Original article:

Relationship between Standing Static Position, Balance, Muscles and Anthropometric Measurements in Young Adults Population of North India

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ABSTRACT

Aims: In this study we aimed to investigate the relationship between standing static position, Balance, muscles and Anthropometric features in young adults and we studied the Anterior, Posterior, Neutral posture and muscle shortening/Contractures.

Methods: The present study was carried out in Department of Anatomy, Teerthanker Mahaveer Medical College & Research Center, Moradabad, Uttar Pradesh (India) from a period of March 2017 to November 2018. 400 subjects (of both sexes) at Teerthanker Mahaveer University, Moradabad UP (India) aged between 18-30 years were taken for the study. Subjects under the age of 18 years and above the 30 years, with any Muscular disorder, orthopedic deformities and not willing to participate in study were excluded. In the study, type of balance in lateral posture analysis was investigated and anthropometric measurements were conducted and a plumb-line was used for lateral static balance analysis.

Results: Neutral posture was present in majority of males in all age groups {(18-21, n=78) (22-25, n=22), and (26-30, n=09)}. Followed by Anterior posture {(18-21, n=48), (22-25, n=15), and (26-30, n=05) and posterior posture {(18-21, n=44), (22-25, n=13), (26-30, n=03)}. Neutral posture was present in majority of females in all age groups {(18-21, n=71) (22-25, n=11), (26-30, n=04)}. Followed by Anterior posture {(18-21, n=36) (22-25, n=05), (26-30, n=01)} and posterior posture {(18-21, n= 27), (22-25, n= 04), (26-30, n= 04)).

Conclusion: As a conclusion, there was a significant relationship between anthropometric properties (muscle shortness and waist/thigh ratio) and postural balance type in the light of study results, and taking this information into account in the clinical evaluation of these individuals would be helpful for the treatment of painful standing defects.

Keywords: Standing Static Position, Balance, Muscles, Pain, Contractures.

INTRODUCTION

Anthropometry is a single most portable, easily applied, inexpensive and noninvasive method of assessing body composition, which reflects both health and nutrition and predicts performance, health and survival.[1] It refers to the measurement of the human individual for the purposes of understanding human physical variations.[2] Changes in life style, nutrition and ethnic composition of population lead to changes in the distribution of body dimensions, and require regular updating of anthropometric data collection.[3]

Posture is one of the most important factors affecting physical and mental status of the individuals through their lives. Posture in humans is affected by different factors including familial factors, anatomical structural impairments, postural habits, and occupation.[4] Cailliet stated that "posture may be in

question if static spinal configuration does not lead to fatigue, pain in a certain period and is with acceptable ranges aesthetically."[5] Kapandji defined ideal posture as body's being in balance with minimal stress and loading and stated that spinal movement segment is a mechanical system composed of two adjacent vertebrae, intervertebral disks, ligaments, and facet joints. Anterior and posterior structures share the load on this segment as two columns. Anterior column is the main supportive structure. Anterior column plays a static role, and posterior column plays a dynamic role.[6] With a balanced posture, body and profound dorsal muscles may support the upper half of the body with the minimal muscle strength. When center of gravity slides forward due to impaired posture, dorsal muscles try to improve posture with more effort and provide a balanced position.[7] Muscles and Ligaments should be in balance for a proper posture. Imbalance of impaired posture leads to fatigue, skeletal asymmetry, and pain with nociceptive stimuli. Muscles extremely strain in order to maintain abnormal posture. Spasm and pain emerge in time. Weight is distributed to all body parts, shock is absorbed, range of movement is preserved, and thereby movements needed for stability and mobility are controlled independently with a correct posture.[8,9]

Balance is the process of neuron-muscle coordination including the protection of balance point's location through constant feedbacks received from visual, auditory and neural Senses.[10,11] Balance plays an important role in providing several daily activities such as sitting, standing and walking as well as being an essential factor in order to increase sportive performance and present skills in complicated movements.[12-15] In providing and protecting balance, muscle tonus, muscle strength, muscle resistance and joint movement flexibility are very efficient.[16]

Muscle is a contractile tissue which brings about movements. Muscles can be regarded as motors of the body.[17] The muscle endurance is the main element to show the physical preparation and human body structure performance, Hence muscle endurance reduction is the main element could lead to unnatural movement of body some organs, in this extend the body muscles role have been evaluated toward the damaging pressures in different researches.[18]

In this study, it is aimed to investigate the relationship between standing static position, Balance, muscles and Anthropometric features in young adults and we studied the Anterior, Posterior, Neutral posture and muscle shortening/Contractures.

MATERIALS AND METHODS

The present study was carried out in Department of Anatomy, Teerthanker Mahaveer Medical College & Research Center, Moradabad, Uttar Pradesh (India) from a period of March 2017 to November 2018. 400 subjects (of both sexes) at Teerthanker Mahaveer University, Moradabad UP (India) aged between 18-30 years were taken for the study. Subjects under the age of 18 years and above the 30 years, with any Muscular disorder, orthopedic deformities and not willing to participate in study were excluded.

Measurements Were Taken By Using:

- Caliper Device
- Inch Tap
- Nylon String
- Stadiometer
- Weighing Machine

In the study, type of balance in lateral posture analysis was investigated and anthropometric measurements were conducted and a plumb-line was used for lateral static balance analysis.

PARAMETER DESCRIPTIONS

A. Posture Assessment (Lateral Analysis). Balance status

A plumb-line hanged to the ceiling with a nylon string was used for this purpose. Anterior, neutral, or posterior balance status was determined according to the reference points through which the string passed from the ear lobe, shoulder joint, trochanter major, 1-2 cm anterior of knee joint, and just frontal section of lateral malleolus.[20] As seen laterally from lateral, if reference points are in the anterior of the string, it was defined as anterior balance; if reference points are in the posterior of the string, it was defined as posterior balance; if the strings pass from reference points, it was defined as neutral balance **(Figure 1).**

B. Measurement of Waist Circumference

Measurement was performed when the subject was standing and measurement area was determined using a 1mm sensitive anthropometric measure by taking umbilicus as the reference point **(Figure 2).**

C. Measurement of Thigh Circumference

Measurement was done at the largest section of the thigh using a 1mm sensitive anthropometric measure **(Figure 3).**

D. Supraspinal Skinfold Thickness

Thickness of Skin fold between thumb and index finger at 5 cm superior and medial of spine iliac anterior superior was measured with the Skin fold Caliper device **(Figure 4).**

E. Muscle Shortness Tests.

Length of muscles was tested according to anthropometric criteria. Names and test definitions of the muscles and muscle groups by which shortness test were performed according to these criteria were as follows.

(a) Pectoral Muscles*:* The subject was asked to put his/her hands at the back of the neck and arms were wanted to be loose when the subject was lying in supine position on the examination couch. If elbows are not to touch the couch, it is defined as muscle shortness **(Figure 5).**

(b) Hamstring Muscles: When the subject was in supine position on the examination couch, he/she upheld his/her lower extremities separately and knees were in extension. If the sub Anatomy,(Figure 5): Hamstring muscles shortness test. Ject stated that he/she felt pain and strain in hamstring muscles; it would be defined as muscle shortness as well **(Figure 6).**

(c) Gastrocnemius Muscles: When the subject was in supine position with knee extended on the examination couch, students were asked to bring his/her ankle joint to dorsiflexion. Inability to make dorsiflexion of the foot was defined as muscle shortness **(Figure 7).**

(d) Lumbar Extensor Muscles: When the subject was sitting with his/her legs outstretched, he/she was asked to touch tips of his/her fingers to toes. Inability to do this was defined as muscle shortness **(Figure 8).**

(e) Hip Flexors*:* When the subject was in supine position on the examination couch, if contralateral hip and knee come to some degree of flexion when lower extremities come to flexion from hip and knee joint, respectively, it was defined as shortness of the extremity **(Figure 9).**

Fig. 1: Posture Assessment

Fig 3: Thigh Circumference

Fig. 2: Waist Circumference

Fig 4: Supraspinal Skinfold Thickness

Fig. 5: Pectoral Muscles Test

Fig.6: Hamstring Muscles Test

Fig.7: Gastrocnemius Muscles Test

Fig. 8: Lumbar Extensor Muscles Test

Fig.9: Hip Flexors Test

RESULTS

Total 400 subjects were studied out of which 237 were males and 163 were females. Age of subject ranged from 18-30 years included with mean age 20.214, standard deviation 2.6. Subjects were divided into 3 age groups-18-21, 22-25, and 26-30 years. Neutral posture was present in majority of males in all age groups {(18-21, n=78) (22-25, n=22), and (26-30, n=09)}. Followed by Anterior posture {(18-21, n=48), (22-25, n=15), and (26-30, n=05) and posterior posture {(18-21, n=44), (22-25, n=13), (26-30, n=03)}. Neutral posture was present in majority of females in all age groups {(18-21, n=71) (22-25, n=11), (26-30, n=04)}. Followed by Anterior posture {(18-21, n=36) (22-25, n=05), (26-30, n=01)} and posterior posture {(18-21, n= 27), (22-25, n= 04), (26-30, n= 04)).

Table 1: Shows relationship between Posture and Waist /Thigh Circumference Ratio among subjects of different age groups in Males.

Age Group	Posture	Waist and Thigh Circumference Ratio		Total
		Normal	Over	
18-21 (n=78)	Neutral (n=109)	77	01	109
22-25 (n=22)		22	…	
26-30 (n=09)		09	…	
18-21(n=48)	Anterior(n=68)	45	03	68
22-25 (n=15)		14	01	
26-30 (n=05)		05	…	
18-21 (n=44)	Posterior (n=60)	43	01	60
22-25 (n=13)		13	…	
26-30 (n=03)		03	…	

Table 2: Shows relationship between Posture and Waist and Thigh Circumference among subjects of different age groups in females.

Age Group	Posture	Waist and Thigh Circumference Ratio		Total
		Normal	Over	
18-21 (n=71)	Neutral (n=86)	69	02	86
22-25 (n=11)		11	…	
26-30 (n=04)		04	…	
18-21(n=36)	Anterior(n= 42)	35	01	42
22-25(n=05)		05	…	
26-30 (n=01)		01	…	
18-21(n=27)	Posterior (n=35)	27	…	35
22-25 (n=04)		04	…	
26-30 (n=04)		04	…	

Table 3: Shows relationship between Posture and Muscle shortness among subjects of different age groups in males

Age Group	Posture	Muscles					Total
		Pectoral	Hamstring	Gastro.	Lumbar	Hip Flex.	
18-21 (n=78)	Neutral (n=109)	---	22	04	28	---	74
22-25 (n=22)		--	07	--	10	--	
26-30 (n=09)		--	---	--	03	--	
18-21(n=48)	Anterior (n= 68)	--	17	01	12	--	47
22-25 (n=15)		--	06	01	07	--	
26-30 (n=05)		--	01	02	--	--	
18-21 (n=44)	Posterior (n=60)	--	17	13	14	--	59
22-25 (n=13)		--	08	--	06	--	
26-30 (n=3)		--	01	--	--	--	

Table 4: Shows relationship between Posture and Muscle shortness among subjects of different age groups in females

Age Group	Posture	Muscles					Total
		Pectoral	Hamstring	Gastro.	Lumbar	Hip Flex.	
18-21 (n=71)	Neutral (n=86)	---	17	03	21	02	51
22-25 (n=11)		--	03	--	04	--	
26-30 (n=04)		--	01	--	02	--	
18-21(n=36)	Anterior (n= 42)	--	11	01	17	--	32
22-25 (n=05)		--	01	--	02	--	
26-30 (n=01)		--	--	--	--	--	
18-21 (n=27)	Posterior (n=35)	--	08	--	09	--	28
22-25 (n=04)		--	03	--	03	--	
26-30 (n=04)		--	02	--	03	--	

DISCUSSION

The present study on relationship between standing static position, balance muscles and anthropometric measurement in young adults population of North India, students of Teerthanker Mohave University, Moradabad. In our study the mean, standard deviation of anthropometry features less then comparison to the similar study of Maryam Barzenooni et al. In this study the mean and standard deviation are more of anthropometry features.[19]

In our study the Mean of age is 19.855346 and Standard deviation of age is 2.6549130 less than comparison to the similar study of Maryam Barzenooni et al. In this study the Mean of age is 54.61 and Standard deviation of age is 3.98. In our study the Mean of weight is 52.245283 and standard deviation of weight is 9.7290619 less than comparison to the similar study of Maryam Barzenooni et al. the Mean of weight is 68.08 and standard deviation of weight is 7.25 more than our present study. And the Mean of Height is less 157.628931 than the similar study of Maryam Barzenooni et al.in this study the Mean of Height is more161.92.The standard deviation of Height in our present study is similar 6.4155206 comparison to the similar study of Maryam Barzenooni et al. the standard deviation is 6.47.

In our study, statistical analysis result of waist circumference. The waist circumference is less 67.275$\pm$18.12 in Neutral Posture than similar study of Ragiba Zagyapan. In this study the waist circumference is more 797.70$\pm$94.12 in Neutral Posture.[20]

The waist circumference is less 67.0456$\pm$18.2710 in Anterior Posture than the similar study of Ragiba Zagyapan. In this study the waist circumference is more 839.87$\pm$119.91 in Anterior Posture.[20] The waist circumference is less 67.304$\pm$18.3210 in Posterior Posture. Comparison to the similar study of Ragiba Zagyapan.In this study the waist circumference is more 792.76$\pm$108.06 in Posterior Posture.[20]

Comparison to the similar study by Keionen et al. investigating the relationship between body movements in postural balance and anthropometric

factors in 100 adults, they concluded that changes in body balance in standing position could not be explained with only anthropometric features; however anthropometric features should be emphasized in balance studies.[21]

Comparison to the similar study, in a study of De Souza and Gil Coury conducted in Japan and Brazil, postural changes were investigated in 32 morbid obese patients and obesity was found to negatively affect anterior, posterior, and lateral balance and led to genu valgum deformity in 84.4% of the patients. In our study, anterior balance was detected in 12 out of 14 (6 females, 8 males) subjects whose body mass index was 30 and above and hamstring and hip flexors were found to be shorter compared to normal subjects in terms of anthropometric values. This could be explained by the development of anterior balance resulting from the forward change of gravity center due to intense adipose tissue present around waist and belly in obese individuals. At the same time, shortness in hip flexor group muscles is a natural result in these individuals of anterior balance type.[22]

Comparison to the similar study Greve et al. investigated the relationship between dynamic balance and body mass index (BMI) in study conducted in Brazil and found a significant relationship between obesity and postural instability. Postural instability was observed in obese individuals in the study.[23]

Comparison to the similar study, Csapo et al. compared 11 women who wear high-heeled shoes and 9 women who wear normal shoes and found shortness in gastrocnemius muscle and Achilles tendon compared to control group.[24]

Comparison to the similar Study of Maribo et al. was carried out with 52 subjects with mechanic low back pain, and they suggested that mechanic low back pain had negative effects on postural control and caused pain in paravertebral muscles by altering center of gravity. In their study, subjects were not asked about pain. However, these students daily spend ten hours at desk on average and high body part stays in flexion position. Therefore, habit of this standing position could explain the significantly high frequency of anterior balance in men. This situation is different in females, and higher frequency of posterior balance could be explained by the habit of wearing high-heeled shoes.[25]

CONCLUSION

As a conclusion, there was a significant relationship between anthropometric properties (muscle shortness and waist/thigh ratio) and postural balance type in the light of study results, and taking this information into account in the clinical evaluation of these individuals would be helpful for the treatment of painful standing defects.

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