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Original Article

A Cross-sectional Survey of Growth and Nutritional Status in Children With Cerebral Palsy in West China

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ABSTRACT

BACKGROUND: We describe the growth and nutritional status of children with cerebral palsy (2 to 18 years old) in West China and to explore the correlation between the nutritional status and age, gender, and gross and fine motor function. **METHODS:** We performed a cross-sectional survey of children registered as having cerebral palsy in the China Disabled Persons' Federation branch in Chengdu. Growth (height and weight) and nutritional (body mass index) status were recorded. Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) were used to determine gross and fine motor function, respectively. The association between nutritional status and age, GMFCS and MACS levels was evaluated. **RESULTS:** We enrolled 377 children (53.6% male), among whom 160 (42.4%) were stunting, 48 (12.7%) underweight, 81 (21.5%) thin, and 70 (18.5%) overweight and obese. Thinness was the main nutritional problem in older patients (12 to 18 years), whereas overweight and obesity were the major issues in younger patients (2 to 12 years). Growth deviation and malnutrition were significantly more prevalent in patients with severe motor impairments. A significant negative correlation was found between nutritional status and age, GMFCS and MACS levels, and between growth and GMFCS and MACS levels. **CONCLUSIONS:** Growth abnormality is common in children with cerebral palsy. Malnutrition and overnutrition both exist in children with cerebral palsy. Characteristics at different age stages and motor functional levels should be taken into consideration in the management of growth and nutrition in this population.

Keywords: cerebral palsy, growth, nutritional status, gross motor function, fine motor function

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Introduction

Cerebral palsy describes nonprogressive disturbances that occur in the developing fetal or infant brain and a group of permanent disorders in the development of movement and posture that causes limitations of activity. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, epilepsy, or secondary musculoskeletal problems.[1] Cerebral palsy is one of the leading causes of childhood physical disability worldwide.[2,3] Its prevalence is 1.9‰ among children aged one to six years in China,[2] and the frequency varies between 2‰ and 4.4‰ in the developed countries.[4] The variation of prevalence may result from inconsistent definitions and classifications or different methods of choosing the numerator and the corresponding population denominator.[4]

Although motor function is the primary impairment in cerebral palsy, growth and nutritional disorders are also common. Children with cerebral palsy have unique growth patterns and various nutritional problems, ranging from malnutrition to overweight and obesity.[5-9] These problems

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are more prominent with increasing severity of motor impairment.[5,9] Owing to different study populations and different assessment methods, the reported malnutrition rate in patients with cerebral palsy ranges from 46% to 90%.[10] Poor growth and malnutrition are related to more health care utilization, less societal participation,[11] and worse motor function.[6] On the other hand, in recent years, as obesity has become a global epidemic problem in the general population, some researchers have found that children with cerebral palsy are also at higher risk of becoming overweight and obese. A literature review of 38 articles reported that the prevalence of overweight and obesity in children with disabilities is almost twice as their nondisabled peers.[12] Rogozinski et al.[13] found that, among ambulatory American children with cerebral palsy, the prevalence of obesity has increased from 7.7% to 16.5% over a decade. Hurvitz et al.[14] found that 29.1% of children with cerebral palsy are overweight (95th body mass index [BMI] percentile) or at risk for being overweight (85th to 95th BMI percentile), and their prevalence is higher than in the general population, whether in ambulatory or non-ambulatory children. However, there are few studies concerning the growth and nutritional status in children with cerebral palsy or the association with gross and fine motor function in China.

The purposes of this study are (1) to describe the growth (as determined by height and weight Z scores) and nutritional status (as determined by BMI) in children aged 2 to 18 years with cerebral palsy in West China; (2) to investigate the relationship between growth or nutrition and age, gender, and gross and fine motor function (as determined by the Gross Motor Function Classification System [GMFCS] and the Manual Ability Classification System [MACS]).

Subjects and Methods

Study design

This cross-sectional study was conducted by the West China Second University Hospital of Sichuan University with help from the China Disabled Persons' Federation (CDPF) Chengdu branch from February to April in 2013. The study was approved by both Ethics Committee of West China Second University Hospital of Sichuan University and the Institutional Review Board of each CDPF branch in Chengdu. A written informed consent was obtained from the parents or legal guardians.

The inclusion criteria were children resident in Chengdu, registered as having cerebral palsy, and having received rehabilitation treatments either before or at the time of the study in the CDPF Chengdu branch. Information related to demographics, personal and family medical history, growth and development, diagnosis and rehabilitation intervention, etc. was collected using a self-made questionnaire, and the diagnosis of cerebral palsy was reevaluated by pediatric neurologists and rehabilitation physicians together according to the definition proposed by Rosenbaum et al.[1] GMFCS and MACS were respectively used to assess gross and fine motor function status.

GMFCS and MACS

The GMFCS is an objective functional scale to assess the key functions of ambulation in cerebral palsy[1]; it classifies children with cerebral palsy into five levels according to functional mobility or activity limitation.[15] We employed the GMFCS (Chinese version),[16,17] which has been proved to have good reliability and validity in Chinese children. The MACS is designed to reflect a child's typical manual performance; it classifies how well children aged 4 to 18 years with cerebral palsy use their hands when handling objects in daily activities.[18] Likewise, we used the Chinese version of the MACS,[19] which has been proved to be a valid and reliable measure of manual functions. The GMFCS was evaluated by two senior physiotherapists separately and MACS was assessed by two senior occupational therapists independently. If the evaluation result was inconsistent, the aforementioned experts would reevaluate the patient together and arrive at a final conclusion. Children with GMFCS I-II or MACS I-II were categorized as having minor motor function impairments, GMFCS III or MACS III as moderate impairments, and GMFCS IV-V or MACS IV-V as severe impairments.

Anthropometric measure

Anthropometric data for the weight and height were obtained via standard procedures and measuring instruments by trained staff. All measurements were obtained twice, and the average was used for analysis. Weight was recorded to the nearest 0.1 kg on a digital scale, with the child dressed in a thin set of clothes and without hats or shoes. If the child was unable to stand independently, we weighed the child with a caregiver. The child's weight was found by subtracting the weight of the caregiver from the combined weight. Height was measured using a height scale to the nearest 0.5 cm while the child stood straight; if one could not stand because of muscle contracture, high tone, or poor cooperation, the measurements were unreliable. The height was obtained using a flexible tape with the child lying on their back.

Data reduction

Initially, 578 children were screened. After we excluded children with traumatic, postencephalitic, or progressive disorders, 421 remained with cerebral palsy. Among them, 377 were aged between 2 and 18 years and were eligible for the study. Gender, age, family income, birth weight and gestational age, height and weight, and GMFCS and MACS levels were documented. Children were grouped by age: (1) low age group, two years of age to less than six years of age; (2) middle age group, six years of age to less than 12 years of age; and (3) high age group, 12 years of age to less than 18 years of age. Weight and height were converted to age and sex normalized Z scores according to reference data for healthy children[20,21] while evaluating the growth deviation of children with cerebral palsy. A height Z score below −2 was defined as stunting, whereas a Z score for weight below −2 was considered as underweight. BMI was calculated (BMI = weight [kg]/height [m^2]) to assess the nutritional status. The percentile level of each child's raw BMI score, relative to age- and sex-specific norms, was obtained according to BMI growth curves for Chinese children aged 0 to 18 years.[22] Children were classified into four categories based on their nutritional status: thin, normal, overweight, and obese. Because there were no unified BMI cut-offs for thinness among children younger than six years in China, these children were defined according to the criteria proposed by Cole et al.[23]; and for children older than six years, the BMI cut-off for Chinese school-aged children aged six to 18 years[24] was applied. Overweight and obesity were defined according to the BMI cut-offs proposed by Li et al.[22]

Statistical analysis

Excel 2007 was adopted to establish a database, and all analyses were conducted using the Statistical Package for Social Sciences version 19. Mean and S.D. were calculated in continuous variables such as age, weight Z scores, and height Z scores. The Mann-Whitney test was used to compare differences in growth and nutritional status between genders, and the Kruskal-Wallis test was used to analyze the differences of growth or nutrition among the three age groups, GMFCS levels, and MACS levels. Number and frequency (%) were used to describe categorical variables, and the χ^2 test was used to analyze differences in proportions among groups. Multiple comparisons between the groups were performed using a correct significant level α'. The Spearman rank correlation analysis was used to examine the association between nutritional status and age, GMFCS and MACS levels. $P < 0.05$ was considered statistically significant. For multiple comparisons, significance was considered to be $P<\alpha'$ [$\alpha' = 0.05/n^* (n-1)/2$, n = numbers of groups].