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Original article

A multicenter cross-sectional study to evaluate the clinical characteristics and nutritional status of children with cerebral palsy☆

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SUMMARY

Background & aims: This study was designed to assess clinical characteristics and nutritional status of pediatric outpatients with cerebral palsy (CP) and to determine prevalence of malnutrition based on physicians' clinical judgment and on anthropometric data in relation to percentile reference values.

Methods: A total of 1108 pediatric neurology outpatients (mean ± SEM age: 7.2 ± 0.1 years, 59.3% were males) diagnosed with CP were included in this cross-sectional, non-interventional multicenter single-visit study conducted between October 2015 and July 2016 at 20 centers across Turkey. Data on patient and CP characteristics, concomitant nonneuromotor impairments and gastrointestinal disorders as well as anthropometrics, outcome of nutritional status assessment (via physicians' clinical judgment and Gomez classification and Waterlow classification of anthropometric data) and physician's view on nutritional care in CP patients were collected at a single visit.

Results: The most common CP etiology was asphyxia (62.5%). The most common clinical category was spastic CP (87.5%) with quadriplegic (54.0%) topography and level V gross motor dysfunction (45.4%) in most of patients. The prevalence of malnutrition was considered to be 57.2% based on physicians' clinical judgment, while shown to be 94.3% (3rd degree in 86.7%) according to Gomez classification of Neyzi weight for age (WFA) percentiles and to be 91.3% (severe in 88.3%) according to Waterlow classification of Neyzi height for age (HFA) percentiles.

Conclusions: In conclusion, our findings revealed high prevalence of malnutrition, while also emphasize the likelihood of overestimation of malnutrition in children with CP when anthropometric assessment was based on use of growth charts for general pediatric population. This large-scale survey provided valuable data regarding nutritional assessment practice and malnutrition prevalence among children with CP in Turkey, which may be utilized for future proactive strategies in the prevention and treatment of malnutrition in this population.

1. Introduction

Cerebral palsy (CP) is the most prevalent cause of motor disability in children [1,2] with a global incidence of approximately 2–2.5 per 1000 live births [2,3] and incidence of 4.4 per 1000 live births in Turkey [4].

CP is a syndrome of motor impairment comprising a wide spectrum of childhood movement and posture disorders and often accompanied by disturbances of sensory, cognitive, perceptive, behavioral or epileptic disorders [3,5,6].

Primary neurological insult influences not only physical and mental capacities but also enteric neural pathways leading to dysphagia, vomiting, swallowing deficits, gastroesophageal reflux, aspiration and constipation, compromising the adequate nutrient intake in children with CP [7–10].

Accordingly, children with cerebral palsy are considered to be at an increased risk of malnutrition [7,11,12], and those with severe and longer term gross motor impairment and oropharyngeal dysfunction are considered to have a higher prevalence of malnutrition [10,13,14]. Moreover, poor nutritional status itself has been

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associated with further risk of adverse social, motor, cognitive and health outcomes including respiratory and cardiac dysfunction and mortality [9,13–16].

Assessment of nutritional status and early identification and management of malnutrition via multidisciplinary approach is therefore considered essential for the optimal care in children with CP [10,11,13,17,18].

However, alongside a lack of a gold standard validated pediatric nutrition screening tool in routine clinical practice [19], nutritional assessment in CP is further complicated by the challenges inherent in anthropometry in these children [18,20]. Thus, there is ongoing effort to improve nutritional rehabilitation practice among children with CP by using the most appropriate assessment tools to obtain a more accurate anthropometric profile and more realistic nutritional goals [13,18,20,21].

This study was designed to assess clinical characteristics and nutritional status of pediatric outpatients with CP and to determine prevalence of malnutrition based on physicians' clinical judgment and on anthropometric data in relation to percentile reference values.

2. Materials and methods

2.1. Study population

A total of 1108 pediatric neurology outpatients diagnosed with CP were included in this cross-sectional, non-interventional multicenter single-visit study conducted between October 2015 and July 2016 at 20 centers directed by members of Turkish Pediatric Neurology Society across Turkey. Male or female pediatric neurology outpatients diagnosed with CP aged $\geq$1 and <19 years were included in the study. Genetic disorders, cardiopathies, hypothyroidism or any CP-unrelated chronic diseases, CP of postnatal origin (i.e. traumatic brain injury, near drowning, motor vehicle accident, brain tumor, and/or other acquired injuries) and other concomitant diagnoses (i.e. autism, Down syndrome, degenerative disorders, renal disease, or any other significant diagnosis according to the investigator) were the exclusion criteria. Of 1115 patients initially enrolled, 1108 patients were found eligible to participate in this study since 7 patients were excluded due to protocol violation (not meeting the inclusion criteria for age) detected after enrollment.

Written informed consent/assent was obtained from children and/or children's parents or legal guardian following a detailed explanation of the objectives and protocol. The study was conducted in accordance with the ethical principles stated in the “Declaration of Helsinki” and approved by the institutional ethics committees.

2.2. Data collection

Data on patient demographics (age, gender), birth characteristics (delivery method, gestational age, anthropometrics at birth), CP characteristics [age at CP diagnosis, etiology and type of CP, affected body parts, GMFCS (Gross Motor Function Classification System) level, presence of sibling with CP, CT/MRI findings], concomitant nonneuromotor impairments and gastrointestinal disorders as well as anthropometrics and outcome of nutritional status assessment (via Gomez classification, Waterlow classification and based on physicians' clinical judgment) and physician's view on nutritional care in CP were collected at a single visit.

2.3. Outcome measures

Outcome measures included patient profile and CP characteristics, anthropometric measurements, prevalence of malnutrition (according to physicians' clinical judgment and anthropometric data in percentiles using Gomez classification and Waterlow classification), and physicians' view on nutritional care in CP.

2.4. CP classification

CP was clinically categorized into spastic, dyskinetic or extrapyramidal, cerebellar or ataxic, hypotonic, and mixed, on the basis of the predominant motor impairment [22].

GMFCS was used to classify severity of motor impairment into five subgroups including level I (walks without limitations), level II (walks with limitations), level III (walks using a hand-held mobility device), level IV (self-mobility with limitations, may use powered mobility) and level V (transported in a manual wheelchair) according to published criteria [23].

2.5. Anthropometrics

Anthropometric measurements included body weight (kg), height (cm), body mass index (BMI; kg/m^2), head circumference (cm), triceps skinfold thickness (TSFT) and mid-upper arm circumference along with estimation of mean z-scores and percentiles for weight-for-age (WFA), height-for-age (HFA), head circumference-for-age (HCFA) and weight for height (WFH). Body weight was measured using an digital baby weight scale (10 g precision) in children aged $\leq$2 years, while with adult electronic scale (100 g precision) in children aged >2 years. Height measurement was performed using a 1-m length measuring tape (0.1 cm precision) in children aged $\leq$2 years and with a wall mounted stature meter (0.2 cm precision) in children aged >2years. MUAC was measured from the left upper arm flexed slightly at the elbow, at half distance between the acromion and the olecranon using a plastic measuring tape. TSFT was measured from the left arm, and at half distance between the acromion and the olecranon, using a skin fold caliper. TSFT and MUAC percentiles could only be analyzed in those aged 1–8 years because lack of Neyzi reference for these measures and availability of growth reference data (WHO) for these measures up to age of 8 years.

2.6. Nutritional status assessment

Nutritional status assessment was based on physicians' clinical judgment as well as anthropometric data including Gomez classification of WFA percentiles and Waterlow classification of WFH and HFA percentiles using WHO and/or Neyzi standard growth charts.

2.7. Gomez classification

The Gomez classification uses the percent-of-median, which is a convenient measure if the reference population distribution has not been normalized. On the basis of availability of WHO or Neyzi percentiles which are normalized databases, Gomez and Waterlow cut points were applied to the WHO (or Neyzi) percentiles in the present study. Gomez classification of nutritional status was based on WFA percentiles and categorized as normal nutritional status (percentile 91–100), 1st degree malnutrition (percentile 76–90), 2nd degree malnutrition (percentile 61–75) and 3rd degree malnutrition (percentile $\leq$60) [24]. While the classification was created using both WHO and Neyzi standard growth charts, it should be noted that WHO WFA growth chart involves data only up to 10 years of age whereas the Neyzi WFA growth charts continues to 18 years of age, therefore the Gomez classification for WHO could only be created for children up to 10 years of age.

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