

# Association between Anthropometric Measures and Pulmonary Function: Exploring the Need of Athlete-specific Spirometric Measures

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## ABSTRACT

**Background:** In contrast to general population, athletes demonstrate enhanced cardiovascular functions and thus higher spirometric values, which necessitates the need of spirometric measures typically specific to athletes, which could avert misdiagnosis of certain respiratory dysfunction in them. Addressing this issue, the present study conducted in athletes vis-à-vis nonathletes assessed their anthropometric measures and pulmonary function parameters and explored for association, if any.

**Materials and methods:** A cross-sectional study was undertaken in athletes vis-à-vis nonathletes. Respondents were screened for risk factors and were then assessed for their anthropometric measures including height, weight, body circumferences, fat level, skeletal muscle, and skinfold thickness. Pulmonary function test was then conducted in all respondents.

**Results:** Mean anthropometric measures including body mass index, body fat percentage, waist circumference, waist-hip ratio, and skinfold thickness were on a slightly higher mark for nonathletes. Spirometric indices were on a bit higher grades for athletes' group. However, consistent negative association was noted between increased anthropometric measures and pulmonary functions.

**Conclusion:** Standardizing higher level of normalcy in spirometric indices for athletes may be considered to avoid misdiagnosis or misclassification of certain respiratory dysfunctions in them.

**Keywords:** Anthropometric measures, Athletes, Spirometry.

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## INTRODUCTION

Anthropometric measures are now considered a better risk predictor of chronic disease in various populations due to its low cost and less methodological complexities. Various chronic ailments such as cardiovascular diseases, certain cancers, and diabetes have been associated with obesity. Furthermore, many respiratory disorders and loss in pulmonary function have also been linked with obesity.<sup>1,2</sup> Spirometry is the most important and most frequently performed pulmonary function test necessary for the prevention, diagnosis, and evaluation of a range of respiratory impairments. Reference ranges for spirometric measures generally apply for the general population.<sup>3,4</sup> Nonetheless, these lung function determinants may be significantly affected in athletes as the type, duration, and exercise intensity have been shown to affect lung volumes in them. Quite in contrast to general population, athletes demonstrate enhanced cardiovascular functions, larger stroke volume, greater cardiac output, and thus higher spirometric values. There exists the need of spirometric measures typically specific to athletes, which could avert misdiagnosis of certain respiratory dysfunction in them.<sup>5</sup> Addressing the dearth of studies probing this association, the present study was conducted in athletes vis-à-vis nonathletes who were assessed for their anthropometric measures and pulmonary function parameters.

## MATERIALS AND METHODS

A cross-sectional study was undertaken involving 70 participants of whom 35 were professional footballers (group A) and 35 were nonathletes (group B). Permission was obtained from

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Institutional Ethics Committee for the conduct of the study. Nonsmoker, healthy consenting male volunteers of 18–30 years age-group were included in the study. Those with any established pulmonary disorders and any contraindication to perform spirometry were excluded. Respondents were screened for risk factors and were then assessed for their anthropometric measures including height, weight, body circumferences (waist, hip), fat level (total, visceral), skeletal muscle, and skinfold thickness (triceps, subscapular). Subjects were recommended to wear loose clothing that would otherwise not interfere with breathing process. Participants were requested to have

light meals before few hours of the test. Intake of alcohol or performing exercise hours before the test was strictly prohibited. Pulmonary function test was then conducted in all respondents. Spirometric measures as below were noted:

**Forced expiratory volume in 1 second (FEV1):** The maximum air volume that can be forcefully expired within 1 second after maximal inspiration.

**FEV1/FVC:** Ratio of FEV1 to FVC, expressed as a percentage.

**Peak expiratory flow (PEF):** The maximum airflow rate attained during forced expiration.

Data collected were checked for completeness and then statistically analyzed. Descriptive data were represented as mean or percentages. Where possible, demographic and categorical data were analyzed with parametric or nonparametric tests whichever found applicable.

**RESULTS**

A total of 70 participants were enrolled in the study, 35 being athletes and 35 nonathletes. Demographic parameters were noted for both the groups. Baseline mean anthropometric measures including body mass index, body fat percentage, waist circumference, waist-hip ratio, and skinfold thickness were noted for both athletes and nonathletes, respectively (Table 1).

Pulmonary function test was conducted in all respondents. Percentage forced expiratory volume in 1 second (FEV1%), percentage forced vital capacity (FVC%), and percentage peak

expiratory flow (PEFR%) were measured for all the subjects (Table 2).

Association of pulmonary measures with anthropometric measures was assessed using correlation coefficient (Table 3).

**DISCUSSION**

Obesity has been a global concern recently. With exponentially increasing statistics, obesity is now a prime contributor to global burden of chronic diseases and disability. Obesity has also been a risk factor for decreased pulmonary functions, though less explored. It is suggested that excess fat surrounding the rib cage and abdomen may further decrease the available volume of lungs to expand and function.<sup>6</sup> Given the fact that obesity may affect lung function through these mechanical changes in respiratory system, anthropometric measures such as body mass index and body composition indices may be assessed in routine practices to prognosticate pulmonary risks a priori. Obesity is also inversely related to physical fitness, which in turn is positively associated with pulmonary functionalities.<sup>7</sup>

The present study tried to probe association between anthropometric measures and lung function in two categories of individuals who varied in their physical fitness, and thus chose athletes and nonathletes as study cohorts. Mean anthropometric measures including body mass index, body fat percentage, waist circumference, waist-hip ratio, and skinfold thickness were noted for both these groups, which were obviously on a slightly higher mark for nonathletes as expected. Spirometric indices were on a bit higher grades for athletes' group. However notably, our study observed consistent negative association between increased anthropometric measures and pulmonary functions in contrast to study conducted by Durmic et al.<sup>5</sup> where body mass index showed positive correlation with all spirometric measures. However, body fat percentage showed negative correlation with all spirometric parameters in the same study,<sup>5</sup> which corroborates with our findings too.

**Table 1:** Basic demographic and anthropometric measures

	Group A (athletes)	Group B (nonathletes)
<b>Basic demographics</b>		
Age (in years)	24.3 ± 4.52	24.9 ± 3.91
Height (in cm)	173.42 ± 4.31	170.12 ± 3.27
Weight (in kg)	72.15 ± 5.78	75.23 ± 6.71
<b>Anthropometric measures</b>		
Body mass index	24.07 ± 2.11	26.31 ± 3.01
Body fat (%)	20.29 ± 2.48	27.32 ± 3.37
Waist circumference	80.46 ± 3.65	84.6 ± 9.23
Waist-hip ratio	0.86 ± 0.07	0.94 ± 0.10
Mid-thigh skinfold thickness	3.93 ± 0.58	5.56 ± 2.02
Subscapular thickness	6.8 ± 1.52	8.26 ± 2.09
Triceps thickness	4.36 ± 0.85	5.06 ± 1.91

**Table 3:** Association Measures (Using Pearson's Correlation Coefficient)

	FEV1%	FVC%	PEFR%
Body mass index	-0.366*	-0.552 <sup>#</sup>	-0.646 <sup>#</sup>
Body fat (%)	-0.173 <sup>NS</sup>	-0.431*	-0.537 <sup>#</sup>
Waist circumference	-0.147 <sup>NS</sup>	-0.376*	-0.456*
Waist-hip ratio	-0.100 <sup>NS</sup>	-0.227 <sup>NS</sup>	-0.148 <sup>NS</sup>

NS = Nonsignificant;  
\*correlation significant at 0.05 level;  
<sup>#</sup>correlation significant at 0.01 level

**Table 2:** Pulmonary function measures

Anthropometric measures		Group A (athletes)			Group B (nonathletes)		
		FEV1%	FVC%	PEFR%	FEV1%	FVC%	PEFR%
Body mass index (Asian criteria)	Normal	111 ± 21.04	121.78 ± 17.45	111.11 ± 9.81	103.65 ± 13.34	119.13 ± 12.34	104.21 ± 4.53
	Overweight	96.71 ± 11.68	95.21 ± 8.28	88.28 ± 7.37	88.73 ± 9.33	82.66 ± 6.86	81.25 ± 6.33
	Obese	81.57 ± 9.22	81.28 ± 9.35	70.71 ± 4.75	76.12 ± 7.65	79.63 ± 8.86	66.72 ± 5.34
Waist circumference	Ideal (<90 cm)	97.46 ± 17.86	99.93 ± 19.37	101.03 ± 16.85	93.36 ± 13.22	90.21 ± 11.76	89.01 ± 12.35
	High	-	-	-	86.62 ± 9.65	74.23 ± 6.86	76.32 ± 7.94
Body fat%	Ideal (<28.8%)	97.46 ± 17.86	99.93 ± 19.37	101.03 ± 16.85	91.26 ± 11.63	89.21 ± 9.35	91.04 ± 10.93
	High (>28.8%)	-	-	-	81.36 ± 8.43	79.28 ± 5.63	71.35 ± 8.71



There exists a possibility that trained athletes develop discordant changes in their respiratory system with time, which influence their performance and response to pulmonary function tests. Such changes include intrathoracic and extrathoracic obstruction, expiratory flow limitation, respiratory muscle fatigue, and exercise-induced hypoxemia.<sup>8</sup> Thus, standardizing higher level of normalcy in spirometric indices for athletes may be considered to avoid misdiagnosis or misclassification of certain respiratory dysfunctions in them. There exists dearth of research stressing on spirometric measures specific to athletes.

## CONCLUSION

The present study noted consistent negative association between increased anthropometric measures and pulmonary function. Physical training may have a significant role in developing a greater endurance in respiratory muscles. For evaluation of respiratory disorders in athletes, we may need to consider higher levels of normalcy of pulmonary functions. Besides, respiratory parameters can play a determinant role in qualitative and quantitative evaluation of athletes.

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