TÜRK PEDİATRİ ARŞİVİ
TURKISH ARCHIVES of PEDIATRICS

Original Article

Examination of the relation between body mass index, functional level and health-related quality of life in children with cerebral palsy

Tülay Tarsuslu Şimşek[1], Gamze Tuç[2]

[1]Dokuz Eylül University, Physical Therapy and Rehabilitation Academy, İzmir, Turkey
[2]Private Keşan Public Hospital, Tekirdağ, Turkey

Abstract

Aim: The aim of this study was to examine the relation between body mass index (BMI) and functional level and health-related quality of life in children with cerebral palsy (CP).

Material and Methods: Two hundred seventy-eight children with CP aged between 2 and 18 years were included in the study. The sociodemographic properties of the children were recorded. Their functional independence levels were assessed with WeeFIM and their health-related quality of life levels were assessed with the Child Health Questionnaire-Parent Form (PF-50). Approval was obtained from the ethics committee of Abant İzzet Baysal University Medical Faculty for this study (Number: 2008/100-77).

Results: When classified by body mass index, 26.3% of the children had a normal body weight, 5.4% were overweight, 11.5% were obese and 56.8% had a low body weight. The rate of low body weight was higher in children with moderate and severe CP (52.7% and 53.8%, respectively), while the rate of obesity was higher in children with mild CP who could walk (7.1%). A significant difference was found in children with CP with a normal body weight, overweight children with CP, obese children with CP and children with CP with a low body weight in terms of the total WeeFIM score and the variables of quality of life including physical functionality and role/social limitations because of physical health ($p<0.05$). In the correlation analysis, a positive correlation was found between WeeFIM and BMI and the subdimensions of role/social limitations because of emotional or behavioral difficulties, pain and discomfort and self-esteem ($p<0.05$).

Conclusions: Our results showed that BMI affected functional independence and health-related quality of life in children with CP and this was more prominent in children who had severe CP and low BMI values. More studies are needed in this area.

(Türk Ped Arş 2014; 49: 130-7)

Key words: Cerebral palsy, functional level, health-related quality of life, obesity, body mass index

Introduction

When compared with normal children, children with cerebral palsy (CP) have malnutrition, poor oral motor function, insufficient function of the upper extremities, insufficient nutrition and growth retardation arising from cognitive disorders (1-4). However, recent studies have shown that children with CP with a lower degree of involvement (hemiparetic and diparetic) and with better function have a higher rate of obesity compared to children with CP with a higher degree of involvement. Similarly, children with a low degree of involvement have a lower rate of neuromuscular disorder arising from spasticity and decreased motor control which affect functional activities in daily life compared to children with a

Address for Correspondence: Tülay Tarsuslu Şimşek, Dokuz Eylül University, Physical Therapy and Rehabilitation Academy, İzmir, Turkey.
E-mail: tulay_tarsuslu@yahoo.com

Received: 14.05.2013 **Accepted:** 05.12.2013

DOI:10.5152/tpa.2014.1238

moderate and high degree of involvement (5-8). However, they have less energy consumption, limited participation in physical activities and sportive activities compatible with their age compared to their healthy peers (5, 9). Thus, the risk of obesity is increased in these children who are more immobile compared to healthy children. It has been reported that obesity causes to a defect in functional disease rate and many health problems. Obesity complicates the success of daily activities further and may affect the general health negatively by leading to limitation in participation in physical activities and insufficient self-care (5). These problems in children with CP together with feeding problems may result in limitation in social participation, indifference, decreased learning ability, limitation in playing activities and decreased academic succes with decreased consumption of energy which is required for participation in activities. This may considerably decrease the general well-being and quality of life of the child.

Studies have shown that there is a significant relation between growth and health and body composition affects the general health status, the child's success in participation in activities and intra-familial activity level in children with CP (7, 10). Body composition is a significant factor which affects the quality of life of both the child and the family (10, 11) and affects the child's functional ability (for example, activity and social participation) and general well-being in different dimensions in children with CP.

In the literature, there are studies which tried to determine body composition and feeding problems in children with CP, but no study investigating the effect of body mass index (BMI) on functional status and health-related quality of life (HRQL) is found. Our study which was planned considering this defect has the characteristic of being the first study in this area. The aim of this study was to determine BMI in children with CP with different degrees of involvement and examine the relation between BMI and functional independence and HRQL.

Material and Methods

Two hundred seventy-eight children diagnosed with CP aged between 2 and 18 years were included in the study. Thye study was conducted with children who were attending physiotherapy and rehabilitation programs in different private education and rehabilitation centers in Western Black Sea region of our country. The size of the population was decided to be 278 considering a rate of feeding problem of 40-50% (12) in children with CP, a 95% confidence interval and a tolerance value of 0.05. The study inclusion criteria included having a diagnosis of CP and accesibility of the parents. The study exclusion criteria included presence of another genetic and/or neurological problem, failure to reach the parent/caregiver who takes care of the child and joint limitation hindering height measurement.

The children were included in the study with the permission of their parents after obtaining informed consent following the necessary explanations and briefing given to the parents. The ethics committee approval was given by the ethics committe of Abant İzzet Baysal University, Medical Faculty (Number: 2008/100-77).

The age, gender, height, weight values of the children and type and severity of involvement were recorded. BMI which was obtained by dividing the body weight to the square of the height value was obtained with the corresponding value on the percentile curves which were established seperately for girls and boys. In the scope of the study, the children were divided into four groups as follows: low weight: 0-49th percentile, normal weight: 50-84th percentile, overweight: 85-94th percentile and obese: 95th percentile and above.

The level of gross motor function of the children was evaluated using the gross motor function classification system (GMFCS)(13) and functional independence was evaluated using the functional independence measurement WeeFIM which was developed for children (14) and the Child Health Questionnaire -Parent Form (CHQ PF-50) (15).

GMFCS was used to determine motor function levels of the children (13). The gross motor function classification system is a classification system which is used in determining the functional level in children with CP which ranges between level 1 and level 5. Level 1 indicates that the child is active in indoor and outdoor activities without limitation and without a need for assistive devices for movement and level 5 indicates that self-movement is not possible even if assistive decives are used (16). In our study, the children with level 1 and 2 were considered to have mild involvement, the children with level 3 were considered to have moderate involvement and the children with level 4 and 5 were considered to have severe involvement.

WeeFIM is a measurement method used to determine functional limits in daily life in children with CP and other developmental disorders. It is composed of 6 parts and 18 items: self-care (six items), sphincter control (two items), mobility (three items), locomotion (three items), communication(two items), social interaction (three items). There is a scoring system between 1 and 7. A score of 1 indicates full dependence and a score of 7 indicates full independence (14).

The Child Health Questionnaire- Parent Form-PF50 is composed of 14 subdimensions and contains a total of 50 question items. The concepts measured are as follows: general global health (GGH), physical function (PF), role/social

limitations as a result of emotional or behavioural problems (REB), role/social limitations as a result of physical health (RP), bodily pain/discomfort (BP), behaviour (BE), mental health (MH), self-esteem (SE), general health perception (GH), parental emotional impact (PE), parental time impact (PT), family activities (FA), familial compatibility (FC). In addition, it includes the part " change in health" which compares the health status of the child with the status one year ago. The total score ranges between 0 and 100. A high score indicates a better function and well-being status. The validity and reliability study of the Turkish version was performed and used in this study (15).

Statistical analysis

In statistical analyses, PASW (SPSS ver. 18, Chicago, IL, USA) statistical program was used. Descriptive statistics belonging to the data obtained were expressed as numbers and percentage frequencies and mean±standard deviation (mean±SD) in tables. Kruskal Wallis test was used to determine the difference between the groups classified by body mass index in terms of functional level and health-related quality of life. Pearson correlation analysis was used to determine the difference between BMI and functional level and health-related quality of life. Mann-Whitney U test with Bonferroni correction was used to determine which groups showed difference among the groups which were found to have significant difference as a result of Kruskal Wallis test. A p value of <0,05 was considered significant.

Results

A total of 278 children with CP with a mean age of 8.50±4.49 years 156 (56.1%) of whom were female and 122 (43.9%) of whom were male were included in the study. 17.9% of the children had diparetic CP, 19.06% had hemiparetic CP and 62.94% had quadriparetic CP. When classified according to BMI, 73 of the children (26.3%) had normal weight, 15 (5.4%) were overweight, 32 (11.5%) were obese and 158 (56.8%) had low weight.

According to gross motor function classification, the great majority of the children (37.8%) had a level above 5. 10.1% of the children had a level of 1, 19.8% had a level of 2, 18.7% had a level of 3 and 13.7% had a level of 4 (Table 1).

In our study, the rate of low weight was found to be higher in children with CP who had moderate and severe involvement (52.7%, 53.8%, respectively), while the rate of obesity was higher in ambulatory children with mild involvement (7.1%) (Table 2).

On the comperative statistical analysis, a difference was found between the children with CP who had normal weight, overweight, obesity and low weight in terms of the total WeeFIM score and CHQ dimensions of physical function and role/social limitations as a result of physical health ($p<0.05$). The statistical difference arised from the children who had normal and low body weight. A difference was found between the children who had normal weight and low weight in terms of the total WeeFIM score and CHQ dimensions of physical function and role/social limitations as a result of physical health ($p<0.05$), while no statistical difference was found between the children with normal

Table 1. Demographic and clinical properties of the children (n=278)

Age (years), mean±SD	8.50±4.49
Gender, n (%)	
Female	156 (56.1)
Male	122 (43.9)
Topographic classification, n (%)	
Diparetic	50 (17.9)
Hemiparetic	53 (19.06)
Quadriparetic	175 (62.94)
BMI, n (%)	
Normal	73 (26.3)
Overweight	15 (5.4)
Obese	32 (11.5)
Low weight	158 (56.8)
GMFCS, n (%)	
Level 1	28 (10.1)
Level 2	55 (19.8)
Level 3	52 (18.7)
Level 4	38 (13.7)
Level 5	105 (37.8)
Cooperation, n (%)	
Yes	185 (66.5)
No	93 (33.5)

BMI: body mass index; GMFCS: Gross motor function classification system; Mean±SD:mean±standard deviation

Table 2. Difference in BMI values according to gross motor function classification system

BMI	Mild (GMFCS 1, 2) (n=83) n (%)	Moderate (GMFCS 3) (n=52) (%)	Severe (GMFCS 4,5) (n=143) n (%)
Normal weight	11 (39.3)	18 (32.7)	15 (28.8)
Overweight	2 (7.1)	3 (5.5)	4 (7.7)
Obese	6 (21.4)	5 (9.1)	5 (9.6)
Low weight	9 (32.1)	29 (52.7)	28 (53.8)

BMI: body mass index; GMFCS: Gross motor function classification system

Table 3. Differences in CHQ and WeeFIM between the groups by body mass index

	Normal weight (n=73)	Overweight (n=15)	Obese (n=32)	Low weight (n=158)		
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	χ^2	p
TotalWeeFIM	68.85±39.85	60.53±36.42	64.91±38.67	53.12±36.55	7.623	0.049*
Physical function	57.98±42.24	48.88±50.18	41.65±39.92	38.26±40.22	12.475	0.006*
Role/social limitations as a result of emotional or behavioral problems	57.07±41.75	48.88±45.18	48.42±41.33	41.11±41.70	7.323	0.054
Role/social limitations as a result of physical health	57.98±40.83	51.10±45.19	47.38±39.50	41.91±40.36	8.530	0.036*
Bodily pain and discomfort	55.34±16.67	60.66±14.37	55.31±18.13	50.69±17.88	6.709	0.082
Behaviour	55.06±29.31	59.49±27.36	54.63±26.07	52.79±27.07	1.160	0.763
Intelligence health	57.26±22.17	53.66±26.95	53.04±24.92	55.78±24.49	0.855	0.836
Self-esteem	65.44±17.71	65.38±18.70	59.68±18.89	58.80±21.79	6.010	0.111
General health perception	49.61±19.62	40.84±18.85	43.40±19.09	49.40±19.49	4.692	0.196
Parental emotional impact	56.13±40.11	54.72±38.85	59.99±36.78	58.96±38.23	0.361	0.948
Parental time impact	53.82±37.95	60.27±41.63	46.10±40.09	51±38.88	1.470	0.689
Family acitivities	59.36±33.11	67.33±37.17	58.07±35.62	59.10±35.98	1.019	0.797
Familial compatibility	68.49±23.23	67±24.84	65±27.85	61.77±27.94	2.457	0.483

*Kruskal-Wallis Test, X^2 tests, p<0.05; Mean±SD: mean±standard deviation

Table 4. Relation between body mass index and WeeFIM subdimensions and total WeeFIM (n=278)

		BMI	Self-esteem	Sphincter control	Mobility	Locomotion	Communication	Social interaction	Total WeeFIM
BMI	r	1							
	p								
Self-esteem	r	-.168*	1						
	p	.011							
Sphincter control	r	-.136*	.865**	1					
	p	.039	.000						
Mobility	r	-.152*	.931**	.842**	1				
	p	.021	.000	.000					
Locomotion	r	-.169*	.926**	.826**	.964**	1			
	p	.01	.000	.000	.000				
Comunication	r	-.164*	.777**	.854**	.737**	.741**	1		
	p	.012	.000	.000	.000	.000			
Social interaction	r	-.166*	.826**	.884**	.803**	.797**	.962**	1	
	p	.011	.000	.000	.000	.000	.000		
Total WeeFIM	r	-.175**	.954**	.918**	.932**	.926**	.877**	.918**	1
	p	.008	.000	.000	.000	.000	.000	.000	

*p<0.05, **p<0.01, Pearson correlation coefficient; BMI: body mass index; GMFCS: Gross motor function classification system

Table 5. Relation between body mass index and CHQ PF-50 subdimensions (n=278)

		BMI	PF	REB	RP	BP	BE	MH	SE	GH	PE	PT	FA	FC
BMI	r	1												
	p													
PF	r	-.201**	1											
	p	.001												
REB	r	-.160**	.817**	1										
	p	.007	.000											
RP	r	-.168**	.788**	.837**	1									
	p	.005	.000	.000										
BP	r	-.130*	.517**	.491**	.403**	1								
	p	0.03	.000	.000	.000									
BE	r	-.043	.250**	.352**	.229**	.403**	1							
	p	.471	.000	.000	.000	.000								
MH	r	.021	.124*	.173**	0.059	.227**	.525**	1						
	p	.722	0.04	.004	0.331	.000	.000							
SE	r	-.145*	.320**	.279**	.324**	.401**	.349**	.287**	1					
	p	.016	.000	.000	.000	.000	.000	.000						
GH	r	.013	.185**	.166**	.182**	.138*	.037	.214**	.146*	1				
	p	.824	.002	.006	.002	.021	.537	.000	.015					
PE	r	.034	.372**	.409**	.306**	.376**	.252**	.145*	.157**	.423**	1			
	p	.568	.000	.000	.000	.000	.000	.015	.009	.000				
PT	r	-.039	.446**	.492**	.445**	.413**	.178**	-0.002	.303**	.247**	.505**	1		
	p	.512	.000	.000	.000	.000	.003	.968	.000	.000	.000			
FA	r	-.013	.398**	.425**	.350**	.375**	.306**	.127*	.212**	.285**	.519**	.550**	1	
	p	.834	.000	.000	.000	.000	.000	.034	.000	.000	.000	.000		
FC	r	-.11	.219**	.176**	.126*	.337**	.350**	.340**	.235**	.116	.301**	.033	.134*	1
	p	.067	.000	.003	.036	.000	.000	.000	.000	.053	.000	.579	.026	

*p<0.05,**p<0.01, Pearson corrrelation coefficient; BMI: body mass index; PF:physical function; RP: role/social limitations as a result of physical health; GH: general health perception; BP: pain and discomfort; REB: role/social limitations as a result of emotional or behavioral problems; SE: self-esteem; BE: behaviour; PE: parental emotional impact; PT: parental time impact; FA: familial activity; FC: familial compatibility

weight and the obese and overweight children and between the overweight children and obese children (p>0.05). No difference was found in terms of the variables including role/social limitations as a result of emotional or behavioral problems, bodily pain and discomfort, behavior, intellectual health, self-esteem, general health perception, parental emotional impact, parental time impact, family acitivities and familial compatibility (p>0.05) (Table 3).

In the correlation analysis performed between BMI and WeeFIM, a negative correlation was found between BMI and the dimensions of self-care, sphincter control, mobility, locomotion, communication, social interaction of WeeFIM (p<0.05) and a positive correlation was found between GMFCS and BMI (p<0.05) (Table 4).

In the analysis of Child Health Questionnaire-Parent Form and BMI, a positive correlation was found between BMI and the subdimensions including physical function, role/social limitations as a result of physical health, bodily pain and disconfort and self-esteem (p<0.05). No correlation was found between BMI and the other subdimensions of CHQ (p>0.05) (Table 5).

Discussion

The main findings we obtained in our study were as follows: there was a difference between the children with CP who had normal weight, low weight, obesity and who were overweight in terms of functional independence levels and a negative correlation was present between BMI and functional independence level and health related quality of life.

As far as we know, this study is the first study performed in this area and we think that the results of this study will be a good source for other future studies targeted to be conducted.

Although studies have reported that the rate of low weight is higher in children with CP as a result of poor and inadequate nutrition, the rate of obesity and overweight has also been reported to be increased in children with CP (especially the ones who can walk) as in healthy children and children with other different disabilities (1, 3, 5, 16-18). In parallel to these studies, the rate of low weight was found to be higher in children with CP in our study (56.8%), though the rates of overweight and obesity were found to be 5.4% and 11.5%, respectively. In children with CP, malnutrition does not originate only from poor/inadequate nutrition, but also from factors which are not related with nutrition including immobility, endocrinological changes and spasticity (4). Similar to the other studies performed, the rate of obesity was found to be higher in children with mild involvement who could walk and the rate of low weight was found to be higher in children with moderate and severe involvement (5, 16). The factors including excessively increased muscle tonus, oral motor disorders and immobility may have a negative impact on the level of nutrition and this results in low weight. We think that determining the factors causing to malnutrition in children with CP with moderate and severe involvement in the early period and regular follow-up of height and weight are important in terms of reaching healthy BMI values.

In studies performed to examine nutrition and growth in children with CP, it has been reported that the majority of the children had inadequate nutrition and growth and inadequate nutrition caused to an increase in healthcare expenses and limitation in functional mobility and participation in function especially in children with severe involvement (5, 10, 11). In children with CP with low energy sources, the rates of hospital admissions, physician visits, school absenteesim, time spent in bed and failure to perform daily activities are considerably high (10). Studies have shown that decreased nutrition in children with CP was related with decreased mobility (GMFCS) and decreased quality of life (11, 19). In our study, a difference was found between the children who had obesity, overweight, low weight and healthy BMI values in terms of functional independence in daily life (WeeFIM) and HRQL physical function and role/social limitations as a result of physical health dimensions. In our study, the group with the lowest WeeFIM score was constituted of the children who had low weight. Overweight and obese children followed this. The majority of the children had severe involvement according to GMFCS (level 5). The children with low weight had the lowest score in WeeFIM and the dimensions of physical function and role/social limitations as a result of physical health. This was followed by obese and overweight children. Although no significant difference was found, children with low weight were found to have lower scores in many other dimensions of HRQL. Insufficient amount and consumption of energy which is required to allow and maintain walking in children with CP, weak muscle strength, muscle tonus disorders and nutrition problems arising from various factors lead to negative changes in the health status, have a negative impact on the activity success required for independence in daily life and this may lead to a decrease in the quality of life by decreasing physical function and social participation. This is experienced with a higher rate in children with severe involvement and low BMI values. We think that determining the factors which cause to malnutrition and approaches to eliminate these factors are considerebly significant in terms of achievement of independence in daily life and in terms of increasing health-related quality of life in children with CP who have severe involvement and low BMI values.

Another significant result which we obtained in our study was the relation of BMI with GMFCS and WeeFIM. In our study, a negative correlation was found between BMI values and self-esteem, sphincter control, mobility, locomotion, communication, social interaction and total WeeFIM values. It was found that BMI was related with walking and disability level in children with CP and affected independence in daily life. The majority of the children were quadriparetic children with severe involvement who could not walk and they had low a BMI value. According to the results we obtained in our study, it was concluded that other problems accompanying the picture of CP (muscle strength, energy consumption, muscle tonus, etc.) and malnutrition limited the functional independence in daily life. Follow-up of the height and weight values from the early period with regular intervals and determining deviations from normal are considerably significant in terms of preventing possible problems which can develop in relation with mobility and participation in activities in children with CP.

In our study, it was also found that BMI was positively correlated with the subdimension of HRQL including physical function, role/social limitation as a result of emotional or behavioral problems, role/social limitations as a result of physical health, bodily pain/discomfort and self-esteem. BMI is a significant indicator of the health status in children and adults and an important variable which has a significant impact on the well-being and thus the quality of life. In children and adults, having a healthy nutrition and weight values may affect the individual's physical activity level, social participation and self-confidence. Having a low body weight and/or being overweight is an important variable which affects walking negatively (20, 21).

The results obtained in our study showed that BMI had an impact on functional independence and HRQL in children with CP and this was more prominent in children with severe involvement (quadriparetic children with level 4 and 5 according to GMFCS) and low BMI values. Regular height and weight measurement is a considerably important factor in rehabilitation programs which aim to increase participation in daily life activities and increase the quality of life in children with CP. Healthcare workers should be sensitive about this issue and take the necessary precautions. Further studies are needed in this area.

As far as we know this study is the first study which examines the relation of BMI with functional independence in daily life and HRQL and the results of the study showed that children with CP had lower functional independence in daily life and lower physical function and social participation and thus decreased quality of life compared to obese and overweight children. Body mass index may decrease the activity level in daily life and the quality of life in different ways in children with CP with different types and different involvement levels. Providing sufficient energy for maintenance of walking also in adolescence and adulthood in children with CP with mild involvement and for achievement of functional independence in daily life in children with moderate and severe involvement may depend on height and weight measurements starting from the early period. Precautions and regular follow-up from the early period are considerably important. Further studies should be conducted in this area.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Abant İzzet Baysal University Faculty of Medicine.

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - T.T.Ş., G.T.; Design - T.T.Ş., G.T.; Supervision - T.T.Ş.; Funding - T.T.Ş.; G.T.; Materials - G.T.; Data Collection and/or Processing - G.T.; Analysis and/or Interpretation - T.T.Ş.; Literature Review - T.T.Ş., G.T.; Writer - T.T.Ş.; Critical Review - T.T.Ş.; Other - T.T.Ş.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Dahlseng MO, Finbraten AK, Julliusson PB, Skranes J, Andersen G, Vik T. Feding problems, growth and nutritional status in children with cerebral palsy. Acta Paediatrica 2012; 101: 92-8. [CrossRef]
2. Arrowsmith F, Allen J, Gaskin K, Somerville H, Clarke S, O'Loughlin E. The effect of gastrostomy tube feeding on body protein and bone mineralization in children with quadriplegic cerebral palsy. Dev Med Child Neurol 2010; 52: 1043-7. [CrossRef]
3. Tüzün EH, Güven DK, Eker L, Elbasan B, Bülbül SF. Nutritional status of children with cerebral palsy in Turkey. Disabil Rehabil 2013; 35: 413-7. [CrossRef]
4. Tomounm HY, Badawy NB, Hassan NE, Alian KM. Anthropometry and body composition analysis in children with cerebral palsy. Clin Nutr 2010; 29: 477-81. [CrossRef]
5. Rogozinski BM, Davids JR, Davis RB, et al. Prevelance of obesity in ambulatory children with cerebral palsy. J Bone Joint Surg Am 2007; 89: 2421-6. [CrossRef]
6. Arrowsmith FE, Allen JR, Gaskin KJ, et al. Reduced body protein in children with spastic quadriplegic cerebral palsy. Am J Clin Nutr 2006; 83: 613-8.
7. Stevenson RD, Caraway M, Chumlea WC, et al. Growth and health in children with moderate-to-severe cerebral palsy. Pediatrics 2006; 118: 1010-8. [CrossRef]
8. Stallings VA, Cronk CE, Zemel BS, Charney EB. Body composition in children with spastic quadriplegic cerebral palsy. J Pediatr 1995; 126: 833-9. [CrossRef]
9. van den Berg-Emons HJ, Saris WH, de Barbanson DC, Westerterp KR, Huson A, van Baak MA. Daily physical activity of school children with spastic diplegia and of healthy control subjects. J Pediatr 1995; 127: 578-84. [CrossRef]
10. Samson-Fang L, Fung E, Stallings VA, et al. Relationship of nutritional status to health and societal participation in children with cerebral palsy. J Pediatr 2002; 141: 637-43. [CrossRef]
11. Liptak GS, O'Donnell M, Conaway M, et al. Health status of children with moderate to severe cerebral palsy. Dev Med Child Neurol 2001; 43: 364-70. [CrossRef]
12. Reilly S. Feeding problems in children with cerebral palsy. Mini symposium. Current pediatrics 1993; 3: 109-13.
13. Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. Development and reliability of a system to classify gross motor function in children with cerebral palsy. Dev Med Child Neurol 1997; 39: 214-3. [CrossRef]
14. Aybay C, Erkin G, Elhan AH, Sirzai H, Ozel S. ADL assessment of nondisabled Turkish children with the WeeFIM instrument. Am J Phys Med Rehabil 2007; 86: 176-82. [CrossRef]
15. Ozdoğan H, Ruperto N, Kasapcopur O. The Turkish version of the Childhood Health Assessment Questionnaire (CHAQ) and Child Health Questionnaire (CHQ). Clin Exp Rheumatol 2001; 19: 158-62.
16. Hurvitz EA, Green LB, Hornyak JE, Khurana SR, Koch LG. Body mass index measures in children with cerebral palsy related to gross motor function classification. Am J Phys Med Rehabil 2008; 87: 395-403. [CrossRef]
17. Park ES, Chang WH, Park JH, Yoo JK, Kim SM, Rha DW. Childhood obesity in ambulatory children and adolescents with spastic cerebral palsy in Korea. Neuropediatrics 2011; 42: 60-6. [CrossRef]
18. Rimmer JH, Yamaki K, Davis BM, Wang E, Vogel LC. Obesity and overweight prevelance among adolescents with disabilities. Prev Chronic Dis 2011; 8: 1-6.

19. US Department of Health and Human Services. National Center for Health Statistics. Third National Health and Nutrition Examination Survey, 1988-1994, NHANES III Examination Data File (CD-Rom Series 11, Nos. 1 and 2A). 1998, Hyattsville, MD: Centers for Disease Control and Prevention.
20. Taylor ED, Theim KR, Mirch MC, et al. Orthopedic complications of overweight in children and adolescents. Pediatrics 2006; 117: 2167-74. [CrossRef]
21. Dufek JS, Currie RL, Gouws PL, et al. Effects of overweight and obesity on walking characteristics in adolescents. Hum Mov Sci 2012; 31: 897-906. [CrossRef]