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ORIGINAL RESEARCH

Evaluation of growth status of children with non-syndromic oral clefts

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Abstract

To assess the growth status of children with non-syndromic oral clefts (NSOC) and explore potential influencing factors. The data of NSOC children aged ≤5 years hospitalized between December 2018 and June 2020 were retrieved and evaluated, including their height, weight, NSOC subtypes and demographic characteristics before reparative surgeries. The growth status of the children was assessed using height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ). In total, 504 NSOC children (271 females & 233 males) were included. The proportion of stunting (HAZ <−2), underweight (WAZ <−2) and wasting (WHZ <−2) was 4.96%, 5.16% and 3.97%, respectively. In addition, we observed that HAZ and WAZ decreased with increasing age (both $p < 0.01$). Moreover, non-syndromic cleft palate only (NSCP) and non-syndromic cleft lip and palate (NSCLP) were associated with lower HAZ and WAZ compared with non-syndromic cleft lip only (NSCL) (all $p < 0.01$), while NSCLP was associated with a lower WHZ compared with NSCL ($p < 0.01$). The growth retardation and low weight rate of NSOC children under 5 years old were higher than the national average level and differed by the age of NSOC children and disease subtypes. Further improvements are warranted to promote the growth status of the NSOC-affected children.

Keywords

Non-syndromic oral cleft; Child; Growth; Z-score

1. Introduction

Non-syndromic oral clefts (NSOC) are one of the most common congenital birth defects, which include non-syndromic cleft lip only (NSCL), non-syndromic cleft palate only (NSCP) and non-syndromic cleft lip and palate (NSCLP) [1]. It was found that NSOC is more prevalent in Asians than in Europeans and Africans [2, 3]. A recent epidemiological study showed that the prevalence of NSCL, NSCP and NSCLP in China was 0.56‰, 0.27‰ and 0.82‰, respectively [4].

Children with NSOC may experience feeding problems, resulting in growth delays and malnutrition [5, 6]. Malnutrition is a characteristic feature of NSOC children [7]. In addition, physical growth might reflect children's growth status and chronic health conditions. Previous studies also found that NSOC children might suffer from growth retardation and abnormal weight and height patterns compared with normal healthy children [8–10]. In regard to treatment, surgery and postoperative rehabilitation are important procedures for NSOC, which are usually determined based on the growth status of the patients. Thus, assessing the growth status of NSOC-affected children will provide a valid basis for further interventions and ultimately benefit their health. To the best of our knowledge, little evidence was found about the growth status of NSOC children in China.

The Peking University Hospital of Stomatology NSOC Treatment Center has the capacity to treat 1500 NSOC children per year, which makes this institution accessible to thoroughly investigate the growth status of NSOC children. Thus, in this study, we evaluated the growth status of NSOC-affected children using the Z-score method proposed by the World Health Organization (WHO) [11] and explored potential factors influencing their growth status based on data from the Peking University Hospital of Stomatology to provide evidence for improving the management of these patients.

2. Patients and Method

2.1 Study design and participants

We conducted a comparative cross-sectional study to collect information on children diagnosed with NSOC and hospitalized at the Peking University Hospital of Stomatology in China from December 2018 to June 2020. Patients were eligible for inclusion if they met all the following criteria: diagnosed as NSCL, NSCP or NSCLP; aged under 5 years, without previous corrective surgery and had a full-term normal birth weight as they were born. Children with rachitis, inherited metabolic disorders, circulatory disorders, or digestive diseases were excluded. A total of 504 children were included in the final analysis.

2.2 Measurements

All physical examinations were completed before the surgery. NSOC children's body weight and height were obtained by trained technicians using a standard measuring device. The body weight was examined when wearing light underwear and recorded to the nearest 0.1 kg. A medical baby scale was used for children under 1 year old, and an electronic scale for children over 1 year old. During the height measurement, the participants were required to take off their shoes, hat and coats. The body height of children below three years of age was measured in a supine position using a baby horizontal measuring bed, and the height of those above three years was measured in an upright position using a height-measuring instrument to the nearest 0.1 cm. Body weight and height were examined twice for each child to ensure the robustness of the measurement results, and the median of the measurements was used for statistical analysis.

2.3 Indicators

We adopted the Z-score developed by the WHO to assess the NSOC children's growth status. The formula for calculating Z-score according to the WHO was *Z-score* = $(X-m)/SD$, in which X is the observed value (weight, height), and m and SD are the median and standard deviation values. In addition, m and SD were obtained according to the WHO Child Growth Standards. According to the WHO Child Growth Standards, a height-for-age Z-score (HAZ) <-2 is an indicator of stunting, a weight-for-age Z-score (WAZ) <-2 is an indicator of underweight, and the weight-for-height Z-score (WHZ) <-2 is an indicator of wasting [12].

2.4 Statistical analysis

Descriptive statistics were used to assess baseline characteristics such as age, gender, disease subtypes, and areas of the study participants. p-values for different gender and area groups were obtained using the chi-square test, while age and subtype groups were determined using the Fisher exact test. Multiple linear regression analysis was conducted to analyze associations of age (months), gender, subtypes and areas with the Z-score of NSOC children at the same time due to the independent relationship among these variables. All analyses were conducted using the R software (version 3.6.3, R Core Team, Vienna, Austria). The threshold for statistical significance was set as 0.05.

3. Results

3.1 Baseline characteristics of NSOC children

A total of 504 NSOC children were eligible for this study, and their baseline characteristics are shown in Table 1. Most of the children were aged below one year (341, 67.7%), while 113 (22.4%) were aged 1 to 3 and 50 (9.9%) were aged over 3 years. Of them, 46.2% (233) were males, and 53.8% (271) were females. The proportion of NSCL, NSCP and NSCLP was 22.6% (114), 66.9% (337) and 10.5% (53), respectively. In addition, 44.8% (226) of the children were from urban areas, and 55.2% (278) were from rural areas.

3.2 Growth status of NSOC children

Among the 504 NSOC children, there were 25 stunting children (HAZ <-2), 26 underweight children (WAZ <-2) and 20 wasting children (WHZ <-2), at a corresponding rate of 4.96%, 5.16% and 3.97%, respectively (Table 1). The growth status of NSOC children across different groups is also shown in Table 1. The proportions of underweight and wasting in the 3 to 5 years old groups were higher than in other age groups ($p < 0.05$). In addition, the proportions of underweight and wasting in males were higher than in females ($p < 0.05$).

3.3 Factors affecting the growth of children with NSOC

The associations between four factors (age, gender, disease subtype and areas) and HAZ are shown in Table 2. The results showed no significant difference in HAZ across different areas or gender groups (areas: $p = 0.46$; gender: $p = 0.07$). However, age was negatively associated with HAZ ($\beta = -0.06, p < 0.01$). In addition, the HAZ of NSCP ($\beta = -0.51$, $p < 0.01$) and NSCLP ($\beta = -0.69$, $p < 0.01$) children were lower compared with NSCL children.

We also assessed the associations of age, gender, disease subtype and areas with WAZ but found a significant association only with age ($\beta = -0.03, p < 0.01$) but not with gender ($p = 0.42$) and areas ($p = 0.96$) (Table 2). Further analysis showed that NSCP ($\beta = -0.44, p < 0.01$) and NSCLP ($\beta = -0.89, p < 0.01$) had lower WAZ than NSCL.

No significant association was found for age ($p = 0.96$), gender ($p = 0.85$) and areas ($p = 0.76$) with WHZ (Table 2). In addition, there was no significant difference in WHZ between NSCL and NSCP, while the WHZ of NSCLP was significantly lower than that of NSCL ($\beta = -0.59, p < 0.01$).

4. Discussion

This study evaluated the growth status of 504 NSOC children <5 years old using the Z-score and explored potential factors associated with their growth status. The results showed that Z-scores significantly differed by age and disease subtypes. A larger proportion of low body weight was observed with increased age. The growth status of children with NSCL or NSCP was significantly better than that of children with NSCLP.

According to the National Program of Action for Child Development in China (2011–2020), the growth retardation rate and low weight rate of children under five years old in 2019 were 1.12% and 1.37%, respectively [13], which were comparatively lower than our present study (4.96% and 5.16%, respectively), indicating that NSOC children might have malnutrition problems. We assumed that this inconsistency could be related to a limited understanding on malnutrition and growth delays in NSOC children despite improvements in people's lifestyles

TABLE 1. The growth status in different groups of children with non-syndromic oral clefts.

Variables	N	Stunting (HAZ <−2)		Underweight (WAZ <−2)		Wasting (WHZ <−2)	
		N (%)	*p*-value	N (%)	*p*-value	N (%)	*p*-value
Total	504	25 (4.96)		26 (5.16)		20 (3.97)	
Age (years)							
<1	341	12 (3.52)		11 (3.23)		7 (2.05)	
1–3	113	11 (9.65)	0.034	9 (7.96)	0.009	7 (6.19)	0.002
3–5	50	2 (4.00)		6 (12.00)		6 (12.00)	
Gender							
Male	233	13 (5.58)	0.553	20 (8.58)	0.001	14 (6.01)	0.030
Female	271	12 (4.43)		6 (2.21)		6 (2.21)	
Subtypes							
NSCL	114	2 (1.75)		3 (2.63)		4 (3.51)	
NSCP	337	20 (5.93)	0.181	16 (4.75)	0.022	12 (3.56)	0.377
NSCLP	53	3 (5.66)		7 (13.20)		4 (7.55)	
Areas							
Urban area	226	12 (5.31)	0.745	12 (5.31)	0.890	7 (3.10)	0.367
Rural area	278	13 (4.68)		14 (5.04)		13 (4.68)	

NSCL, non-syndromic cleft lip only; NSCP, non-syndromic cleft palate only; NSCLP, non-syndromic cleft lip and palate; HAZ, height-for-age Z-score; WAZ: weight-for-age Z-score; WHZ: weight-for-height Z-score.

TABLE 2. Association between different variables and Z-scores of children with non-syndromic oral clefts.

Variables	HAZ			WAZ			WHZ		
	Estimate (β)	95% CI	*p*	Estimate (β)	95% CI	*p*	Estimate (β)	95% CI	*p*
Age (months)	−0.06	−0.08∼−0.04	<0.01	−0.03	−0.05∼−0.01	<0.01	−0.0005	−0.02∼0.02	0.96
Gender									
Female	1			1			1		
Male	−0.24	−0.51∼−0.02	0.07	−0.10	−0.34∼0.14	0.42	−0.02	−0.27∼0.22	0.85
Subtypes									
NSCL	1			1			1		
NSCP	−0.51	−0.84∼−0.18	<0.01	−0.44	−0.74∼−0.13	<0.01	−0.05	−0.36∼0.26	0.77
NSCLP	−0.69	−1.17∼−0.21	<0.01	−0.89	−1.33∼−0.45	<0.01	−0.59	−1.04∼−0.14	<0.01
Areas									
Urban area	1			1			1		
Rural area	−0.10	−0.35∼0.16	0.46	−0.01	−0.24∼0.23	0.96	0.04	−0.20∼0.28	0.76

HAZ, height-for-age Z-score; WAZ, weight-for-age Z-score; WHZ, weight-for-height Z-score; CI, confidence interval; NSCL, non-syndromic cleft lip only; NSCP, non-syndromic cleft palate only; NSCLP, non-syndromic cleft lip and palate.

and strengthening health care awareness. Thus, practitioners should focus on the nutrition issues in infancy, emphasize health education in parents and guide proper feeding behaviors to reduce the risk of growth retardation.

Our study also identified significant differences in growth retardation, underweight and wasting rates among different age groups. The growth retardation rate of 1–3 years old group (early childhood) was significantly higher than that of other groups, which was consistent with a previous study reporting that the overall growth conditions of infants with NSOC were relatively poor and did not reach the average level until they were 25.5 months old [9, 14]. A previous research [15] reported that about 5%–15% of children had wasting disorders, of whom most were six to 24 months old, and 20% to 40% of them suffered from short stature even after 24 months old. The highest incidence age of malnutrition was reported to be from three to 24 months [16] and that the first two years after birth was a critical window of opportunity to prevent growth retardation [17]. Therefore, rational infant feeding is very important for improving their growth status.

Previous studies [18, 19] showed that susceptibility to malnutrition positively correlated with NSOC severity. We found that children with NSCLP had higher proportions of stunting, wasting and underweight than NSCL. NSCLP has a greater impact on sucking and swallowing than NSCL, as the malformation severity of NSCLP was comparatively higher, hindering their normal eating behaviors and nutrient intake. In addition, they were more likely to have repeated respiratory tract infections, thus affecting their growth status. Furthermore, due to appearance defects, parents have great psychological pressure and unstable emotions, which might lead to neglecting the feeding and nursing of these children [20].

Our study showed that among children under three years, an older age was associated with lower HAZ and WAZ, consistent with a previous study [21]. Infancy and puberty are two peaks of growth during a lifetime. The children in this study were experiencing or had just passed the first growth peak. The feeding problems caused by NSOC might lead to growth retardation in infancy, during which children should grow rapidly. Thus, growth retardation is more critical due to the cumulative effect of increasing age. In this study, there were significant differences in HAZ, WAZ and WHZ among children with different disease subtypes, as children with NSCLP had the lowest Z-scores, implying that these three subtypes of disease might have different influences on eating behaviors, among which NSCLP demonstrated the greatest effects. We also found that the Z-scores of NSCLP were all less than zero, demonstrating that their growth status was worse than normal healthy children according to the WHO data. Our research did not show that the growth status of children from different areas differed significantly, which may benefit from the narrower living standard gap between urban and rural areas, improvement in healthcare and increasing awareness about congenital malformation in China [22].

Previous studies showed that the most critical determinants of growth in children under five years were not genetic and racial factors but rather feeding methods, living environment and health care [23]. The guidelines of The American Cleft Palate-Craniofacial Association (ACPA) pinpointed the importance of strict growth evaluation in NSOC children and the critical importance for medical practitioners to manage feeding status and guide proper parental feeding techniques [24]. However, few studies have evaluated the growth status of children with NSOC, leading to a lack of pertinence in nutritional intervention. This study evaluated the growth status of children with NSOC in China using Z-scores, and the results showed that these children still suffered from nutritional problems such as growth retardation, low weight and wasting. Therefore, it is suggested to refine the evaluation of the growth status of children with cleft lip and cleft palate to detailedly learn their physical growth and provide higher evidence-level references for follow-up feeding and nursing.

This study had some limitations. First, the findings were based on a mono-institutional cross-sectional study with a limited age group of children under five years old. Although the hospital from which the data were retrieved is one of the most authoritative hospitals in NSOC and included cases from different parts of China, the generalizability of the findings should be cautiously assessed. Further, height and weight were only measured before the surgeries; thus, we could not assess the growth trends of the investigated children. In addition, some other potential factors that might be associated with the growth status of NSOC children, such as family income and parents' education, were not adjusted due to the unavailability of these information and the retrospective nature of this study. As only 32% of the affected children in this study were aged over one, we could not accurately describe their growth characteristics; thus, a small proportion of the sample might affect the statistical power in exploring the influential factors. Altogether, more studies with larger sample size and follow-up studies are needed to determine factors associated with the growth status of NSOC children.

5. Conclusions

The prevalence of non-syndromic oral cleft in Asians is higher than among Europeans and Africans. Children with non-syndromic oral clefts may experience growth delays and malnutrition. However, the growth status of non-syndromic oral clefs children in China remains unclear. In this present study, we found that the growth status of non-syndromic oral cleft children was significantly worse than that of healthy Chinese children. Both age and disease subtypes were associated with growth status, indicating the need for more attention to reduce growth retardation in children with non-syndromic oral cleft. Additionally, the rates of growth retardation and low weight in these children under 5 years old were higher than that of the national average level of China, urging the need for more accurate epidemiological data and new strategies to improve the growth status of these children.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

NL, HZ and ZZ—designed the research study. NL, KZ, XC, JC, XH, DZ, MW, ZZ, GC and HZ—performed the research. NL, XC and MW—analyzed the data. NL, KZ and XC—wrote the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by Peking University Biomedical Ethical Committee (PKUSSIRB-201946074). Written informed consent was obtained from all the participants' guardians.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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