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Epidemiological Distributions and Critical Contributions to the Growth Rate for Infants and Young Children in Hubei Province of China during 2017 to 2018: A Review

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Abstract

The growth rate for infants and young children manifests the significant differences between age, sex, regional, and seasonal distributions. The growth rate for infants and young children is a complex process that depends on interaction of the genetic and environmental factors. All genetic and environmental factors jointly contribute to the growth rate for infants and young children, for example heredity, birth weight, gestational ages, nutrition, diseases, assisted reproductive technology, parenting style, living condition, and economic situation. In this review, we report the epidemiological distributions and critical factors contributing to the growth rate for infants and young children.

Key Words: Children, Epidemiological distributions, Environmental factors, Growth rate.

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1- INTRODUCTION

The growth rate for infants and young involves conducting a physical measurement longitudinally, and screening for the risk factors which result in deviation from the trajectory of growth and development. The growth rate for infants and young children is considered to be a relatively smooth curve: the rapid growth during infancy followed by the steady growth in childhood, and finally the pubertal spurt during adolescence (1). However, some global studies have shown that the growth rate for infants and young children is a nonlinear process with the marked variation. This has been called as a saltatory model in which the growth rate for infants and young children is defined as a series of the rapid growth intervals (saltations) separated by the tardy growth intervals (stases) (2, 3). The World Health Organization (WHO) has conducted a global multicenter study (Brazil, Ghana, India, Jordan, Norway and America) to collect a sample of the longitudinal data of infants and young children aged from 0 to 24 months and the transverse data aged from 18 to 60 months since 2005. The growth curves provided a single international standard to represent the best description of the growth rate for all children aged from birth to 5 years (4, 5). In order to explore the trajectory of growth and development in China, the national government completed a study with a large sample of the longitudinal data to establish a reference value of the growth rate for infants and young children in 2010. In this review, we reported the epidemiological distributions and critical factors contributed to the growth rate for infants and young children.

2- MATERIALS AND METHODS

2-1. Method

This review was part of a review of scientific evidence on the epidemiological distributions and critical factors contributing to the growth rate for infants and young children. We sought studies that described the relation between the critical factors and the growth rate for infants and young children. Studies were eligible for inclusion if they reported at least two measurements of the growth rate, for example height and weight from birth to 2 years. We followed some study methods recommended by the Centre for Reviews and Dissemination. Study quality was assessed by using a checklist and summarized as to whether there was a low, medium, or high risk for study results. The critical factors were interaction of the genetic and environmental factors influencing on the growth rate for infants and young children.

2-2. Ethical approval

Informed written consent was obtained from all participants and/or their parents. The study protocol was approved by the Ethical Committee of Maternal and Child Health Hospital of Hubei province, China.

3- RESULTS

1. Epidemiological distributions of the growth rate

The growth rate for infants and young children showed the significant differences between age, sex, regional, and seasonal distributions.

1.1 Age distribution

The growth rate for infants and young children is a process of the nonlinear and dynamic variation with an increase of age. The growth rate of height for infants was the fastest in all ages, in which there was 3.0 to 3.5 cm increase per month from birth to 3 months, 2.0 cm increase per month from 4 to 6 months, and 1.0 to 1.5 cm per month increase per month from 7 to 9 months. However, the growth rate of height for young children rapidly declined with an increase in age, in which there was 25.0 cm increase per year for 0-1 years, 10.0 to 11.0 cm increase per year for 1-2 years, and 5.0 to 8.0 cm increase per year for 2-3 years. Meanwhile, the growth rate of weight for infants was also the fastest in all ages, in which it was about 2 times the birth weight at 3 months, and about 3 times the birth weight at 12 months. Nevertheless, the growth rate of weight for young children rapidly dropped with an increase in age, in which there was about 2.0 to 2.5 kg increase per year for 1-2 years, and about 2.0 kg increase per year for 2.0-10.0 years (6, 7).

1.2 Sex distribution

The growth rate for infants and young children was significantly different between boys and girls. The growth rate of height for boys was faster than that for girls at 3 months: 2.67±0.38 cm increase per month in boys compared with 2.56±0.36 cm increase per month in girls (P=0.01). Thereafter, the growth rate of height was not significantly different between girls and boys until 10 years of age: 0.42±0.16 cm increase per month in boys compared with 0.48±0.20 cm increase per month in girls (P=0.01). Meanwhile, the growth rate of weight for boys was also faster than that for girls at 3 months: 0.70±0.13 kg increase per month in boys compared with 0.65±0.12 kg increase per month in girls (P=0.01). Afterwards, the growth rate of weight was not significantly different between girls and boys until 10 years of age: 0.27±0.10 kg increase per month in boys compared with 0.30±0.10 kg increase per month in girls (P=0.04) (8, 9).

1.3 Regional distribution

The growth rate for infants and young children was obviously different between urban and rural regions over the past 20 years. The mean birth weights for the urban boys and girls were 3.30 kg and 3.20 kg, while those for the rural boys and girls were 3.11 kg and 3.06 kg respectively. Moreover, the mean weights for the urban boys were estimated to be 4.1% and 7.2% heavier than those for the rural girls at 90 days and 360 days. Meanwhile, the mean heights for the urban boys were estimated to be 3.4% and 10.5% higher than those for the rural girls at 90 days and 360 days (10, 11).

1.4 Seasonal distribution

The growth rate for infants and young children was varied with seasonal alternation. Generally, the growth rate for infants and young children was lower in the months of September to February compared with the months of March to August. There was a growth retard in autumn with a nadir in midwinter, and followed by a growth spurt in spring with a zenith in midsummer. As detailed in a report by the World Health Organization, the growth rate of height for infants and young children was the fastest in May with an average of 7.3 mm increase, and the slowest in December with an average of only 3.3 mm increase. It was probably the most characterized cyclical pattern of seasonal variation in the long run (12, 13).

2. Critical factors of the growth rate

At present, many studies have showed that interaction of the genetic and environmental factors contributed to the growth rate for infants and young children (14-16). Linear growth during childhood might be influenced by the cumulative effects of many genetic and environmental exposures.

2.1 Genetic factors

Genetic factors were the important factors in which ethnic groups show a positive correlation with the growth rate for infants and young children. A study by Van Dommelen et al. indicated that the growth rate of height for the monozygic twins was slightly higher (+0.29 to +0.40) compared to that for the dizygotic twins (17). Classically, the variation in the growth rate for infants and young children was best characterized by a genetic model in which height was much more influenced than weight by the genetic factors. As for the variance explained by the genetic factors, the heritability of height was 52.0% for girls and 58.0% for boys, while the heritability of weight was approximately 58.0% for both sexes at 2 years of age. Moreover, the snap of height was also mainly influenced by the genetic factors, while the snap of weight was influenced by both the genetic and environmental factors (18-20).

2.2 Perinatal factors

Perinatal factors, as reflected by birth weight/height and gestational ages, were associated with the growth rate for infants and young children. Concerning perinatal exposures, birth weight/height were the positive determinants of the growth rate for infants and young children. A survey by Xiong et al. showed that height for age Z-score (HAZ), weight for age Z-score (WAZ), and weight for height Z-score (WHZ) for low birth weight (LBW) infants were lower than those for normal infants during 1999-2001 in Louisiana (21). Similarly, Arifeen et al. reported that LBW infants had lower height and weight than those for normal infants in 2001 at Bangladesh's Dhaka slum. However, LBW infants have shown difficulties to achieve the standard weight or length at 12 months (22). Furthermore, a review reported that children with birth weight >3.5 kg had a Z-score of 0.31 higher than those with birth weight ≤2.5 kg (P= 0.02), and children with birth height >51.0 cm had a Z-score of 0.51 higher than those with birth height ≤48.0 cm (P= 0.01) (23). Therefore, birth weight/height was more sensitive to the potentially detrimental effect of the growth rate in early postnatal life. Meanwhile, gestational ages were correlated with the growth rate for infants and young children (24). A study by Sharma et al. found that HAZ, WAZ, and WHZ in small for gestational age (SGA) infants had a Z-score of 0.6, 1.1, and 1.1 lower than those in appropriate for gestational age (AGA) infants at 18 months of corrected age. However, HAZ, WAZ, and WHZ had no significant differences between SGA and AGA infants after 5 years of age (25). Consequently, there might be a developmental trade-off between the metabolic rate and the growth rate for infants and young children.

2.3 Nutritional factors

Nutritional factors, such as feeding patterns and weaning foods, played an important role in the growth rate for infants and young children. Breast feeding has been recommended for babies aged 0-6 months. Several studies reported that the growth rate of bottle feeding babies was higher than those of breast feeding and mixed feeding babies aged 0-6 months. Nevertheless, the growth rate had no significant differences between bottle feeding, breast feeding and mixed feeding babies aged 9 months (26). Breastfeeding experience and support within 1 hour and a few days after birth would affect the ability of mothers to continue breastfeeding (27). Only a few previous longitudinal investigations have reported long-term associations between infant feeding practices and anthropometric outcomes. More importantly, several studies have shown negative associations between the episodes of some infectious diseases and the growth rate for infants and young children (28). Hence, breast feeding could reduce the prevalence rates of many infectious diseases compared to bottle feeding and mixed feeding, so it has been suggested that breast feeding be recommended for babies aged 0-6 months by WHO (29). Moreover, the growth rate for infants was largely determined by nutrition intake. Many studies found that the growth rate of weight for babies aged 6-12 months was related to early introduction of weaning foods (30).

Furthermore, other studies have characterized this relationship between the growth rate of weight between 0-2 years and early introduction of solid foods particularly for formula fed infants at 6 months (P<0.01). Therefore, early introduction of weaning foods was vital to the growth rate for infants aged 6-12 months (31). Multiple micronutrients (MMN), such as Iron, Zinc, Vitamin A, Folic acid, and Vitamin B, had a direct impact on the growth rates for infants and young children. A study reported that MMN interventions manifested the significant improvements in height (ES=0.13, 95%CI: 0.06-0.21), and weight (ES=0.14, 95%CI: 0.03-0.25) for infants and young children (32). Meanwhile, a meta-analysis showed that the case group had more height and weight gains than the placebo group with a difference of 8.2 mm (HAZ: 0.3) (33). As a result, the MMN interventions might improve the growth rates for infants and young children.

2.4 Morbid factors

Morbid factors had a negative impact on the growth rate for infants and young children. For example, the growth rate of weight was positively associated with current asthma (RR=1.22, 95%CI: 1.18-1.26), and recurrent lower respiratory tract infection (RR=1.14, 95%CI: 1.10-1.19), but the growth rate of height was not associated with any of the respiratory disorders (34). Diarrhea was concluded to drastically reduce the growth velocity in weight and length, e.g. in a Brazilian study (35). Acute respiratory infection has also been observed to be significantly associated with incremental weight loss of infants, e.g. in Indonesia. Meanwhile, the growth rates of weight and height were positively associated with congenital heart disease and some metabolic diseases (36). However, further study on the mechanism of some morbid factors to the growth rate or infants and young children should be undertaken.

2.5 Assisted reproductive factors

Assisted reproductive technology (ART) was the high risk factor in which in vitro fertilization (IVF) was closely associated with the growth rate for infants and young children. A multi-step analysis reported that ART remained significantly associated with the adverse health outcomes considering a range of the confounding factors and alternative explanations (37). Recently, a large sample study by Romundstad et al. revealed that the incidence rates of preterm and low birth weight by ART were more markedly increased than those by non-ART (38). A review reported that 10% of singleton births by ART was preterm compared to 6.8% of singleton births by non-ART (P<0.01) (39). As a result, infants born after ART were at increased risk for the adverse health outcomes which had a potential impact on the growth rate for infants and young children.

2.6 Environmental factors

Environmental factors had a positive bearing on the growth rate for infants and young children (40, 41). It was reported by van Dommelen et al. that the growth rate for infants and young children would be regarded by some environmental factors, for example educational level, household income, smoking, excessive drinking, drug abuse and discrimination in a 4,649 Dutch twin study (42). Furthermore, a review reported that children with low-educated mothers had an increase of 0.26 (standard deviation score, SDS) (95%CI: 0.08-0.45) for weight compared to children with high-educated mothers in the first year of life, but children with low-educated mothers had an increase of 0.27 SDS (95%CI: 0.11-0.42) for weight compared to children with high-educated mothers in early childhood (43-45). Therefore, we found that socioeconomic background was a predictor of the growth rate for infants and young children, and interventions should be focused on social inequalities in early life.

4- CONCLUSION

This research was part of a review of scientific evidences on the epidemiological distributions and critical factors contributed to the growth rate for infants and young children in Hubei province of China during 2017 to 2018. This review provided contemporary evidence on the epidemiological distributions and critical factors contributed to the growth rate for infants and young children. The epidemiological distributions were demonstrated as age, sex, regional and seasonal characteristics of the growth rate for infants and young children. Moreover, interaction of the genetic and environmental factors was related to the growth rate for infants and young children. The identified critical factors were heredity, birth weight, gestational ages, nutrition, diseases, assisted reproductive technology, parenting style, living condition, and economic situation. Therefore, it pointed out the direction for interventions to improve the growth rate for infants and young children.

5- KEY POINTS

1. The epidemiological distributions were demonstrated as age, sex, regional and seasonal characteristics of the growth rate for infants and young children.
2. Interaction of the genetic and environmental factors was related to the growth rate for infants and young children.
3. It pointed out the direction for interventions to improve the growth rate for infants and young children.

6- CONTRIBUTORS' STATEMENT

Zhonggui Xiong composed this paper thoroughly. Jiong Yan proposed some suggestions for this paper. Shuhua Shi reviewed this paper for her helpful comments.

7- CONFLICT OF INTEREST: None.

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