

Fetal growth and organ development in Bangladesh

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Abstract of thesis

The author investigated the relationship between fetal growth and organ development in childhood, using cohort data from a population-based prospective study called the MINIMat (Maternal and Infant Nutrition Intervention in Matlab) in Bangladesh. This study enrolled a total of 4436 pregnant women from November 2001 to October 2003. The women were followed up at their clinic visits, and there were 3267 singleton live births to them. These infants were then followed up at 15 days, 1, 2, 3, 4 and 6 months, and every 2 months afterwards until 1 year of age, and further followed up at the age of 2 years, 4.5 years, and 9 years. During the follow-ups, a kidney volume was measured with an ultrasound machine, and lung function was assessed using a spirometer, in addition to anthropometric measurements. Based on these cohort data, the author conducted the following two studies.

In Study 1, the author investigated whether low birth weight influenced kidney size and function in a sub-cohort of 1067 full-term singleton live births. Their kidney volume (cm³/m²) was measured at 4.5 years of age, and their glomerular filtration rate (eGFR) was assessed at 9 years of age. The author found that the mean kidney volume of children at 4.5 years was 64.2 cm³/m², with a significant mean difference between children of low birth weight and those of normal birth weight, which was estimated to be 2.92 cm³/m² smaller in children of low birth weight after adjusting for child's age and sex, maternal age, body mass index in early pregnancy, and socioeconomic index in

multivariable analyses. Moreover, the analyses showed that eGFR in children of low birth weight was lower than children of normal birth weight by 5.44 mL/min/1.73m². The author concluded that low birth weight children have a smaller kidney volume (in proportion to body size), thus low birth weight affects kidney function in childhood.

In Study 2, the author examined the effect of postnatal malnutrition trajectory on lung function at preadolescence in a subset of 517 children who were measured for lung function at the follow-up. Lung function (forced vital capacity, forced expiratory volume per second [FEV_{1.0}], maximum mid-expiratory flow, and peak expiratory flow) was measured with a spirometer at the age of 9 years, and weight and length or height were measured from birth to 9 years of age. The author found that more than half of the children have experienced a stunting phenomenon up to 9 years of age, and only 21.9% of those (58/265) had shown catch-up growth at 9 years of age. Children who were persistently or intermittently stunted showed a significantly lower mean z-score of FEV_{1.0} than the normal stature children. In multivariable analyses, children with catch-up growth showed a better lung function than children remaining in the same growth and children who had faltering growth. The author concluded that improving adequate height for age may modify postnatal lung function.

These studies add an evidence to adult disease progression that the initiation of disease risk can be determined in early childhood. The findings of these studies support the DOHaD (developmental origins of health and disease) hypothesis, highlighting the importance of securing optimal fetal development. This is indeed challenging but vital for Bangladesh where restricted fetal growth and infectious disease-related morbidity and mortality are still high, while there is a rapid emergence of chronic diseases such as hypertension, diabetes and kidney disease.

Abstract of assessment result

General Comments

The author examined the impact of fetal growth on organ development during childhood in Bangladesh where child survival remains a major public health challenge to date. Her findings support the DOHaD (developmental origins of health and disease) hypothesis, calling for further efforts of ensuring healthy fetal development, which is indeed crucial because health transition from communicable to non-communicable diseases has already begun in Bangladesh. The study therefore has important policy implications in the country's population health development.

Assessment

The examination committee conducted a final examination on December 26, 2018. The applicant provided an overview of dissertation, addressed questions and comments raised during Q&A session. All of the committee members reached a final decision that the applicant has passed the final examination.

Conclusion

The examination committee approved that the applicant is qualified to be awarded Doctor of Philosophy in Medical Sciences.