

A Pilot Study “To Derive the Normal Values of Single Breath Count in Young Healthy Adults”

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Abstract

Introduction: Pulmonary function tests such as spirometer and peak expiratory flow rate are the standard measures to test lung volumes and capacities; but generally there is a lack of such equipment in emergency departments. Hence there is a need for an easier, quicker and convenient outcome measure in such set-ups. Single breath count (SBC) can be a simple assessment method in such clinical settings. However no studies for normal values of SBC in young Healthy adults were found during the search for literature.

Objective: The objective of this study was to estimate normal value of SBC in Healthy young adult population.

Results: 100 participants were enrolled from 18-24 years of age in the study. The mean SBC was 39(±7) and 41(±9) in females and males respectively. The SBC had a significant positive correlation with age at $r=0.3$, p value 0.0051 and height at $r=0.28$, p value 0.0038. The SBC had a non-significant negative correlation with BMI and weight.

Discussion: The results show that SBC was influenced significantly by gender (males>females), age and height of the individuals. However BMI and weight did not seem to influence the SBC.

Conclusion: SBC is a test which is easy to perform and appears to correlate well with standard measures of pulmonary functions. We estimated the normal values of SBC in young healthy adults which can be used in the clinical set up.

Key Words: Single Breath Count; Young adult; Gender; Height; Age

Introduction

Respiratory system is a biological system consisting of organs and structures used for respiration- exchange of gases through alveolar membrane in humans.¹ Pulmonary ventilation is the flow of air between the lung and theatmosphere.¹ Pulmonary ventilation is recorded by the movement of air in the lungs.² Apart from FEV & FVC, arterial blood gas analysis (ABG), slow vital capacity (SVC), Peak expiratory flow rate, Functional residual

capacity, plethysmography and Single breath count can be used to assess lung function.³ The technique Spirometry measures the rate of air flow and estimates lung volumes and capacities². Pulmonary Function tests such as lung volumes are used for the screening and evaluating respiratory functions and its physiological parameters. Single breath count (SBC) test is defined as maximum numeral an individual can count in normal speaking voice after a maximal effort inhalation in cadence with a metronome set at 2 counts/second. Single breath count test is a method by which

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lung volumes and capacities are measured. In this test the participants are advised to count numbers as far as they can in a normal speaking voice, after a maximal inspiration.⁷ Previous studies have correlated PEFV and SBC in normal adults⁶ and derived normograms of SBC among healthy pediatric population⁷ but no previous study has been done to assess normal values of SBC in young adults. This correlates well with the forced expiratory volume (FEV).⁸

The various factors influencing lung volumes and capacities are Gender, Body built, Posture, Occupation and Athletic participation.¹

Lung volume tests are the most definite way to measure how much air the lungs can hold. The commonly used measures include forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and the ratio of the two (FEV1/FVC).¹

Previous studies have evaluated the validity of SBC as a measure of assessment in acute exacerbation of asthma⁴ and its accuracy to determine low vital capacity.⁵

As phonation is directly related to respiratory system, SBC test can be used to evaluate pulmonary functions.⁹

SBC is an inexpensive method of assessment which requires a digital metronome. The digital metronome can be replaced with a metronome app or an analog watch. Considerable patient cooperation and the ability to count in English is required for the performance of SBC. However it is still easier to perform as it does not require any specific breathing technique like other PFT's. Studies have shown a good correlation between SBC and standard PFT.⁷ A set of normal values needs to be established prior to using the SBC test in clinical set-ups. SBC is a quick tool for bedside assessment and can be easily communicated by providers. Thus, this study attempts to identify the normative values of SBC among normal healthy adults aged 18-24 years.

Objective

The objective of this study was to establish normal value of Single Breath Count- a simple cost effective and quick assessment tool in Healthy young adult population.

Method

This is an observational study including healthy students of the Physiotherapy institute an academic health centre.

Inclusion criteria: study participants were healthy individuals from the age of 18 to 24 years who were able to understand the instruction and count numbers in English

Exclusion criteria: Participants were those who had a medical record or whose interview suggested any respiratory infection were excluded from the study. Participants who were not fluent in counting numbers in English or had any speech anomalies were also excluded from the study.

Methodology: demographic data like age, gender, height (centimeter) and weight (kilogram) were noted.

Materials: SBC was explained and measured by the examiner using a standard digital metronome.

Verbal informed consent was taken from all the participants. The procedure was explained and demonstrated by the researcher.

The participants were asked to take a deep breath and count as far as possible in their normal speaking voice in a single inspiration without taking another breath while exhaling. The pace was set with a digital metronome set at 2 beats per second. Both visual and auditory cues were provided⁷. The participant started counting from number 1 till the next inhalation. Three attempts were performed & recorded. The best performance was considered for final data analysis. One minute rest was provided between the consecutive performances.

Sample size: 238 students of the institute were identified as attending the college at the time of data collection. Hence using the formula for sample size calculation for finite population as above. The sample size was calculated to be 148 participants formula

$$\text{Sample size} = \frac{z^2 \times p(1-p)}{e^2} \div \left(1 + \frac{z^2 \times p(1-p)}{e^2 N} \right)$$

N = population size • e = Margin of error (percentage in decimal form) • z = z-score

p = Percentage of population/ population proportion

Thus the calculated sample size was 148 participants.

148 students were randomly selected from the 238 attending students to participate in the study. However, 13 students reported having upper respiratory tract infection at the time of data collection. Another 29 students didn't agree for participating in the study, 3 students were in the post covid phase and 3 students reported as being asthmatic. Thus the data collected from 100 participants were subjected to data analysis.

Results

The data was analyzed using SPSS and the descriptive analysis was done and presented as means, percentages and standard deviations.

The data was subjected to Kolmogorov-Smirnov test for normality. The result showed that the data was normally distributed with the value of the K-S test statistic (D) was 0.09661 and with $p=0.2892$. Therefore Parametric tests like student t test, Karl Pearson correlation were used for further data analysis.

The calculations were performed at 95% confidence interval with $p<0.05$ being considered statistically significant.

The participants included 78 girls and 22 boys with a mean age of 21 years respectively and mean SBC of $39(\pm 7)$ & $41(\pm 9)$ respectively. The z score for the

population proportion for gender distribution was significant with z-value 7.9196 and $p\text{-value}<.00001$. The number of female participants was found to be significantly higher than males. The peak single breath count of male participants was significantly higher than the female participants at a $p\text{-value}$ of 0.05

Table 1 shows the demographic data and the frequency distribution of the participants across the ages.

A weak positive correlation existed between peak SBC and age with an $r=0.3$. The correlation though technically weak was statistically significant for the sample with a p value 0.005.

A weak positive correlation existed between peak SBC and height with $r=0.28$. The correlation though technically weak was statistically significant for the sample with a p value 0.004. A weak negative correlation existed between SBC vs BMI with $r=-0.0033$, the correlation was technically weak and statistically insignificant for the sample with a $p\text{-value}$

0.976. A weak positive correlation existed between SBC vs weight with $r=0.1$; the correlation was technically weak and statistically insignificant for the sample with a $p\text{-value}$ 0.171.

The mean of the three attempts of SBC were 35,37 and 37 for attempt 1, attempt 2 and attempt 3 respectively. The mean SBCs were not significantly different from each other. 3 participants had a history of smoking. Analysis to identify the effect of smoking on SBC was not undertaken as only 3 participants gave the history of cigarette smoking.

Table 1: Demographic data and Frequency Distribution of participants across the ages

Age	18	19	20	21	22	23	24	Total
N (%)	11	12	15	14	16	16	16	100
Females	9	10	9	13	12	15	10	
N(%)	(82)	(83)	(60)	(93)	(75)	(94)	(62)	
Males	2	2	6	1	4	1	6	22
N%	(18)	(17)	(40)	(7)	(25)	(6)	(38)	
BMI	22	22	22	21	23	21	24	22
SD	(4)	(3)	(4)	(4)	(4)	(4)	(5)	(4)
PRavg	40	34	39	36	40	40	44	39
SD	(4)	(5)	(7)	(8)	(7)	(6)	(8)	(7)

Discussion

The purpose of this study was to identify the mean SBC among healthy adult individuals from 18 to 24 years as no similar studies were found during the search for review of literature. Most of the studies have been on hospitalised patients. This study focuses in deriving the normal values and its correlation with physiological parameters like gender, age, height, weight and BMI. This is essential if SBC has to be used in clinical set up as a tool to screen individuals for any discrepancies in respiratory function among adults. Our study demonstrates the variation between the readings of SBC with respect to age, gender, height and weight. The number of females in this study was significantly higher than the males as the participants were all students pursuing Bachelors or Masters in Physiotherapy and this is a field which is dominated by females. The SBC was significantly higher among the males as compared to females. This result is supported by studies which suggest that men have higher lung volumes than women.

There was a positive correlation between the age, height and weight and SBC which states that as the age height and weight increases there was an increase in the SBC. SBC was directly proportional to age, height, weight and level of physical activity in the included age group. This result is concurrent with other studies which also report similarly. Literature and previous studies state that there is a positive correlation between the age height built and lung volumes.^{1,7} Various studies suggest that smoking would affect lung functions and decrease lung volumes.¹⁰ However this analysis was not undertaken in our study as only 3 out of 100 participants gave history of smoking. Previous reviews suggest that smoking may influence the lung function which may influence the SBC.

Conclusions

SBC is an extremely simple test to perform which is also concurrent with various other lung function tests. The study intended to estimate the range of normal values for SBC among young healthy adults.

The small sample size however maybe a limitation of the study. The participants included in the study were from various states of the country such as Karnataka-47, Maharashtra-25, Goa-15, Tamil Nadu-2, Rajasthan-2 Andhra Pradesh-4 and Gujarat-1. Thus we would like to conclude that these

results maybe generalized to these states of India. However the unequal distribution of participants across the states maybe a drawback as it was a single site study. However studies in future maybe undertaken using larger sample size and covering other parts of the country too.

Conflict of interest: The authors have no conflict of interest to declare.

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