 CHEST

Impact of Childhood Anthropometry Trends on Adult Lung Function

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BACKGROUND: Poor fetal growth rate is associated with lower respiratory function; however, there is limited understanding of the impact of growth trends and BMI during childhood on adult respiratory function.

METHODS: The current study data are from the Mater-University of Queensland Study of Pregnancy birth cohort. Prospective data were available from 1,740 young adults who performed standard spirometry at 21 years of age and whose birth weight and weight, height, and BMI at 5, 14, and 21 years of age were available. Catch-up growth was defined as an increase of 0.67 *Z* score in weight between measurements. The impact of catch-up growth on adult lung function and the relationship between childhood BMI trends and adult lung function were assessed using regression analyses.

RESULTS: Lung function was higher at 21 years in those demonstrating catch-up growth from birth to 5 years (FVC, men: 5.33 L vs 5.54 L; women: 3.78 L vs 4.03 L; and FEV_1, men: 4.52 L/s vs 4.64 L/s; women: 3.31 L/s vs 3.45 L/s). Subjects in the lowest quintile of birth (intrauterine growth retardation) also showed improved lung function if they had catch-up growth in the first 5 years of life. There was a positive correlation between increasing BMI and lung function at 5 years of age. However, in the later measurements when BMI increased into the obese category, a drop in lung function was observed.

CONCLUSIONS: These data show evidence for a positive contribution of catch-up growth in early life to adult lung function. However, if weight gain or onset of obesity occurs after 5 years of age, an adverse impact on adult lung function is noted. CHEST 2015; 147(4):1118-1126

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ABBREVIATIONS: FEF_{25-75} = forced expiratory flow, midexpiratory phase; IUGR = intrauterine growth retardation; MUSP = Mater-University of Queensland Study of Pregnancy

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Increasing evidence suggests that low birth weight is associated with long-term morbidity, including adverse cardiovascular, endocrine, and respiratory outcomes.[1] The relationship between birth weight and lung function has been studied in different groups, and a small but direct association has been noted.[2,3] The strength of the association declines through adulthood, suggesting that environmental influences contribute to the decline in lung function with age.[2] There are few reports in the literature on the impact of intrauterine growth retardation (IUGR) on adult lung function and the role of catch-up growth in early life and how it influences adult lung function.[4,5] Hancox et al[4] reported a small, direct impact on lung function that did not reach statistical significance. Kotecha et al[5] reported lower lung function at school age in those with IUGR and a trend toward higher lung function in those with catch-up growth that was not statistically significant. However, the impact on adult lung function of weight gain or catch-up growth that occurs in childhood has not been studied in detail. Postnatal growth has the potential to contribute to eventual lung function, and a longitudinal study in which details about IUGR, catch-up growth, and adult lung function are available gives us the opportunity to explore this further.

Various research is available in the literature on the impact of BMI on lung function; but we found only two studies that looked at BMI trends through childhood and how this impacts adult lung function.[6,7] Bua et al,[6] in their study of a Danish cohort, reported advantages of higher BMI during childhood toward higher lung function. However, this association with BMI was not noted in the second decade or during adulthood. Curry et al,[7] in their Australian longitudinal cohort, reported that a positive association between higher BMI and lung function was possibly related to lean body mass and that adiposity adversely impacted the adult lung function attained.

The aims of the current study were (1) to investigate the association of catch-up growth in childhood at the ages of 5 and 14 years with lung function at 21 years of age using prospectively collected data, (2) to assess the strength of this association in babies born with IUGR, and (3) to describe how BMI at different ages during childhood impact adult lung function. We hypothesized that catch-up growth improves lung function at 21 years and that the onset of obesity in childhood reduces the eventual lung function at 21 years. We used data from the Mater-University of Queensland Study of Pregnancy (MUSP), a large community-based birth cohort study, to investigate these aims. Our study is unique in that it explores all these three aims in a longitudinal cohort.

Materials and Methods

The Study

The MUSP is a prospective study of 8,556 pregnant women interviewed after their first clinic visit in pregnancy, with 7,223 singleton infants constituting the birth cohort. They were followed up at 3 to 5 days, 6 months, and 5, 14, and 21 years.[8]

At the 21-year follow-up, 5,185 young adults who were singleton babies and whose mothers had agreed at the 14-year follow-up to be contacted again were sent a questionnaire. Almost 3,800 completed the questionnaire, of whom a subsample of 2,612 young adults attended for physical assessment including lung function tests. Because of limited funding, those living outside Brisbane or who were unable to make an appointment for a face-to-face interview completed a mailed questionnaire and did not undergo the physical assessment. Ethics approval was obtained from the institution (University of Queensland Ethics Committee, B/660/SS/01/NHMRC, Mater Hospital 506A), and written consent was appropriately obtained from all participants. For this analysis, we included data obtained from 1,740 young adults who underwent spirometry at 21 years and for whom anthropometric data at birth and at 5, 14, and 21 years were available.

The study sample used in these analyses was comparable to the original cohort on most aspects. Loss to follow-up was related primarily to social disadvantage (Table 1).

Measurements

Lung Function Testing: Lung function testing was performed at the 21-year follow-up using a Spirobank G spirometer system attached to a laptop computer. Qualified and trained interviewers familiar with the instrument performed standard spirometry, in accordance with American Thoracic Society guidelines.[9] A minimum of three and a maximum of five trials were attempted. If testing was unsatisfactory for any reason, the reason(s) were noted on the record sheets. For the purpose of this study FVC; FEV_1; and forced expiratory flow, midexpiratory phase (FEF_{25-75}), were considered as outcomes of interest. The all-age reference[10,11] ranges for spirometry were used to compute *Z* scores of our lung function values.

Anthropometry and Early Life Variables: Birth weight (in grams) and gestational age were recorded at delivery. The following variables were selected from the first clinical visit questionnaire for further analysis: maternal history of smoking, maternal education, and height of both mother and father. These variables were selected in view of the reported associations with lung function in the literature[12-15] and their availability in our dataset. Subjects' smoking history was obtained from the 21-years questionnaire.

Maternal history of smoking during pregnancy was classified into the following groups: nonsmokers, mild smokers (1-9 cigarettes per day), and heavy smokers ($\geq$ 10 cigarettes per day). The level of mother's education was assessed at entry to the study, and answers were divided into three groups: incomplete high school, high school completers, and tertiary education. Personal smoking at 21 years was classified as nonsmoker, mild smoker, or heavy smoker (as described previously).

Height and weight measurements during the 5-year, 14-year, and 21-year follow-up were documented. Height was measured without shoes using a portable stadiometer to the nearest 0.1 cm, and weight was measured in light clothing with a scale accurate to 0.2 kg. Two measures of weight and height were taken, and the mean of these two measures