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Forced Vital Capacity Parameters in Tibetan Youths Born and Residing in India

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Abstract

Background and Objective -There is evidence of considerable variation in pulmonary functions in different ethnic groups, between races and across generations attributed to genetic factors leading to the formation of airways of different size or with different elastic recoil. This study was aimed to evaluate and compare pulmonary functions between Tibetan males with Indian origin and young Indian males.

Materials and Method- Forced Vital Capacity parameters (measured using spiroanalyser SPL -95) of 50 Tibetan males aged 20-30 years born and brought up in Mundgod, North Karnataka District, were compared with 50 Indian males matched for age, sex, height and weight as controls. The obtained data was analyzed between the two groups by applying unpaired student's 't' test.

Results -The anthropometric data between the two groups showed no statistical significant difference. The FVC (litres), FEV_1(L/sec) and FEV_1/FVC were higher in Tibetan males with Indian origin when compared to Indian males being statistically significant at $P<0.001$ [95% CI(0.79,1.08), (0.87, 1.20) and (0.02,0.06) respectively]. Flow rates [MMEF (L/sec), $MEF_{75\%}$(L/sec) and $MEF_{50\%}$(L/sec)] were higher in Tibetan males as compared to Indian males. MMEF was statistically significant at $P<0.01$[95% CI (0.24, 1.17)] , $MEF_{75\%}$ and $MEF_{50\%}$ were statistically significant at $P<0.001$ [95%CI (2.13, 3.73) and (0.43, 1.51) respectively]. The $MEF_{25\%}$ was lesser in Tibetan males than compared to Indian males but was not statistically significant.

Conclusion - There is a difference in lung functions between Tibetan youths with Indian origin and Indian youths though both share similar environmental challenges showing that Tibetan males with Indian origin still retain better respiratory parameters as their ancestors which could be due to their inheritance of genetic factors that favour their survival at a high altitude.

Keywords- *Tibetan males with Indian origin, Indian males , pulmonary function, environmental factors.*

Introduction

Pulmonary function testing measures the function of lung capacity and chest wall mechanics to determine whether or not the patient has a lung problem[1]. A person's genetic constitution influences the size of lungs. Additional variation is contributed by selective migration, nutrition, habitual activity and other environmental factors. Together these factors give rise to ethnic differences in lung volumes and related indices between people[2]. Tibetans are the oldest population living permanently at high altitude (4000m)[3]. Previous research has shown that Tibetans living at high altitude have superior pulmonary functions[4]. Pulmonary gas exchange functions such as lung volumes and diffusing capacity may be more strongly influenced by environmental and developmental components[5]. In the early 1960s (52 yrs back), Tibetans had come to India as refugees for political shelter. Present Tibetan youths of this study have been born and brought up completely in India since then. There are very few studies in India which have thrown

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light on this subject. These factors have made us to study respiratory volumes and capacities in these Tibetan young males with Indian origin and to compare the data with other young Indian males.

Materials and Method

A comparative study was conducted on 50 healthy Tibetan young males with Indian origin aged 20-30 years born and residing in Mundgod, North Kannada District, Karnataka and 50 other young Indian males, (students of Karnataka Institute of Medical Sciences, College, Hubli) matched for age, sex, height and weight as controls. This study was carried out during June 2011 to May 2012.

In the present study visits were made to Mundgod to sensitize the Tibetan youths regarding objectives of the present study. This study was carried out at DTR (Doeguling Tibetan Resettlement) hospital, Mundgod. Assistance of local doctors and technician was obtained to inform the details of the tests to Tibetan youths in their own language.

The study and its conduct were cleared from institutional research and ethical committee. The prior permission of subjects and controls were taken and an informed written consent from the youths involved in the study were obtained. A detailed Performa was filled up for both subjects and controls and a thorough clinical examination of each subject was done to rule out any significant findings coming under the exclusion criteria.

About 75 Tibetan young males with Indian origin had come forward amongst which 50 were randomly selected on the basis of following inclusion and exclusion criteria. Similarly height and age matched 50 young Indian males, (students of medical college KIMS, Hubli), were involved as controls in the present study.

Inclusion criteria:

Healthy young Tibetan males born and residing in India and never migrated to Tibet or to any other high altitude regions.

Exclusion criteria:

Youths born in India but travelled to Tibet or to any other high altitude regions.

History of smoking.

History of occupational hazards / exposure to dust (particulate matter).

History of COPD and obstructive sleep apnoea syndrome.

History of congenital cardiopulmonary diseases.

History of Diabetes Mellitus, Hypertension.

History of medications like antihypertensive, antitubercular drugs.

History of addiction to narcotics.

Age less than 20yrs and more than 30yrs.

History of allergy and any bone deformity of chest and spine.

Anthropometric data like height, weight, body surface area (BSA) and body mass index (BMI) of each subject and control was recorded. BSA was calculated using Dubois nomogram. BMI was calculated using the formula BMI=Weight in kg / Height in metre^2. Vital parameters like pulse rate, blood pressure and respiratory rates were recorded. A detailed clinical examination of respiratory, cardiovascular and central nervous system was done.

Evaluation of forced respiratory parameters and flow rates such as Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV_1), Maximal Mid Expiratory Flow Rate (MMEFR), Maximal Expiratory Flow Rate at 75% FVC ($MEF_{75\%}$), Maximal Expiratory Flow Rate at 50% FVC ($MEF_{50\%}$) and Maximal Expiratory Flow Rate at 25% FVC ($MEF_{25\%}$) were carried out on both the groups by using Spiroanalyser SPL-95.The instrument was calibrated daily using calibration syringe of 2 litres. The obtained data was tabulated, analysed and expressed as Mean ± Standard Deviation (Mean ± SD) to assess anthropometric, vital and various Pulmonary Function Test parameters in the 2 groups. In order to compare the level of PFT parameters between the two groups, the unpaired student's 't' test was applied by using SPSS version 16 and statistical significance was indicated by 'P' value less than 0.05 ($P < 0.05$) at 95% confidence intervals (95% CI).

Procedure-The sensor was kept on the stand and the FVC key pressed. The subject was asked to keep the mouthpiece in mouth taking care to avoid obstruction by tongue. The start button was pressed and subject

was asked to take a maximum inspiration followed by forceful expiration and then followed by maximum inspiration after which the stop button was pressed. The screen displays values and graphs representing FVC, FEV_1, MMEF, $MEF_{75\%}$, $MEF_{50\%}$, $MEF_{25\%}$. The best one of the three tests was used as observed value.

Results

In the present study the anthropometric data [age in years, height in cms, weight in kgs, BMI in kg/m^2 and BSA in sq.m] of Tibetan males with Indian origin when compared to Indian males showed that the mean and standard deviation observed was not significant statistically ($P > 0.05$) [95 % CI (-0.25, 2.61), (-1.86, 3.22), (-2.84, 5.40), (-0.91, 1.53) and (-0.10, 0.02) respectively]. (Table No-I)

The vital parameters [respiratory rate (breaths/min), pulse rate(beats/min), systolic blood pressure (mmHg) and diastolic blood pressure (mmHg)] of Tibetan males with Indian origin and Indian males showed that the mean and standard deviation observed was statistically significant in Tibetan young males with Indian origin [95% CI (0.42,2.50), (1.39, 4.88), (-0.39, 4.15) and (-4.29, -0.26) respectively] except for systolic blood pressure which was not statistically significant. (Table No-II)

The forced vital capacity parameters [FVC (litres), FEV_1(L/sec) and FEV_1/FVC] were higher in Tibetan males with Indian origin when compared to Indian males being statistically significant at $P<0.001$ [95% CI(0.79,1.08), (0.87, 1.20) and (0.02,0.06) respectively]. (Table No-III)

Flow rates [MMEF (L/sec), $MEF_{75\%}$ (L/sec) and $MEF_{50\%}$ (L/sec)] were higher in Tibetan males with Indian origin as compared to Indian males. MMEF being statistically significant at $P <0.01$[95% CI for MMEF(0.24, 1.17)], but $MEF_{75\%}$ and $MEF_{50\%}$ being statistically significant at $P <0.001$ [95% CI for $MEF_{75\%}$ and $MEF_{50\%}$ were (2.13, 3.73) and (0.43, 1.51) respectively]. The $MEF_{25\%}$ was lesser in Tibetan males with Indian origin than compared to Indian males but this was not statistically significant [95% CI (-0.42, 0.27)].(Table No-III)

Discussion

Although our subjects in the present study were well matched for age, body size and nutritional condition, we observed that the values of FVC, FEV_1, FEV_1/FVC, MMEF, $MEF_{75\%}$ and $MEF_{50\%}$ in Tibetan young males with Indian origin were significantly higher than those in the young Indian males. The flow rates indicate the patency of smaller airways.

FVC is an important index of pulmonary function.[6] Increase in FVC may be due to the relative increase in the negativity of the intrapleural pressure which may be brought about by an increased expansion of thoracic cavity by muscles of respiration.[7] The difference in FVC and FEV_1 between Tibetan refugees and Caucasians was related to differences in height between the 2 groups.[8] Recent studies confirm that FEV_1, exhibit systemic differences between ethnic groups.[9] One of the study concluded that higher PFT values in Tibetan youths are due to their having a greater alveolar surface area and increased capillary surface volume and a greater capacity in their O_2 transport system.[9] A study observed that Tibetans born at low altitude do not seem to differ from lowlanders with regard to their metabolic responses whereas their ventilatory response to exercise is greater.[10] One of the studies comparing Tibetans and Caucasians observed that Tibetan lowlanders born with genetic adaptations of their ancestors, could be expected to acclimatize to high altitude more quickly than Caucasians.[11] Another study found that there was no statistically significant difference in pulmonary functions between Tibetan refugees and Caucasians living at moderate altitude.[5] Tibetan lowlanders born with genetic adaptation of their ancestors could be expected to perform better cardiorespiratory parameters. Tibetan lowlanders are characterised by smaller muscle fibre cross- sectional area, this adaptive change may result in a shorter diffusion path for oxygen at the muscular level.[11] In one study it was found that there is an association between genetic ancestry and lung functions among subjects who identified themselves as African Americans.[12] A study showed that improved pulmonary functions indicate that there could be a change in the compliance of the lungs and a possible increase in surfactant levels.[13] Another study provided the data which indicates that growth at high altitude produces small to moderate increase in lung volumes (about 6%) relative to genetically similar groups growing up at low altitude[14]. This indicates that environmental factors have interfered in the lung function test values of Tibetan young males with Indian origin. Ancestors

of the Tibetans youths of our study had been living at high altitude since birth, whereas Indian youths of our region were born at sea level. Lung functions are influenced by chest wall anatomy, mechanical properties of the thorax, parenchymal lung development and current body mass index.[15] More precise information is also needed regarding the genetic factors underlying the characteristics of ventilatory functions of Tibetan youths.[16]

Conclusion

The pulmonary function parameters such as FVC, FEV_1, FEV_1/FVC, MMEF, $MEF_{75\%}$ and $MEF_{50\%}$ showing significantly higher values in Tibetan males with Indian origin compared to Indian males may be due to stronger forces of contraction of the respiratory muscles, high compliance, mechanical properties of thorax and better parenchymal lung functions. Though Tibetan young males with Indian origin of our study were born and brought up in India and never migrated to Tibet or any other high altitude regions, most of the pulmonary function test values are found higher in them. Though both Tibetan young males with Indian origin and other young Indian males shared similar environmental challenges, this difference in PFT could be attributed to genetic component. These genetic effects on pulmonary function tests may be obscured after some years because of environmental conditions existing in their camps. Environmental factors (staying at sea level) just like that of other young Indian males have not made their impacts on effects on the lung function tests of Tibetan young males with Indian origin that are genetically inherited. Therefore it is required to evaluate the role of genetic versus environmental factors in the genesis of better lung function tests in Tibetan young males with Indian origin.

Table No-I: The anthropometric data of Tibetan young males with Indian origin and other young Indian males

	Tibetan young males with Indian origin	**Young Indian males**	**'t' value**	**(95% CI)**
No. of Subjects	50	50		
Age (years)	25.58 ± 4.11	24.40 ± 3.00	1.63	(-0.25, 2.61)
Height (cms)	169.70 ± 6.68	169.02 ± 6.14	0.53	(-1.86, 3.22)
Weight (kgs)	66.30 ± 11.58	65.02 ± 9.06	0.615	(-2.84, 5.40)
BMI (kg/m^2)	23.00 ± 3.66	22.69 ± 2.38	0.49	(-0.91, 1.53)
BSA (sq.m)	1.72 ± 0.15	1.75 ± 0.17	-1.10	(-0.10, 0.02)

*P < 0.05, **P <0.01, ***P<0.001

P-value: P < 0.001 HS Highly significant, P 0.01 to 0.05 S Significant, P > 0.05 NS Not significant

Table No-II: The vital data of Tibetan young males with Indian origin and other young Indian males

	Tibetan young males with Indian origin	**Young Indian males**	't' value	(95% CI)
No. of Subjects	50	50		
RR(per min)	16.64 ± 2.84**	15.18 ± 2.37	2.78	(0.42, 2.50)
Pulse (beats/min)	78.34 ± 4.77***	75.20 ± 3.98	3.57	(1.39, 4.88)
SBP (mmHg)	122.60 ± 5.33	120.72 ± 6.08	1.64	(-0.39, 4.15)
DBP (mmHg)	77.48 ± 4.56	79.76 ± 5.53*	-2.24	(-4.29, -0.26)

*P < 0.05, **P<0.01 and ***P<0.001

P-value: P < 0.001 HS Highly significant, P 0.01 to 0.05 S Significant, P > 0.05 NS Not significant

Table No- III: Comparison of forced vital capacity parameters and flow rates between Tibetan young males with Indian origin and other young Indian males

Variables	Tibetan young males with Indian origin	Young Indian males	't' value	(95% CI)
No. of Subjects	50	50		
FVC (Litres)	4.59 ± 0.40***	3.65 ± 0.34	12.66	(0.79, 1.08)
FEV_1 (L/sec)	4.17 ± 0.49***	3.13 ± 0.31	12.64	(0.87, 1.20)
FEV_1 / FVC	0.90 ± 0.04***	0.85 ± 0.04	5.18	(0.02, 0.06)
MMEF (L/sec)	4.14± 1.38**	3.43 ± 0.93	3.00	(0.24, 1.17)
$MEF_{75\%}$ (L/sec)	7.28 ± 2.26***	4.34 ± 1.70	7.31	(2.13, 3.73)
$MEF_{50\%}$ (L/sec)	4.80 ± 1.54***	3.82 ± 1.15	3.59	(0.43, 1.51)
$MEF_{25\%}$ (L/sec)	2.30 ± 1.05	2.38± 0.67	-0.44	(-0.42, 0.27)

*P < 0.05, **P<0.01, ***P<0.001

P-value: P < 0.001 HS Highly significant, P 0.01 to 0.05 S Significant, P > 0.05 NS Not significant

Conflict of Interest –Nil

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