus anterior, LS-left serratus anterior, RR-right rhomboids, LR-left rhomboids, SD-standard deviation. P values show the strength comparison between both male and female. *Statistically significant difference p<0.001

Table 5. Correlation between variables and the normalized muscle strength for both genders

		RUT	LUT	RMT	LMT	RLT	LLT	RS	LS	RR	LR
Male	Age	-0.84	-0.84	-0.75	-0.72	-0.78	-0.76	-0.82	-0.83	-0.76	-0.73
	BMI	-0.29	-0.29	-0.37	-0.4	-0.34	-0.36	-0.31	-0.3	-0.35	-0.38
	Height(cm)	-0.18	-0.17	-0.23	-0.23	-0.2	-0.23	-0.17	-0.17	-0.24	-0.23
	Weight(kg)	-0.46	-0.46	-0.59	-0.62	-0.53	-0.58	-0.48	-0.46	-0.59	-0.61
Female	Age	-0.85	-0.85	-0.79	-0.75	-0.8	-0.78	-0.83	-0.83	-0.78	-0.76
	BMI	-0.48	-0.48	-0.53	-0.54	-0.5	-0.53	-0.49	-0.49	-0.52	-0.54
	Height(cm)	-0.18	-0.18	-0.19	-0.22	-0.21	-0.2	-0.18	-0.19	-0.21	-0.21
	Weight(kg)	-0.65	-0.64	-0.72	-0.76	-0.7	-0.73	-0.67	-0.67	-0.73	-0.75

RUT-right upper trapezius, LUT-left upper trapezius, RMT-right middle trapezius, LMT-left middle trapezius, RLT-right lower trapezius, LLT-left lower trapezius, RS-right serratus anterior, LS-left serratus anterior, RR-right rhomboids, LR-left rhomboids, SD-standard deviation.

DISCUSSION

The purpose of this study was to assess the scapular muscle strength normative strength ranges in a group of healthy adults. The following characteristics were taken into account to explain how they connect to the muscle strength measurements: age, gender, height, weight, and BMI. The results of this study indicated that while height and BMI had a poor link with scapular muscular strength, gender, weight, and age were strongly associated with strength.

Scapular strength and gender

Numerous researchers have noted that gender can have an impact on scapular muscle strength. In every age group and in every evaluated scapular position, males had more muscle strength than girls. Body weight was shown to be an effective parameter using normalisation data. It has been noted that gender differences in bone density, muscle morphology, muscle physiology, and muscle mass contributed to the research study's findings.[11–18,21–22,25,26]

Scapular strength between bilateral arms

There is no discernible difference between the right and left sides of the arm for any given scapular muscle measurement between the male and female subject groups. Therefore, muscle strength can be measured and compared using the pain-free side. It aids medical professionals in the field of rehabilitation in establishing strength training regimens and in treating, preventing, maintaining, and lowering the risk of pain.[15–18,20–22,24–26]

Scapular strength with BMI and height

Height and BMI had a weak correlation with muscle strength and were not useful parameters for comparing strength assessments across genders and ages. A few researchers have explained in their studies that because they have no effect on muscle mass, muscle strength, physiology, or morphology, the body movements that are controlled by these muscles stay intact.[17,18,23,26]

Scapular strength and age

This study found that scapular muscle strength is directly correlated with age. The ageing process, loss of muscle mass, anatomical changes, physiological changes, and a sedentary lifestyle all have an effect on the strength and anatomical activities of the scapular muscles due to the degenerative process. Gender-wise, older men are stronger

than older women; yet, as people age, both scapular muscle strength and strength diminish. [19,23,26,29]

Limitation

The subject selection bias was the primary research limitation. The Delhi NCR population was the source for study. A broader population should be included in future research. over the age of fifty and the younger subject were excluded from this research. Hence, this study does not show normative strength ranges for younger and older subjects. More information regarding how strength varies with age would have been provided by included both younger and older population in this study.

Furthermore, this research study used verbal mode to record the patient's medical and surgical history as well as their pain complaints in order to assess the subject's and scapular health. There was no valid examination performed to look for asymptomatic pathology of the neck, shoulders, and scapula. A specific assessment could have contributed to the argument that the research population was in good health.

CONCLUSION

The results of this study have provided the normal limits of scapular muscle strength for a cohort of healthy adults over a thirty-year span. This study depicts that the strength ranges of disease-free, healthy people are normal. This research has given clinicians the foundation to determine whether, in the case of a healthy uninvolved side, that side can be utilized as a reference for measuring strength. Normative ranges demonstrate that the strength data is gender- and age-specific. During rehabilitation, reference data assists clinicians in setting objectives, tracking advancement, and modifying treatment plans. It demonstrates a relationship between muscle strength, side dominance, BMI, and a comparison of strength between the sexes. Future studies can be done in large population sizes and cross-cultural differences.

Declaration By Authors

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