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ORIGINAL ARTICLE

DYNAMIC LUNG FUNCTIONS IN UNDERWEIGHT GUJARATI INDIAN ADOLESCENTS BOYS

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ABSTRACT

Background: Underweight due to poor nutrition is the serious problem in our country. Undernourishment is associated so many health problem in children and adolescents. The objective of the study was to study the association of underweight on dynamic lung functions in Gujarati Indian adolescents.
Methodology: A cross sectional study was conducted on 85 Gujarati Indian adolescents boys of 17-21 years age group. The nutritional status of the participants was assessed by measuring BMI and they were grouped into normal weight and underweight boys. Total body fat % and fat mass were measured by Omron Body Fat Monitor HBF-302. Dynamic lung functions (FEV1, FEV6, FEV1/FEV6 and PEFR) were recorded, using Piko-6 and Wright's Peak flow meter.
Results: FEV1 (P <0.01), FEV6 (P <0.01) and PEFR (P <0.01) were found to be significantly lower in the underweight boys in comparison to the normal weight boys. BMI showed a significant positive correlation with dynamic lung functions. Amongst underweight boys body mass index and fat mass index were directly associated with dynamic lung functions.
Conclusion: We may conclude that nutritional status plays a major role in dynamic lung functions in Gujarati Indian adolescents.

Keywords: Underweight boys, body mass index, fat mass index, dynamic lung functions, Gujarati Indian Adolescents

INTRODUCTION

Our country is facing dual burden of underweight and overweight[1]. Approximately 43-48% of Indian man and woman of 15 -45 years of age group are facing this dual burden, out of which 30-36% people are underweight and 9-13% people are overweight [1]. Underweight due to under-nourishment is most common problem in developing countries and it is burning issue in our country[2,3]. Though underweight is commonly seen in rural areas, it is not uncommon in urban areas.

Underweight is not a disease by itself but its ramifications are very vast[4] . Studies have demonstrated that pulmonary function tests vary with weight and body fat %[5]. Under-nourishment reduces diaphragm contractility by reducing muscle mass and also reduces other respiratory muscle mass[6]. In comparison to normal weight subjects, underweight subjects show reduced diaphragmatic motion[7]. In underweight persons respiratory muscle and exercise performance are poor. Under- nutrition is associated with severe airflow obstruction. Low FEV1, FVC and PEFR are directly correlated with high pulmonary, cardiovascular and general mortality and morbidity[8]. The effect of nutritional status on pulmonary functions has also been observed in Chronic Obstructive

Pulmonary Disease (COPD). Underweight patients of COPD are found to have lower dynamic lung functions and reduce exercise efficiency which has been linked to muscle wasting and low fat free mass[9]. Nutritional therapy has also been found to improve lung functions in COPD[10].

The objectives of conducting the current study were two. First, though sufficient literature is available indicating the effect of nutritional status on dynamic lung functions, most of the research conducted so far has mainly shown the relationship of BMI with dynamic lung functions and not much is known about the effect of adiposity per se on the dynamic lung functions. Second, not much is known about the relationship in Gujarati Indian adolescents and since ethnic differences exist in the aetiopathogenesis of disease, it is essential to study the local population. Hence, we conducted the current study to understand the impact of nutritional status especially, adiposity per se, on the dynamic lung functions in Gujarati Indian adolescents.

MATERIAL AND METHODS

A cross sectional study was conducted on 85 Gujarati Indian Adolescent boys of 17 –21 years age group, studying at college in the vicinity after taking the approval of Institute's Human Research Ethics Committee. Students were informed about the nature of study, procedure and usefulness of the study to our country. Informed consent was taken from the each volunteer. All the students were physically healthy without any disease or symptoms. Students having any respiratory problems and taking treatment for any disease and those who are doing regular exercise of any type were excluded from the study.

Nutritional Status:

The body composition was assessed in a light weight of clothing. Body weight was recorded in kilograms on an empty bladder and before lunch on a Krups weighing machine. The body weight (Wt) was recorded bare footed to the nearest 0.1 kg. The height was measured using meter scale without footwear to the nearest 0.1 cm. BMI was calculated as the weight (kg) divided by the square of height (m^2). Total Body Fat Percentage (BF %) and Body Fat Mass (FM) was assessed by bioelectrical impedance technique using Omron Body Fat Monitor HBF - 302. Fat Mass Index (FMI) was calculated as the Fat Mass (kg) divided by the square of height (m^2) .Fat free mass (FFM) was calculated by deducting fat mass from body weight and Fat Free Mass Index (FFMI) was calculated as the Fat Free mass (kg) divided by the square of height (m^2) [11].

Dynamic Lung Functions:

FEV_1, FEV_6 and FEV_1 /FEV_6 were recorded by Piko-6. PEFR was recorded by Wright's peak flow meter. These tests were recorded at noon before lunch, as expiratory flow rates are highest at noon[12]. All dynamic lung functions were recorded on the same day, in sitting position with head straight. Prior to testing, all tests were explained and demonstrated to each student volunteer. For each volunteer three readings were taken at full effort and the best one was taken for the study as per the guideline of the American Thoracic Society [13].

Statistical Analysis:

Statistical analysis was conducted after grouping the participants into normal weight boys (having BMI in range of 18.5 to 24.9 kg/m^2) and underweight boys (having BMI ≤ 18.4 kg/m^2).

Mean and standard deviation were calculated for the study variables. Student unpaired t-test was used to determine if any significant differences ($P<0.05$) existed in the body composition and dynamic lung functions between the normal weight and underweight subjects. Pearson's correlation coefficient was determined to study the Correlationship of body composition with dynamic lung functions.

RESULTS

The result of anthropometric parameters of the normal weight boys and underweight boys are given in Table 1. In our study age and height of the subjects were homogenous. In underweight boys, total body fat % and fat mass were reduced significantly ($P < 0.01$).

The dynamic lung function tests parameters are given in Table 1.The measured mean values of the dynamic lung functions (FEV1, FEV6 and PEFR) were significantly reduced in underweight boys ($P < 0.01$).

As per Table 2, in underweight boys BMI showed significant positive correlation with FEV1 ($r = 0.47$), FEV6 ($r = 0.46$) and PEFR (r =

0.38). In underweight boys FMI showed significant positive correlation with FEV1 (r = 0.22) and PEFR (r = 0.22).

Table 1: Comparison of dynamic lung functions between normal and underweight Gujarati Indian adolescents

Parameters (n)	BOYS	
	Normal Weight (n=45)	Underweight (n=40)
Age (years)	19 ± 1.2	18.6 ± 0.93
Height (cm)	1.73 ± 0.06	1.71 ± 0.1
Weight (kg)	60 ± 6.16	49.9 ± 4.36*
BMI, kg/m^2	19.9 ± 0.52	16.87 ± 0.88*
Total Body Fat%	17 ± 4.85	11 ± 3.34**
Fat Mass, kg	10.2 ± 2.95	5.76 ± 2.3**
FMI	3.41 ± 1.04	1.96 ± 0.756***
FFM	49.86 ± 5.5	44.14 ± 4.14
FFMI	16.64 ± 1.06	15.07 ± 0.856
FEV1	2.75 ± 0.56	2.28 ± 0.50**
FEV6	3.17 ± 0.59	2.63 ± 0.59**
FEV1/FEV6	0.84 ± 0.15	0.86 ± 0.07*
PEFR	547 ± 67.2	495 ± 74.7**

Values indicate Mean ± SD , *P<0.05, **P<0.01, ***P<0.001

Table 2: Correlation of BMI and FMI with dynamic lung functions in Gujarati Indian adolescents

Explanatory Variable	BMI	FMI
FEV1	0.47**	0.22*
FEV6	0.46**	0.18
FEV1/FEV6	0.02	0.13
PEFR	0.38**	0.22*

Values indicate *P<0.05, **P<0.01

DISCUSSION

Lung function in normal subject may vary due to age, gender, height, weight, body fat, physical activity status and ethnic differences[5]. Our study indicates that underweight Gujarati Indian adolescents have a significantly lower dynamic lung functions as compared to the normal weight adolescents which is in line with findings reported by D J Chinn and J E Cotes et al [14,15].

As per study of T J Ong, malnourished children were found to have a significantly reduced lung function and there is direct correlation of lung function with weight[16]. M M Faridi, Pratibha Gupta and co-workers showed that lung function reduces in undernourished children and later on it was supported by R Harikumaran Nair et al. [17,18] . Lung function shows U shaped relationship with body mass index [19], that means diminished lung function is seen at both extremes of body mass (underweight or obese)[19,20] and remains normal within normal range of BMI.

We believe that this difference is probably due to the differences in the body composition of underweight and normal weight adolescents. Body mass mainly consists of fat mass and lean mass (fat free mass). Reduced body mass is suggestive of either reduced fat mass or reduced fat free mass or both [14]. One such significant difference which has been observed in our study is the difference in body fat percentage which is found to be significantly lower in underweight adolescents as compared to their normal weight counterparts. As it has been observed in the study that adiposity has a significant positive correlationship with dynamic lung function[21], it is thus possible that lower body fat in underweight as compared to normal weight may be responsible for the lower dynamic lung functions amongst the underweight. This may be explained by the fact that sympathetic activity is influenced by adiposity and increase adiposity is accompanied by sympathetic overactivity[20,21]. It is thus possible that low body fat percentage may be associated with lower sympathetic activity such that it increases the bronchial tone resulting in lower air flow.

The other probable cause of low dynamic lung functions in undernourished may be the lower level of muscle mass. There is direct positive relationship between fat free mass (FFM) and lung functions[21]. In prolonged undernutrition, energy utilized at the expense of muscle protein. There may be reduction in respiratory and diaphragmatic muscle mass. Studies have shown a direct positive association of lung function with diaphragm and other respiratory muscles. This is supported by study of Lewis MI, et, al and Kelsen SG, et al, in animals, undernutrition reduces diaphragm muscle fibre and causes deleterious changes in diaphragm muscle structure that ultimately impairs diaphragm's ability to generate force [22,23].

CONCLUSION

It may thus be concluded that lower adiposity level tends to decrease the dynamic lung functions in Gujarati Indian adolescents.

LIMITATION AND FUTURE PERSPECTIVE

A major limitation in the current study is that it is a cross-sectional study which is a useful but a weak tool in the assessing the relationship between association of body mass with dynamic lung function in underweight boys. In future we want to work on undernourishment and its consequences on various body functions.

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