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Original Research Article

Does Bodybuilding Affect the Pulmonary Function Tests?

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ABSTRACT
Increasing evidence suggests that body building may have powerful implications for health; however, very few studies have focused on the association between body building and pulmonary functions. This study was aimed at examining the association between body building and pulmonary functions. We recruited thirty young male body builders aged 20 to 30 years. They were mainly undergoing resistance training since 2 to 3 years. Another thirty age matched, sedentary men served as controls. The body builders had been regularly attending the gyms for 1 to 3 years. Pulmonary function tests were recorded in all the participants. The data were analyzed by unpaired 't' test. $P < 0.05$ was considered significant. All the PFT values except MEF_{25} showed no significant ($P > 0.05$) difference between the two groups. In conclusion, the current study has shown that, the body building has no significant effect on pulmonary function in Indian men.
Keywords: Body Building, Strength Training, Resistance Training, Pulmonary Function Tests

INTRODUCTION

Bodybuilding is a form of physical exercise and body modification involving intensive muscle hypertrophy. An individual who engages in this activity is referred to as a bodybuilder. Bodybuilders prepare for competition through a combination of dehydration, fat loss, oils, and tanning which combined with lighting make the definition of the muscle group more distinct.

Muscle hypertrophy occurs primarily through chronic anaerobic, high-intensity resistance activity, like that which happens during resistance training lifting weights. (1-4) Resistance training causes neural adaptations, which result in changes in muscular endurance and muscular strength, and eventually, the size of the muscles. (5)

Resistance training causes an increase in the cross-sectional area (CSA) of all muscle fiber types (1,2,4,6,7) without an increase in muscle fiber numbers. (4) Exercises that build muscle the best are compound, multi-joint exercises, as they recruit more of the body to perform the exercise (8) and thus recruit and activate more muscle fibers. (9) The best compound exercises for hypertrophy are the squat and the dead lift, as they use pretty much every muscle in your body. (10) Other compound exercises that are good to include are the power clean, bench press, shoulder press, pull-ups, and dips. Various previous studies have shown that body building may have powerful implications for health; however, no study has focused on the association between body building and pulmonary functions in South Indian Men. This study was aimed at examining the association between body building and pulmonary functions.

MATERIALS AND METHODS

This study was approved by ethics committee of the institute, KIMS, Hubli. We recruited thirty young male body builders aged 20 to 30 years. They were mainly undergoing resistance training since 2 to 3 years. Another thirty age matched sedentary men, served as controls. All the participants were non-smokers, non-obese and were not showing any clinical signs of any pre-existing cardiopulmonary disorders. Diabetics and hypertensives were excluded from the study. All subjects provided written informed consent. This study conformed to the standards set by *Declaration of Helsinki and* the procedures followed were in accordance with the ethical standards as laid by the ICMR-Ethical Guidelines for Biomedical Research on Human Participants.

The health status, the amount, duration and intensity of training were assessed with the use of specifically designed questionnaires. The survey excluded persons who had clinical or laboratory evidence of any current or recent illnesses or infections or had used any prescription drugs during the preceding 1 week. None of the participants had any records of previous chronic medical disorders. Subjects' height and weight were measured; BMI was calculated.

Subjects were asked to refrain from tea, coffee, chocolates and caffeinated soft-drinks on the day of recording Spirometry. The forced expiratory maneuver was demonstrated to all the subjects. PFT was recorded by a computerized spirometer (CPFS/DUSB, Medgraphics Company) in standing position. Subjects were instructed to take maximum inspiration and blow into the pre-vent pneumotach as rapidly, forcefully and completely as possible for a minimum of 6 seconds, followed by full and rapid inspiration to complete the flow volume loop. The best of the three trials was considered for data analysis. Calibration of spirometer and all testing protocols were performed as outlined in the instruction manual of the spirometer.

The data were analyzed using Microsoft Excel software; two tailed unpaired (equal variance) t test was applied to compare the PFT values between the two groups. Statistics were tested at the $P < 0.05$ level of significance and data were reported as mean ± standard deviation.

RESULTS

The main clinical characteristics of the study and control groups are presented in the table 1. All the PFT values except MEF_{25} showed no significant ($P > 0.05$) difference between the two groups (tables 2-4). Subjects were comfortable and there were no serious adverse events during the study.

Table 1: Anthropometric data of the male body builders and controls

Parameters	Body Builders Mean ± SD (N = 30)	Controls Mean ± SD (N = 30)	*P* Value	Significance
Age	23 ± 5	22 ± 3	> 0.05	Not Significant
Height (cm)	171 ± 7	169 ± 8	> 0.05	Not Significant
Weight (kgs)	68 ± 10	66 ± 11	> 0.05	Not Significant
Body Surface Area (m^2)	1.9 ± 0.1	1.7 ± 0.1	> 0.05	Not Significant
BMI (Kg/m^2)	21 ± 3	21 ± 2	> 0.05	Not Significant

SD Standard Deviation, N Number of subjects, BMI Body Mass Index

Table 2: Slow vital capacity parameters of the male body builders and controls

Parameters	Body Builders Mean ± SD N = 30	Controls Mean ± SD N = 30	*P* Value	Significance
Vital Capacity (L)	3.3 ± 0.5	3.3 ± 0.4	> 0.05	Not Significant
Expiratory Reserve Volume (L)	1 ± 0.4	1.1 ± 0.3	> 0.05	Not Significant
Inspiratory Reserve Volume (L)	1.6 ± 0.5	1.7 ± 0.4	> 0.05	Not Significant
Inspiratory Capacity (L)	2.3 ± 0.6	2.2 ± 0.4	> 0.05	Not Significant
Tidal Volume (L)	0.6 ± 0.2	0.5 ± 0.2	> 0.05	Not Significant

SD Standard Deviation, N Number of subjects

Table 3: Forced vital capacity parameters of the male body builders and controls

Parameters	Body builders Mean ± SD N = 30	Controls Mean ± SD N = 30	*P* Value	Significance
Forced Vital Capacity (L)	3 ± 0.6	3 ± 0.5	> 0.05	Not Significant
FEV1 (L)	2.9 ± 0.6	2.8 ± 0.4	> 0.05	Not Significant
Expiratory Time (Sec)	1.5 ± 1	1.7 ± 0.6	> 0.05	Not Significant
FEV1/VC Ratio	0.9 ± 0.2	0.8 ± 0.1	> 0.05	Not Significant
FEV1/FVC Ratio	0.96 ± 0.1	0.95 ± 0.1	> 0.05	Not Significant
MMEF (L/Sec)	4.4 ± 1.1	4 ± 1.1	> 0.05	Not Significant

SD Standard Deviation, N Number of subjects, FEV_1 Forced Expiratory Volume in one second, VC Vital Capacity, FVC Forced Vital Capacity, MMEF Maximum Mid Expiratory Flow rate

Table 4: Forced vital capacity and maximal voluntary ventilation of the male body builders and controls

Parameters	Body Builders Mean ± SD N = 30	Controls Mean ± SD N = 30	*P* Value	Significance
PEFR (L/sec)	7.8 ± 1.5	7.5 ± 1.3	> 0.05	Not Significant
MEF75 (L/sec)	7 ± 1.4	6.8 ± 1.6	> 0.05	Not Significant
MEF50 (L/sec)	4.8 ± 1.2	4.6 ± 1.4	> 0.05	Not Significant
MEF25 (L/sec)	3.3 ± 0.72	2.3 ± 0.7	< 0.001*	*Significant*
MEF/FVC Ratio	1.3 ± 0.3	1.4 ± 0.4	> 0.05	Not Significant
MVV (L/min)	109 ± 15	113 ± 21	> 0.05	Not Significant

SD Standard Deviation, N Number of subjects, PEFR Peak Expiratory Flow Rate, MEF Mid Expiratory Flow rate, FVC Forced Vital Capacity, MVV Maximum Voluntary Ventilation

DISCUSSION

A lot of data has been published on the concept of pulmonary adaptation to different types of training activities; some studies have shown a definite difference between trained and sedentary groups in some PFT parameters and no difference in few of the PFT parameters; and there are certain studies, which have found no significant differences at all in most of the pulmonary function parameters among exercise and non-exercise group.

The results of this study show that, the PFT values did not differ significantly between male body builders and sedentary men except for Mid Expiratory Flow rate 25 (MEF25) value which was significantly higher in body builders compared to sedentary men. The reason for higher MEF25 value in body builders in our study is uncertain.

Willmore JH and Haskell WL [11] showed that, though PFT parameters were higher in football players than sedentary, they were significantly less than top endurance athletes. Another fact they presented is that as far as football players are concerned, Body composition and PFT parameter relation was not consistent.

Lakhera SC et al. [12] stated that athletic training from childhood is the reason for superior lung volumes and capacities in U.S. athletes. They opined that, as boxing, basket ball and gymnastics are less strenuous than swimming, football, running and wrestling; they do not lead to significant improvement in PFT.

Mehrotra PK et al. [13] studied pulmonary functions in different sportsmen. They found all of them had larger lung volumes than controls. The possible explanation they gave was regular forceful inspiration and expiration for prolonged periods during playing leads to strengthening of respiratory muscles. This helps the lungs to inflate and deflate maximally. This maximum inflation and deflation is an important physiological stimulus for the release of lung surfactant and prostaglandin into the alveolar spaces thereby increasing lung compliance and decreasing the bronchial smooth muscle tone respectively.

Balabinis CP et al. [14] compared the effects of endurance training & resistance training on VO_2max. They found that, the resistance training decreased VO_2max whereas endurance training led to an increase in VO_2 max. They opined that resistance training predominantly influences adaptation in muscular system, whereas endurance training leads to a fitness of cardio-respiratory system. This may in part explain why bodybuilders in our study who were mainly engaged in resistance training did not show much changes in PFT.

Armour J et al. [15] studied PFT in runners, swimmers and controls. They found no difference of PFT between runners and controls, but significantly larger lung volumes for swimmers; they also opined that, swimming may lead to an increase in the number of alveoli which may lead to higher lung volumes in swimmers.

Dempsey JA and Johnson BD [16] stated that pulmonary diffusion capacity and at least some aspects of respiratory muscle function seem to be overbuilt in the young untrained athletes and this margin of safety no longer prevails as the athlete becomes fitter. This relative lack of adaptability of pulmonary system may explain the similar values of PFT among the bodybuilders and controls in this study.

Hagberg JM et al. [17] studied pulmonary functions in 4 groups, older athletes & controls, younger athletes and controls. They found that, the PFT measurements of young athletes did not differ significantly compared to age matched controls; but, older athletes had marginally larger lung volumes compared to age matched controls after normalizing PFT parameters to height.

Dempsey JA et al. [18] in another study, studied numerous pulmonary function variables like diffusion capacity, air flow generating capability, inspiratory pleural pressure etc., and found no significant changes with strength training.

Mahler DA et al. [19] studied ventilatory response to hypoxia at rest and during exercise. They found no significant difference between the two groups in any of the PFT parameters static lung volumes & dynamic lung volumes at rest were similar between the two groups. They opined that pulmonary function may not change much with training, but ventilatory response to exercise should have changed but it remained same because of decrease in dyspnea sensation at higher VO_2 levels leading to a similar VE/VO_2 values.

Body builders have more muscle mass or to put in another way, have more of metabolizing tissues. In a study done by Mc. Innis et al. [20] VO_2 or O_2 consumption was measured at rest and at different levels of exercise. Taken alone VO_2 at any level of exercise was higher in body builders than sedentary controls. But when net VO2 (exercise VO_2 – rest VO_2) was compared between the groups, it was not significantly different. So it can be assumed that higher VO_2 max in body builders is not because of changes in pulmonary or cardiac systems, but due to increased O_2 demand at rest by the increase muscle mass. This may explain the indifference of PFT values between bodybuilders and controls in our study.

CONCLUSION

In conclusion, the current study has shown that, pulmonary system's structural parameters are genetically determined and may not be significantly malleable to exercise training like body building. Our study supports many western and Indian studies in that, PFT values do not change significantly with bodybuilding.

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