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BIRTH WEIGHT AND LUNG FUNCTIONS IN MALE ADOLESCENTS

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Abstract : The aim of this comparative retrospective cohort study was to examine the associations between birth weight and lung function in cohort of 70 adolescent male children aged 12–16 years. The subjects, born in nursing homes located in vicinity of the institution having their complete birth records were traced. They were male children between ages of 12–16 years. Lung function parameters were measured using a portable spirometer DATOSPIR 120 B. The corrected mean difference (95% confidence interval) in forced vital capacity (FVC) was –0.19 ml (–0.55 to 0.16) this was significantly lower in low birth weight group (LBW) as compared to normal birth weight children. All other lung function parameters were not significantly different in the two groups. We did not find a significant association between birth weight at term and lung function parameters in the adolescent age group. While mean FVC which was found to be lower in LBW group in our study might be due to programming in infancy rather than intrauterine life. Our results did not support Barker Hypothesis according to which adverse influences during intrauterine life result in increased disease risk in ‘adulthood.

Key words : birth weight lung functions adolescents

INTRODUCTION

It has been postulated that adult organs are programmed in fetal life. The ‘developmental origins of adult disease hypothesis’, often called the Barker hypothesis after one of its leading proponents, states that adverse influences early in development and particularly during intrauterine life, can result in permanent changes in physiology and metabolism which result in increased disease risk in adulthood (1). It is suggested that such programmed changes in utero also initiate the development of chronic airflow obstruction in adult life (2, 3). Low birth weight (LBW) is reported to be associated with reduced lung function or with increased incidence or prevalence of respiratory illnesses in children (4, 5), adolescents (6) and adults (2).

Intrauterine growth retardation of fetus and small size at birth are widespread in India (7) but very few studies have determined the relationship of fetal growth and adult lung functions. Previous studies of lung function in South Indians have reported lower values for forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC) and peak expiratory flow rate (PEFR) than in European populations (8, 9). Lung functions also seem to be influenced

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by current body mass index (BMI) and its changes in later life. Hence the present study was planned to investigate the association of birth weight and lung functions after controlling for confounding factors like maternal smoking, body mass index, socio economic factors, education and smoking in Indian adolescent population.

MATERIALS AND METHODS

This comparative retrospective study was carried out in 77 subjects at Department of Physiology, University College of Medical Sciences & Guru Teg Bahadur Hospital, Delhi – 110 095. After excluding for error 70 were included for analysis. They were divided into two groups :

Group 1 : (Study group; n = 35) : low birth weight children (<2.5 kg).

Group 2 : (Control group; n = 35) : normal birth weight children (≥2.5 kg).

Sample size of 35 was taken to detect a difference of 2.5 L in FEV_1 between the two groups with the standard deviation of 0.3, alpha of 5% and power of 80% (10).

The subjects selected were born in the nursing homes, located in the vicinity of institution (running since 20 years) and having their complete birth records. These were all males in the age group of 12–16 years. They were traced and grouped according to their birth weight. Controls were age matched with the subjects. Children were mostly from middle income group families according to Kuppuswamy scale (11).

The study was approved by Institute's Research and Ethical Committee. Informed written consent was taken from parents before starting the study. The subjects were called in batches of 2–3 on two days in a week to the laboratory. Anthropometric measurements (weight, height & chest circumference) of both cases and controls were recorded and were entered into the spirometer. The standing height of each child was measured without shoes using a portable stadiometer to the nearest 1 cm and weight by weighing scale to the nearest 1 kg.

A questionnaire was prepared and filled for each subject and those not meeting the criterion given below were rejected. A preliminary clinical examination was done on each to rule out any abnormality/disease. An exclusion criterion was prepared for the selection of subjects comprising of the following : (1) History of upper respiratory tract infection in preceding 3 weeks. (2) Any systemic illness which directly or indirectly influences the respiratory system. (3) Children of low socioeconomic status. (4) Pre pubertal males. (5) Past or present history of smoking. (6) smoker in the family. (7) Children on any medication.

The pulmonary function tests were carried out on subjects using SIBELMED DATOSPIR 120 B precision portable spirometer from Spain with built in computer program using standard laboratory methods. This spirometer is a very sensitive instrument providing a detailed analysis of predicted and observed values. The machine was calibrated daily.

The procedure for performing a FVC maneuver was demonstrated in detail to the subject. After a few practice blows, three reproducible blows (defined as FVC within 10% of the maximal FVC) were produced. The subjects were encouraged to perform these tests to the best of their ability. Graphs which showed hesitancy or cough were not used in the analyses. Of the acceptable recordings for each subject, the one which showed the largest FVC was used to extract the data. For slow vital capacity (SVC) after taking 3-4 tidal breaths, the subject was asked to inhale and exhale slowly and maximally and recording was noted on the spirometer monitor. All lung volumes, capacities and flow rates were measured. The room temperature and barometric pressure were fed into the spirometer to obtain results at BTPS.

Statistical analysis

It was done using SPSS version 13.0. Unpaired Student's 't' test was used to assess the significance of difference between the means for all pulmonary function test (PFT) parameters and anthropometric variables. Multiple regression was used taking PFT as dependent variable (separately for each parameter), while independent variables were birth weight, final age, and BMI for all the cases.

RESULTS

Mean (SD) of all the anthropometric measurements in the two groups (LBW vs. Controls) is depicted in Table I. No significant difference was observed between the two groups for height, 50th percentile height, weight, 50th percentile weight, body mass index (BMI), 50th percentile BMI and chest circumference.

Table II shows mean±SD of all

TABLE I : Anthropometric measurements in low birth weight and normal birth weight children.

Variable	*LBW Mean±S.D. (n=35)*	*Controls Mean±S.D. (n=35)*	*Mean difference*	*95% CI of the difference*	*P value †unadjusted*
Birth weight (kg)	2.12±0.38	3.53±0.42	–1.033	–1.23 to –0.82	<0.001*
Age (yr)	14.25±1.42	13.86±1.38	0.38	–0.28 to 1.05	0.253
Height (cm)	151.58±13.17	154.34±9.74	–2.76	–8.25 to 2.73	0.320
50th Percentile Height (cm)	163.84±8.25	161.55±8.31	2.28	–1.63 to 6.21	0.249
Weight (kg)	46.83±12.17	47.77±10.39	–0.93	–6.3 to 4.42	0.728
50th Percentile Weight (kg)	52.03±7.13	50.26±7.12	1.764	–1.61 to 5.14	0.301
BMI (kg/m^2)	20.08±2.98	19.88±2.74	0.21	–1.15 to 1.55	0.768
50th % BMI (kg/m^2)	19.34±0.98	19.04±0.97	0.27	–0.19 to 0.73	0.244
Chest Circumference(cm)	77.53±10.61	77.74±6.92	–0.22	–4.47 to 4.04	0.920

†Unpaired t test *Significant P<0.05.

TABLE II : Volumes and capacities in low birth weight and controls.

Lung variable	*LBW Mean±S.D. (n=35)*	*Controls Mean±S.D. (n=35)*	*Mean difference*	*95% CI of the difference*	*P value †unadjusted*	*P value †adjusted*	*Standardized coefficient*
FVC (L)	2.65±0.72	2.84±0.80	–0.19	–0.55 to 0.16	0.294	0.038*	–0.24
FEV1 (L)	2.44±0.64	2.55±0.75	–0.11	–0.43 to 0.22	0.52	0.17	–0.15
% FEV1 (%)	111.36±17.1	111.38±21.4	–0.02	–9.18 to 9.14	0.99	0.24	0.23
FEV 0.5(L)	1.75±0.57	5.63±22.3	–3.87	–11.3 to 3.55	0.30	0.19	–0.26
FEV0.5/FVC (%)	71.32±11.39	69.9±18.01	1.42	–5.69 to 8.53	0.69	0.62	–0.1
FIVC (L)	1.22±1.06	1.21±1.2	0.001	–0.53 to 0.54	0.99	0.93	0.01
VC (L)	2.71±1.08	2.69±0.68	0.01	–0.32 to 0.36	0.92	0.86	–0.02
TV (L)	0.9±0.33	0.8±0.34	0.08	–0.07 to 0.24	0.3	0.75	0.06
ERV (L)	1.12±0.47	1.09±0.32	0.02	–0.16 to 0.21	0.79	0.46	–0.122
IRV (L)	0.68±0.37	0.77±0.44	–0.08	–0.27 to 0.10	0.39	0.91	0.018
IC (L)	1.59±0.45	1.59±0.5	0.001	–0.22 to 0.23	0.99	0.7	0.06
MVV (L/min)	79.11±25.77	89.3±30.62	–10.16	–23.56 to 3.12	0.13	0.584	–0.081

†unpaired t test;
‡adjusted for final age, height, weight and BMI by Multivariate analysis;
*significant P<0.05

TABLE III : Flow rates in low birth weight and controls.

Lung variable (L/s)	*LBW Mean±S.D. (n=35)*	*Controls Mean±S.D. (n=35)*	*Mean difference*	*95% CI of the difference*	*P value †unadjusted*	*P value †adjusted*	*Standardized coefficient*
PEFR	2.92±0.45	3.26±0.42	–0.34	–0.25 to –0.63	<0.32	<0.64	–0.078
MEF 25%	1.96±0.74	2.24±0.77	–0.27	–0.63 to 0.08	0.13	0.2	–0.225
MEF 50%	3.26±1.13	3.92±2.08	–0.66	–1.45 to 0.12	0.09	0.50	–0.124
MEF 75%	4.49±1.76	4.47±1.77	–0.01	–0.82 to 0.85	0.08	0.82	0.035
FEF 25-75%	3.08±1.1	3.36±1.13	–0.28	–0.81 to 0.24	0.28	0.27	–0.17
FEF 75-85%	1.56±0.58	1.84±0.63	–0.27	–0.56 to 0.01	0.05	0.34	–0.169
MIF 50%	–0.47±9.77	–1.88±18.87	1.4	–5.68 to 8.49	0.69	0.79	0.05

†unpaired t test;
‡adjusted for final age, height, weight and BMI by Multivariate analysis;
*significant P<0.05

the volumes and capacities in the two groups (LBW vs. Controls). Comparing the group means by unpaired independent 't' test, no difference was observed between the two groups for all lung volumes and capacities when compared without adjusting for confounding factors. On multivariate analysis Mean FVC in LBW group was found to be significantly lower when adjusted for confounding factors like birth weight, age and BMI in the two groups (mean difference –0.19, P 0.038 and β –0.24).

Mean±SD of all the flow rates in the two groups (LBW vs. Controls) is depicted in Table III. Flow Rates were not significantly different in the two groups.

DISCUSSION

In the present study we have observed significantly lower mean FVC in Low birth weight cohort as compared to controls. Children born with lower birth weight tend to have poor lung function than those of higher birth weight (5, 9, 12–14) although longitudinal data assessing the relationship between birth weight and adult lung function are limited and findings have been conflicting (2, 3, 15–21). The association between the fetal development and airway function is likely to be complex, involving causal pathways that include genetic, prenatal and postnatal environmental factors (22).

Mean FVC amongst the volumes and capacities measured in our LBW was lower than in controls. Similar results were seen in other western studies (3, 12, 14, 25) while Barker et al and Bua et al did not find an association between FVC and birth weight (2, 15). The conflicting evidence could be due to lack of control for maternal factors such as maternal height, maternal BMI and maternal smoking that influence birth weight but do not imply an adverse environment in utero.

The interpretation of our findings are in favor of theory of dysanaptic growth of lung components which states that during fetal development all airway branches are formed by the 16th week of gestation, with subsequent prenatal and postnatal growth of the airways resulting from an increase in size rather than number. By contrast, there is a rapid increase in alveolar number during the first 2 years of life, resulting in greater increase in lung volume than airway size during this period (23, 24). Hence components of lung behavior which determine FVC, as opposed to FEV_1, are programmed in infancy rather than intrauterine life.

Mean FEV_1 in our study was not significantly different in the two groups. This was in contrast to western studies where FEV_1 reportedly decreased with decreasing birth weight (2–4, 9, 25–27). In some of these studies it was uncertain whether the finding was related to premature delivery than to intra uterine growth restriction (2, 5). In one of the studies the subjects comprised of very low birth weight (<2 kg) children while most of the subjects in our study had birth weight in the range of 2–2.5 kg. Also FEV_1 is an unreliable index of flow in children of this age (4). A study conducted in British women found a weaker positive linear association between birth weight and all measures of lung function and this could be due to effect of bias from their use of self reported birth weight while we used hospital records as an index of birth weight (17). Maternal smoking during pregnancy is a strong determinant of birth weight (28) and could affect adult lung function (29, 30). In our study group maternal smoking as well as participant smoking were taken into account as confounding factors and were excluded from the study.

Our study has the strength that information for both birth weight and duration of pregnancy was obtained by medical records rather than parental recall and a large number of possible confounding variables like maternal smoking, body mass index, socio economic factors, education and smoking in Indian adolescent population were taken into consideration while analyzing the results. Adjustment for differences in age, height, weight and BMI on lung function was made using multiple regression analyses.

No association was demonstrated between birth weight at term and lung function parameters in the adolescent age group although mean FVC was found to be lower in LBW group, it may be due to programming in infancy rather than intrauterine life. Hence the present result supports the studies that did not find a significant association.

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