

Original Article**VITAL CAPACITY IN DIFFERENT BODY POSTURES AMONG MEDICAL STUDENTS*****Nisha Ghimire, Soumitra Mukhopadhyay***Department of Physiology, Nobel Medical College, Biratnagar, Morang, Nepal**Submitted: 05th - February-2023, Revised: 26th - March-2023, Accepted: 23rd - April-2023***DOI: <https://doi.org/10.3126/mjen.v2i01.56197>****ABSTRACT****Background**

Cross legged sitting posture (sukhasana, yogic) is normal sitting posture in India, Nepal and some neighboring countries. This posture is also claimed to deepen breath. However, not many studies have been documented to observe if there is any difference in vital capacity (VC) of lungs in standing, sitting erect posture in chair, and sitting erect in crossed legged posture. So, our aim is to compare the vital capacity in standing, sitting erect posture in chair, and crossed legged sitting posture.

Methods

Forty medical and paramedical students (20 males and 20 females) of Nobel medical college were selected for the study. After selecting the students as per selection criteria, vital capacity was measured with spirometer in standing, sitting erect on chair (palms facing up and down) and sitting erect in crossed legged posture (palms facing up and down). One way ANOVA followed by post hoc analysis was done to compare the vital capacity among different postures. Data were expressed as Mean \pm SD. p value <0.05 was considered significant.


Results

Significant decrease in vital capacity was observed when posture changed from standing to erect sitting posture (sitting with palms facing up), $\{(2242.50\text{ml} \pm 155.830 \text{ vs } 2095.0\text{ml} \pm 181.29) p=0.05\}$ in females only. No significant changes were seen between erect sitting posture and crossed legged sitting posture in both palms facing up and down conditions.

Conclusion

Vital capacity was highest in standing posture and lowest in erect sitting posture with palms facing up only in females. Though statistically not significant, among sitting postures, the vital capacity was high in crossed legged posture compared to sitting erect in chair in both males and females.

Keywords: Cross legged posture, erect sitting posture, standing posture, vital capacity

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INTRODUCTION

Vital capacity is affected by many factors like age, height, weight, and body surface area.¹ It has been stated that the spirometric parameters in standing posture is more compared to sitting posture in healthy subjects.² The change in lung volume in standing posture is attributed to the movement of diaphragm.³ The study done on patients with obstructive lung functions also showed forced vital capacity to be marginally more in standing condition compared to sitting condition.⁴ Not only sitting and standing, other postures have also been found to affect the vital capacity. In a study done on extreme of postures, spinal extension was found to produce more increase in lung volume compared to spinal flexion.⁵ This has been attributed to the actions of trunk muscles. According to one of the studies, vital capacity was highest in standing posture, followed by sitting in upright posture while it was least during lying down in left and right lateral position.⁶ Sukhasana is a Yogic posture. For ages, this sitting posture has been popular in many parts of world. The posture demands to sit with the legs relaxed and crossed while lifting the spine and opening the chest. Weight is evenly distributed over sitting bones to balance shoulders directly over hips, and to align the head on top of spine. Pelvis should be positioned so that the sacrum is moved in and the abdomen is lifted both inward and upward. This increases the core strength and on repeated practice, tones up the entire torso.⁷ The namaskar posture or forearm extended in knee helps the upper chest expand in Sukhasana and spread the collarbones. This firms the outer shoulder blades and the upper-back muscles, encouraging the upper spine to move inward. Lengthening the sides of the torso also helps to expand the ribcage and deepen the breath.⁷ Sitting upright in chair is also recommended but while sitting on chair people have tendency to lean back and sink through the middle of the body. This sinking posture is seen to weaken back and abdominal muscles.⁷ The above description of the Sukhasana posture clearly indicates that in this posture, the lower and upper part of the body expands and there is extension of spine which certainly increase the body surface area. So, this posture is also claimed to deepen breath.⁷ This posture is recommended in different yogic breathing exercises. The position of the palm is also seen to bring about change in body posture. When the palms turn up, the shoulders rotate outward and the chest opens. So, the cervical spine, rises upward. When the palms turn down, the shoulders rotate inward and the chest seems to collapse.⁸ This change might also bring about change in vital capacity. Many studies have been performed on effect of meditation on pulmonary function test which shows significant increase in PFT parameters after long term practice in these asanas.⁹ But there are very less studies which tell whether mere change in posture from upright sitting in

chair to crossed legs sitting brings about change in vital capacity. So, we aimed to observe the change in vital capacity among standing, sitting upright in chair and sitting upright with crossed leg posture.

Aims and objectives: To compare the change in vital capacity among standing, sitting upright in chair (palms facing up and down) and sitting upright with crossed leg posture (palms facing up and down).

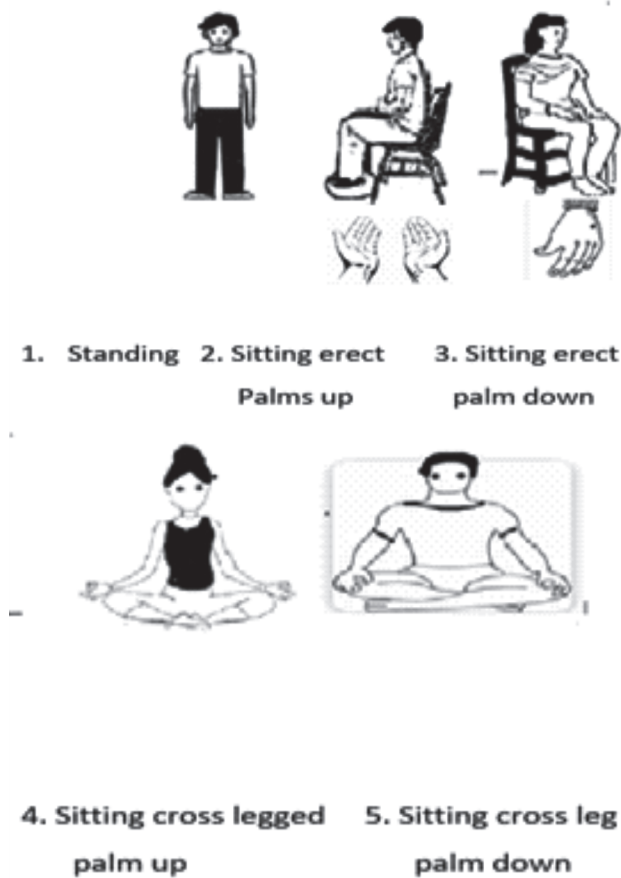
METHODS

In this cross-sectional study, forty healthy paramedical and medical students, (males, n=20), and females (n=20), of Nobel Medical College were taken as subjects. The study was conducted from September 2021 to September 2022 in Physiology Department Nobel Medical College. Convenient sampling technique was done. Subjects having any history of cardiovascular diseases, respiratory diseases, neuromuscular disease, or any medical condition that might affect the data were excluded from the study. The students who regularly practiced Yoga were excluded as it could affect the vital capacity.⁹ Since our aim is to compare vital capacity in standing, erect sitting posture and cross-legged posture, supine, left lateral and right lateral posture were excluded from our study. Subjects who could sit in all postures especially crossed leg postures were selected as subjects. Written informed consent was taken from the subjects. Subjects were asked to come in loose fitting clothes and after having light meal. Subjects were familiarized with the laboratory set up. All the anthropometric measurements like age, height and weight were taken with standard instruments.

The nose was clipped. Mouth piece was placed in the mouth and asked to breathe at rest for some time. Then the vital capacity was measured with spirometer. Subject were then asked to inspire slowly to maximum and then to fully expire with maximum force. Vital capacity was noted. Subjects were advised to perform maximum inspiration and maximum expiration and then return to normal respiration. Three measurements were performed to confirm the reproducibility. This was done in accordance to thoracic society criteria.⁹ The same procedure was performed in standing, sitting upright in chair (palms facing up and palms facing down) and sitting crossed leg posture (palms facing up and palms facing down). After each maneuver the subjects were asked to rest for 10 minutes so that subjects were relaxed and each test was performed in stress free environment. The test was alternated between each subject to reduce the bias. The first subject was asked to perform test on standing as first maneuver, sitting upright on chair as second maneuver and sitting crossed legged as 3rd. second subject performed the test on sitting upright on chair as first, sitting crossed legged as second and standing as third procedure. Third subject performed the test on sit-

ting crossed leg posture as first posture.

Pictures: Vital capacity measurement in different postures



Statistical analysis: Independent-t test is used to compare means between males and females. Anova was used to compare mean between different postures. Post hoc analysis was used only on those parameters which were significant in Anova. All the values were expressed as Mean \pm SD. p value $<$.05 was considered significant.

RESULTS

The anthropometric variables and vital capacity in different postures is tabulated in (Table: 1). All the anthropometric parameters (except age) and vital capacity variables were significantly higher in males compared to females. In case of females, there was significant difference in the vital capacity among different postures (Table:2) When the post-hoc analysis was done among females, significant decrease in vital capacity was observed when posture changed from standing to sitting upright in chair with palms facing up (Table:3). In case of males there was no significant difference (Table:4). Though no statistical differences were found among other postures, the vital capacity was highest in standing posture followed by crossed leg with palms facing down, crossed legs with palms facing up, sitting erect with palms facing down and sitting erect with palms facing up.

Table 1: Comparisons of anthropometric parameters and vital capacity (VC) among different postures between males and females

Anthropometric parameters and VC in different postures	Mean \pm SD Males (n=20)	Mean \pm SD Females(n=20)	P-value
Age (yrs)	18.25 \pm 1.251	18.10 \pm 1.71	.08
Height (cms)	175.26 \pm 7.43	152.30 \pm 14.66	$<$.01
Weight (kgs)	56.70 \pm 6.974	49.10 \pm 7.36	$<$.01
VC standing (ml)	3117.50 \pm 621.178	2242.50 \pm 155.83	$<$.01
VC sitting erect on chair with palms facing up (ml)	2855.00 \pm 644.797	2095.0 \pm 181.29	$<$.01
VC sitting erect on chair with palms down (ml)	2887.50 \pm 634.507	2120.0 \pm 180.20	$<$.01
VC crossed legs with palms up (ml)	2960.00 \pm 513.399	2125.0 \pm 155.17	$<$.01
VC crossed legs with palms down (ml)	2995.00 \pm 678.214	2127.50 \pm 165.01	$<$.01

VC- vital capacity, p $<$.05 is significant

Table: 2 Comparison of vital capacity among different Postures in Females

Postures (n=20)	Vital Capacity (ml) Mean \pm Std. Deviation	P-value One way Anova
Standing	2242.50 \pm 155.83	0.05
Sitting erect on chair with palms facing up	2095.0 \pm 181.29	
Sitting erect on chair with palms facing down	2120.00 \pm 180.20	
Sitting Crossed leg with palms facing up	2125.00 \pm 155.17	
Sitting Crossed leg with palms facing down	2127.50 \pm 165.01	

p- value $<$ 0.05 is significane

Table 3: Post- hoc analysis among different groups in females

Postures (n=20)	Standing	Sitting erect with palms facing up	p-value
Vital Capacity (ml)	2242.50 \pm 155.83	2095.0 \pm 181.29	0.05

p-value $<$ 0.05 is significant

Table: 4 Mean of Vital Capacity among different Postures in Males

Postures	Vital capacity (ml) Mean \pm Std. Deviation	P-value One way Anova
Standing	3117.50 \pm 621.17	0.07
Sitting erect on chair with palms facing up	2855.00 \pm 644.79	
Sitting erect on chair with palms facing down	2887.50 \pm 634.50	
Sitting Crossed leg with palms facing up	2960.00 \pm 513.39	
Sitting Crossed leg with palms facing down	2995.00 \pm 678.21	

p-value $<$ 0.05 is significant

DISCUSSION

This study was conducted among forty healthy medical and paramedical students of Nobel medical college (20 males and 20 females) with mean age 18.25 \pm 1.251 in males and 18.10 \pm 1.714 in females. Various studies have published the changes in PFT parameters in different postures.^{2,3,4} However, very few of these studies have talked about the change in vital capacity in crossed leg posture (Sukhasana). There are many studies which suggest change in lung

volumes with breathing exercises. During breathing exercises subjects are required to sit in crossed leg posture⁹. This posture is claimed to expand the chest and increase tone and strength of core muscles⁷. With this idea, we aimed to observe whether there is change in vital capacity during standing, Sukhasana (crossed leg posture) and sitting upright in chair. For the procedure, subjects were selected as per inclusion criteria. Statistical analysis was done. Except age, all the anthropometric variables were significantly high in males. Similarly in all the postures, the vital capacity in male was more compared to females (Table 1). This is similar to many studies which showed sex is the determinant of vital capacity.¹⁰ ANOVA was applied among all the groups to compare the vital capacity in different postures among both males and females. The difference in vital capacity among different postures were seen only among females (Table 2) and on post hoc analysis the difference was only seen between standing and sitting erect on chair with palms facing up (Table 3). It showed that the highest value was during standing posture and lowest value was during erect sitting posture on the chair with palms facing up. It is similar to another studies which show vital capacity is highest during standing posture which may be due to the movement of diaphragm.^{2,3} The non-significant result in males during standing and sitting posture (Table 4) might be due to small sample size. Though the changes were not statistically significant, the trend was same in males. In both the males and females, highest value was seen in standing posture followed by crossed leg posture with palms facing down, crossed legs with palms facing up, sitting upright with palms facing down and sitting upright with palms facing up (Table 2, Table 4). The change in vital capacity in crossed legged posture was slightly higher compared to sitting upright in chair and was not significant. This could be because in both conditions, the person was erect. However, the small increase in vital capacity during crossed legged posture could have effect in everyday life. As already stated, though erect sitting posture on chair is also recommended, when person tries to sit erect on chair, there is normal tendency to lean back and sink through the middle of the body. One of the studies has shown that the strength of slouched sitting position reduced respiratory muscle movement and tension on sniff nasal

inspiratory pressure measurement.¹¹ In totally erect posture not much difference was seen but in slouched condition it might be less. The measurement of vital capacity in slouched posture in chair could have given an insight in to this. Yoga training on sukhasanas and breathing exercises has shown change in breathing pattern and increase in vital capacity.⁹ They claim that these postures and breathing exercises helps to adapt and increase the strength of muscles. So, from our study also, the increase in vital capacity during sukhasana posture could be considered as a better sitting posture. However, the statistically non-significant result demands further study. Similarly in the palms down posture the vital capacity was more compared to palm up posture (Table 2, Table 4). As stated, palms down collapsed the chest.⁸ Since during the measurement of vital capacity, the forceful expiration was done after full inspiration, and the chest collapse could have supported for expiration and values was more. But the differences are very less and it also needs extended research.

CONCLUSION

Among the five different postures there was significantly more lung volume only in standing posture compared to sitting erect with palms facing up in females. Though the values were not statistically significant in other postures, the trend was same in males and females. The vital capacity was highest in standing followed by crossed legs palms facing up, crossed legs palms facing down, sitting erect palms facing down and sitting erect on chair with palms facing up. To, conclude, though statistically not significant, among different sitting postures, vital capacity values are more when sitting in crossed legged posture compared to erect sitting posture in chair.

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