

A comparison of nutritional status between children with and without disabilities: A community-based study

Ankeeta Menona Jacob¹, Sreekantaiah Pruthvish²,
Nandakumar Bidare Sastry³, Radhika Kunnavil⁴, Mohanraju Shankarappa⁵,
Avinash K. Shetty⁶

¹Department of Community Medicine, K. S. Hegde Medical Academy, Nitte (Deemed to be University), Nithyananda Nagar, Deralakatte, Mangalore, Dakshina Kannada District, Karnataka, India, ²Consultant, National Centre for Disease Informatics and Research, IInd Floor of Nirman Bhavan, ICMR Complex, Kannamangala, Bangalore, Karnataka, India, ³Department of Community Medicine, M. S. Ramaiah Medical College, MSRIT Post, MSR Nagar, Bangalore, Karnataka, India, ⁴Department of Community Medicine, ESIC Medical College and PGIMS and Model Hospital Rajajinagar, Bengaluru, Karnataka, India, ⁵Clinical Psychologist, Department of Psychiatry M S Ramaiah Medical College, Bengaluru, Karnataka, India, ⁶Associate Dean for Global Health, Professor of Paediatrics, Chief, Paediatric Infectious Diseases, Director, Paediatric HIV Program, Director, Global Health Education, Wake Forest School of Medicine, Winston-Salem, NC

ABSTRACT

Background: Children with disabilities are expected to have poor nutritional status in comparison to children without disabilities. However, limited data on nutritional status of children with and without disabilities in rural settings in India. **Objective:** To assess and compare the nutritional status of children with and without disability. **Methods:** A cross-sectional study among children aged 5–15 years was conducted in the rural practise area of a medical college in Karnataka. 290 children (145 with and 145 children without disability) of similar age and sex were studied. Age and sex-specific World Health Organization (WHO) BMI centiles, 24 h dietary calorie and protein intakes were assessed and compared. Median and interquartile ranges were calculated for quantitative variables. Mann-Whitney U test was used to assess the differences in quantitative variables among the two groups. **Results:** As per WHO BMI centiles, 33.1% with and 37.20% without disabilities were undernourished. The median calorie consumed by children with disabilities was 1169.0 (946.5–1586.0) significantly lower compared to that of children without disability, that is, 1362.0 (1167.0–1641.0). The median protein consumed by children with disabilities was 28.0 (22.5–38.0) significantly lower compared to that of children without disability, that is, 32.0 (28.0–40.0). **Conclusions:** Children with disabilities had similar rates of undernutrition as that of their non-disabled peers and their lesser dietary intake in terms of calories and proteins.

Keywords: 24-hour recall method, anthropometry, calorie deficit, weight for age, WHO BMI centiles

Introduction

UNICEF has estimated about 93–150 million children live with disabilities. Of every four children with disabilities, three children reside in low-and middle-income countries (LMICs).^[1] 38% stunting, 21% wasting, and about 36% underweight rates were estimated in Indian children as per the latest survey conducted

Address for correspondence: Dr. Ankeeta Menona Jacob, Department of Community Medicine, K. S. Hegde Medical Academy, Nitte (Deemed to be University), Nithyananda Nagar, Deralakatte, Mangalore - 575 018, Dakshina Kannada District, Karnataka, India.
E-mail: neelankeet@gmail.com

Received: 17-07-2020

Revised: 17-09-2020

Accepted: 24-11-2020

Published: 27-02-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_1464_20

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Jacob AM, Pruthvish S, Sastry NB, Kunnavil R, Shankarappa M, Shetty AK. A comparison of nutritional status between children with and without disabilities: A community-based study. J Family Med Prim Care 2021;10:941-6.

by the National Family Health Survey-4 (NFHS-4).^[2] The percentage of children in rural areas who were stunted was 41% which was much higher compared to urban areas, that is, 34%.^[2] Disability and malnutrition are international public health issues that limit opportunities in life.^[3] Malnutrition and disability share a unique relationship as each of these problems could lead to or cause one another.^[4] The State of World Children (SOWC) Report of 2019 highlighted the triple burden of malnutrition poor nutrition, hidden hunger, and obesity among children. The triple burden becomes more relevant especially among children with disabilities.^[4] Although malnutrition and disabilities rates being high, research in rural areas especially in India is extremely limited. Children with disabilities are usually assumed to have poor nutrition than their able-bodied peers.^[5] However, the information regarding the nutritional status especially in rural settings among children with disabilities in India is limited.

A study on the association of childhood disability and undernutrition showed a positive association. However, varied results on association between childhood disability and Overweight and obesity were found.^[6] Studies from Kenya,^[7] Bangladesh^[1] highlighted that children with disabilities were likely to be underweight and stunted compared to their non-disabled peers. However, in India, published studies have primarily focused on urban slum areas^[8] and there is limited data on malnutrition and childhood disability in rural areas of India where majority of individuals with disabilities reside. As primary care physicians, it is imperative to know whether children with disabilities differ nutritionally from individual without disabilities. In this study, we aimed at determining the nutritional status of children with and without disabilities.

Methods

The present study was undertaken from February 2014 to February 2015 in a rural field practice setting on the outskirts of Bengaluru, Karnataka, India. This rural area is attached to the Department of Community Medicine of a medical college in Bengaluru City and has a resource center for rehabilitation of children with intellectually disabled and visually impaired for around neighboring 36 villages. For this study, villages under three Primary Health Centers (PHCs) around this rural field practice area were included.

Study participants

The field survey was undertaken using the proforma for identifying individuals with a possible disability.^[9] This proforma has been used in studies conducted in rural communities in India for the rapid identification of individuals with disabilities.^[10] To identify individuals with disability, key informant interviews from Anganwadi workers, ASHA workers, Teachers, Community workers, Panchayath members, Rehabilitation Workers, Block Education Officer of Chintamani Taluk, and Rehabilitation Center for children with disabilities run by the medical college in the rural field practise area were also conducted Other sources for information of the children with disabilities were obtained

by reviewing disability records in village level government run schools with appropriate permissions from school authorities. Nominal group technique designed specifically for this study, identify children with any disability was used in areas where data on children with disabilities were not easily available at village level. Children aged 5–15 years with various forms of disabilities (e.g., physical disability/mental/visual and communication disabilities) based on the “The Persons with Disabilities (PWD) (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995^[11] were included for the study.

The reasons for selecting children between 5 and 15 years was that the children would still dependent on their families for nourishment. However, these children could also exercise some degree of choice with respect to nutrition. Individuals with a disability who were not permanent residents, that is, residing in the selected areas for less than 6 months were not included. Written informed consent from caregivers or guardians of the children recruited for the study was taken prior to collecting information from them. The Scientific and Ethical Research Committee clearances before the commencement of study were obtained from the medical college.

Selection of non-disabled peers

Non-disabled peers selected for the study included the classmates, siblings, or neighbors of the same locality or school. The full recruitment of samples after ethical committee approval is described in the article, which has characterized the difficulties faced in feeding individuals with disabilities, which was a part of this study.^[12] A total of 290 children, 145 with disabilities and 145 without disabilities were selected based on the prevalence of moderate to severe malnutrition using height for age which was found to be 69% in children with disabilities and 53% among the non-disabled children by Yousofzai *et al.*^[8]

Study measures

Anthropometric measurements were measured in both the groups using WHO standard techniques. The weight of the child was documented using standard weighing scale and rounded off to the nearest kilogram. The measurement of the bodyweight of the children was done with light clothing. A standard stadiometer with a demarcation of 5 mm was used to measure the height of the children without any footwear on a plane hard surface. In any case of the inability of a child to stand, a second weighing method was employed. The double weighing method was done when the child with a disability, was unable to stand, and was weighed along with a caregiver/teacher. Since some children with disabilities could not stand (i.e., height measurement could not be done), arm span measurements of children were taken as a surrogate to measure. WHO Body Mass Index (BMI) centiles were used to compare the nutritional status of children with and without disabilities.^[13]

Definitions

For the calculation of WHO BMI centiles, raw data of weight and height were included and calculated. The age and sex-specific

WHO BMI centiles were used to classify the children as underweight, that is, less than 3rd percentile, normal as 3rd to 85th percentile, and 85th to 97th percentile as overweight and more than 97th percentile as obese as per the WHO BMI centiles.^[14]

Calorie and protein consumed by the study population was determined by 24-hour recall of food intake, using a food atlas^[15] based on the approximate serving size proportions of meals. Based on the calorie and protein intake in the food atlas, an approximate caloric and protein intake was calculated. Festivals and fasting days were accounted for, when data was collected before taking the 24-hour recall method. Calorie deficit was estimated in children in both groups, according to age and sex requirement of calorie and protein as per the nutrient needs for Indians as prescribed in the Dietary guidelines for Indian population.^[16]

Statistical analysis

Data collected were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences version 20.0. Quantitative variables such as age, height, weight, calories, and proteins consumed among the children with and without a disability were expressed as median and interquartile range (IQR). Qualitative variables such as sex, grades of malnutrition as per WHO BMI centiles, was expressed in terms of proportions. Mann–Whitney U test assess the differences in variables among children of both the groups.

Results

Among the 290 children studied, of the 145 children with disabilities, 88 (60.7%) were males and 57 (39.3%) were females. The 145 children without disability consisted of 74 (51.0%) males and 71 (49.0%) females. Table 1 depicts that the study population were of similar age groups and sex. The most common disability was mental retardation (including cerebral palsy and multiple disabilities) of which 29 (33.0%) were males and 27 (47.4%) were females.

The nutritional status of the study population among the two groups were described based on the Anthropometric assessment and Dietary Assessment.

Anthropometric assessment

The age-wise distribution of weight, height, and WHO BMI centiles among male children with and without any disability

is presented in Table 2. The male children with disability aged 5–10 years weighed significantly lesser and were significantly shorter compared to their able-bodied peers. However, this difference tended to reverse in the age groups of 11–15 years as the children with disabilities weighed more and were taller compared to their non-disabled peers. Similar results were also seen in female children with and without any disability in both age groups, as shown in Table 3. In age group of 5–10 years, girls with disabilities were underweight and shorter compared to their non-disabled peers. However, girls with disabilities aged 11–15 years were taller and weighed more than their able-bodied peers. Table 4 shows the nutritional grades of the children with and without any disability. The degrees of undernutrition were similar in children with and without disabilities and did not differ significantly when the weight and height of males and females aged 5–10 years were compared. As seen in Table 4, children with disabilities aged 5–10 years had a higher proportion of undernutrition when compared to their non-disabled peers. In the age groups of 11–15 years of age, the proportion of overweight and obese children with disabilities was higher compared to their children without disabilities. However, these differences were not found to be statistically significant. As per the WHO BMI centile classification, as shown in Figure 1, there were similar proportions of undernutrition seen in both children with and without disabilities. However, these differences in grades of nutrition were not found to differ significantly. The rates of undernourishment as per the WHO BMI centiles were higher among children without disabilities as compared to children with disabilities.

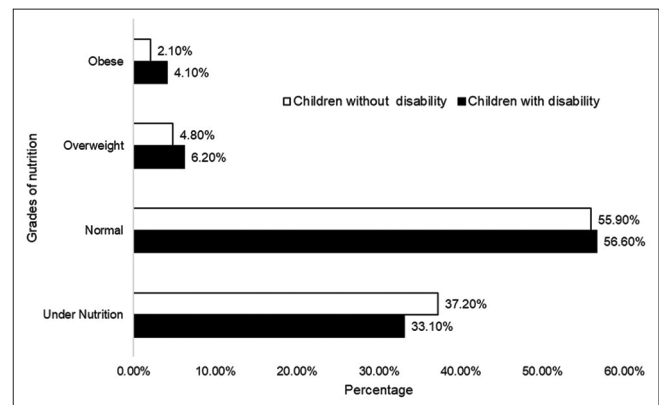


Figure 1: WHO BMI centiles classification of children with and without disability

Table 1: Age group and sex wise distribution of the study population

	Children with disability (n=145) n (%)	Children without disability (n=145) n (%)	Total (n=290) n (%)	t	P
Age groups (years)					
5-10	69 (50.7)	67 (49.3)	136 (100.0)	0.055	0.814
11-15	76 (49.4)	78 (50.6)	154 (100.0)		
Sex wise distribution of the study population					
Males	88 (54.3)	74 (45.7)	162 (100.0)	2.741	0.098
Females	57 (44.5)	71 (55.5)	128 (100.0)		

Chi- square Test, P<0.05

Table 2: Age group distribution of weight and heights and BMI centiles among males

Males (age in years)	Anthropometric measurements	Children with Disability		Children without Disability		P
		Median	IQR	Median	IQR	
5-10 (n=63)	Weight (kg)	18.0	15.0-23.0	25.0	21.0-27.0	<0.001†
	Height (cm)	114.0	105.0-120.0	128.5	122.0-140.3	<0.001†
	BMI centile	14.0	12.0-15.0	15.0	13.0-16.0	0.234
11-15 (n=99)	Weight (kg)	33.0	28.0-43.5	25.0	22.0-29.0	<0.001†
	Height (cm)	144.0	136.5-160.0	131.0	121.8-139.3	<0.001†
	BMI centile	16.0	15.0-18.0	15.0	13.8-16.0	0.02*

Mann Whitney U test. *P<0.05 †P<0.01

Table 3: Age group distribution of weight and heights and BMI centiles among females

Female (age in years)	Anthropometric measurements	Children with Disability		Children without Disability		P
		Median	IQR	Median	IQR	
5-10 (n=73)	Weight (kg)	20.0	15.0-24.25	26.0	23.0-30.0	0.002*
	Height (cm)	117.5	104.0-129.5	133.0	124.0-139.0	0.003*
	BMI centile	15.0	13.75-17.0	15.0	14.0-16.0	0.630
11-15 (n=55)	Weight (kg)	34.0	27.0-38.0	26.0	22.3-29.8	0.002*
	Height (cm)	144.0	139.0-150.0	133.0	127.0-141.5	0.006*
	BMI centile	16.0	15.0-19.0	15.0	13.3-16.0	0.01*

Mann Whitney U test. *P<0.01

Table 4: Age group comparison of the distribution of the grades of nutrition

Age groups	WHO BMI Centiles Classification	Children with Disability n (%)	Children without Disability n (%)
5-10 years	Underweight	20 (29.0)	14 (20.9)
	Normal	40 (58.0)	44 (65.7)
	Overweight & Obese	9 (13.0)	9 (13.5)
11-15 years	Underweight	28 (36.8)	40 (51.3)
	Normal	42 (55.3)	37 (47.4)
	Overweight & Obese	6 (7.9)	1 (1.3)

Table 5: Calorie and protein intake and deficits among the study population

Age Groups	Nutrient intake and deficit	Children with Disability		Children without Disability		P
		Median	IQR	Median	IQR	
5-10 years	Calorie consumed (in kcal)	1006.0	793.0-1254.0	1292.0	(1052.0-1522.0)	<0.001*
	Calorie deficit %	43.8	26.4-54.4	26.8	(12.4-36.3)	0.002*
	Protein consumed (in grams)	25.0	(21.0-32.0)	32.0	(27.0-44.0)	<0.001*
11-15 years	Calorie consumed (in kcal)	1292.0	(1052.0-1522.0)	1431.0	(1260.3-1753.0)	0.106
	Calorie deficit %	26.7	(12.4-36.3)	36.9	(28.6-36.9)	0.01*
	Protein consumed (in grams)	34.0	(25.0-42.8)	32.0	(28.0-32.0)	0.964
Total	Calorie consumed (in kcal)	1169.0	(946.5-586.0)	1362.0	(1167-1641.0)	<0.001*
	Calorie deficit %	42.7	(26.7-54.4)	32.6	(20.0-43.2)	<0.001*
	Protein consumed (in grams)	28.0	(22.5-38.0)	32.0	(28.0-40.0)	<0.001*

The number in parenthesis denotes Interquartile range, *Indicate statistically significant results P<0.05 (Mann Whitney U test)

Dietary assessment

Table 5 shows the comparison of calorie and protein intake and calorie deficits in children. The overall median calorie consumed by children with disabilities was 1169.0 (946.5–1586.0) significantly lower compared to that of children without disability, that is, 1362.0 (1167.0–1641.0). The overall median protein consumed by children with disabilities was 28.0 (22.5–38.0) significantly lower compared to that of children without disability, that is, 32.0 (28.0–40.0). In the children aged 5–10 years, children with disabilities consumed lesser calories than their able-bodied

counterparts. This observation was found to be statistically significant. However, in the 11–15-year age group, a statistically significant difference was found only in calorie deficit between the two groups. Statistically significant differences were also observed in the overall calorie deficit and the median amount of protein consumed among the two groups.

Discussion

This study adds a new perspective of age and sex-related differences in nutritional status of children with disabilities

compared to children without disabilities in a rural setting located in the state of Karnataka, India. The present study highlights that children with disability in younger ages (5–10) years irrespective of their sex weighed less were shorter and consumed fewer calories and proteins than their non-disabled peers. However, in children with disabilities in older ages (11–15) years, irrespective of their sex weighed more, were taller even though they consumed lesser calories and proteins than their non-disabled peers. Children with disabilities had higher rates of undernutrition in younger age groups and higher rates of obesity and overweight in older age groups when compared to children without disabilities in similar age groups. However, these did not reach the level of statistical significance. As primary care physicians, this knowledge helps in planning better diets with help of dieticians and improve physical activity especially in older children.

A meta-analysis conducted by Hume-Nixon^[6] on 17 articles showed that there was a threefold increase in the risk of undernutrition among children with disabilities than children without disabilities. The risk of stunting in disabled children was twice when compared to individuals without a disability. However, mixed results were obtained for the association of disability among children and overnutrition states (i.e., overweight and obesity). A study conducted in South Korea by Sung WJ *et al.* in 2020^[17] showed that children with disabilities had lower WHO BMIs. This study also highlighted that younger children had higher proportions of individuals with lesser WHO BMI especially among younger age groups which was similar to the present study findings.

Jahan I *et al.*, Bangladesh, in 2019 showed significant differences in rates of severely wasted children among of whom 25 (20.4%) when compared to 7 (2.7%) children without disability.^[1] The rate of severe stunting was also notably higher i.e. 599 (48.0%) compared to children without disability, where it was only 115 (9.1%). Observation of similar trends in the proportions of severely underweight among children with a disability was 293 (43.3%) vis-a-vis 81 (12.1%) among children without a disability was seen.^[1] These study findings and the present study have found similar results, though the parameters for the nutritional status used were different (weight and height for age and weight for height instead of WHO BMI centiles). Because of these inherent differences in the methods used in the evaluation the nutritional status, comparison in the rates of overnutrition (overweight and obesity) was not possible. Kuper *et al.*, in Kenya, found that children with disabilities had lower weight for age, height, and WHO BMI for age which significantly differed from children without disabilities as seen in the present study also.^[7]

The specific disabilities of intellectual, physical, and visual disabilities were compared, with our present study findings. Polfuss M *et al.* compared nutritional status in children with developmental disabilities and healthy controls. This study found that children with Down's syndrome and Spina Bifida had a higher

proportion of overweight compared to normal controls.^[18] A study conducted on Japanese children with intellectual disabilities in 2020 (Down's Syndrome) estimated obesity in about 20% of these children, which is much higher compared to our study findings. This may be because of the inclusion of children with only a particular type of disability (intellectual disability).^[19] In the study conducted by Nogay *et al.* in Pakistan, the proportion of underweight among children with intellectual disabilities was 14.3%, much lower compared to our study that estimated about 33.1% as per WHO BMI centiles Classification.^[20] A survey conducted on physically disabled children in Tehran by Neyestani T *et al.*^[21] found that children with physical disabilities showed that the prevalence of undernutrition was higher in children with disabilities when compared to children without physical disabilities which were similar to our study results.

Loisa K *et al.*^[22] showed that children with a motor disability had about 76% of the recommended caloric intake, which was much lower in comparison to the present study of 57.3% and 67.42% among children with and without disabilities, respectively. A study conducted by Ukegbu PO and Ukegbu AU among male and female blind adolescents showed statistically significant differences in the weights and heights of males, comparable to the findings in the present study.^[23]

Because of the difficulties in measurement of height and weight among children with disabilities, there were few limitations. For this reason, the derivation of internationally comparable rates using anthropometric measures for nutritional status such as WHO software (WHO Anthro and WHO Anthroplus) was not done. The caloric and protein intake for the study was calculated based on an approximation of the child's intake using the 24-hour recall method. However, 24 hour recall method of nutrient intake cannot be used as a marker for long-term consequences of under or over nourishment but gives only an estimate of the quantity of food that was taken 24 hour before the interview. Thirdly, since the interview regarding food intake was often with the parents/caregiver regarding the food consumed in the past 24 hour, many were unaware of the food consumed by their wards during the school hours which could have led to some discrepancy in the actual reporting of caloric and protein intakes in children without disability. Fourthly, assessment of the pubertal changes which could have affected the findings of the study.

This paper highlights a significantly high levels of undernourishment in both children with disability and among children without disabilities in the rural population. The children with special needs tend to have higher rates of obesity and overweight in adolescence compared to their children without disabilities despite lesser consumption of calories and proteins. Further research to understand the risk factors for such findings in our settings is needed. As primary care physicians, planning the diets of children with disabilities, so that an optimum balance of food intake and energy expenditure can be achieved so that over nutrition states like overweight and obesity can be undertaken.

Conclusion

Children with disabilities had comparable rates of undernutrition, normal, and overnutrition states like overweight and obesity. The children with special needs consume diet significantly lesser in terms of calories and proteins compared to their peers who did not have any disabilities. However, they tend to have higher rates of obesity and overweight in adolescence (11–15 years).

Acknowledgements

The authors acknowledge the technical help and support provided by the Medico-Social Workers - Mr. Venkateshappa T, Mr. Chandrashekar, Mr. Ramesh, and staff at the Spandana Resource Centre for Visually Impaired and Mentally challenged, Kaiwara, Chintamani Taluk, Karnataka

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (parents/ caregivers/ have given their consent for parents/ caregivers their clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Jahan I, Karim T, Al Imam MH, Das MC, Ali KM, Muhit M, *et al.* Childhood disability and nutrition: Findings from a population-based case control study in Rural Bangladesh. *Nutrients* 2019;11:2728.
- National Family Health Survey (NFHS-4), 2015-16 [Internet]. Mumbai: International Institute for Population Sciences (IIPS) and ICF; 2017 [cited 2020 Feb 26] p. 671. Available from: <https://dhsprogram.com/pubs/pdf/FR339/FR339.pdf>.
- Groce N, Challenger E, Berman-Bieler R, Farkas A, Yilmaz N, Schultink W, *et al.* Malnutrition and disability: Unexplored opportunities for collaboration. *Paediatr Int Child Health* 2014;34:308-14.
- UNICEF. The State of the World's Children 2019. Children, food and nutrition: Growing well in a changing world. Newyork: UNICEF; 2019. p. 258.
- Sullivan PB, Rosenbloom L. Feeding the Disabled Child, Clinics in Developmental Medicine. London and Cambridge, UK: MacKeith Press/Cambridge University Press; 1996.
- Hume-Nixon M, Kuper H. The association between malnutrition and childhood disability in low- and middle- income countries: Systematic review and meta-analysis of observational studies. *Trop Med Int Health* 2018;23:1158-75.
- Kuper H, Nyapera V, Evans J, Munyendo D, Zuurmond M, Frison S, *et al.* Malnutrition and childhood disability in Turkana, Kenya: Results from a case-control study. *PLoS One* 2015;10:e0144926.
- Yousafzai AK, Filteau S, Wirz S. Feeding difficulties in disabled children leads to malnutrition: Experience in an Indian slum. *Br J Nutr* 2003;90:1097-106.
- Thomas M, Pruthvish S. Identification and needs assessment of beneficiaries of community based rehabilitation initiatives. Action Aid India, Bangalore; 2002.
- Kumar S, Das A, Bhandary P, Soans S, Harsha Kumar H, Kotian M. Prevalence and pattern of mental disability using Indian disability evaluation assessment scale in a rural community of Karnataka. *Indian J Psychiatry* 2008;50:21-3.
- The Persons with disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act 1995 [Internet]. 1. Sect. 1, 1 of 1996 Jan, 1996 p. 46. Available from: http://www.scd.kar.nic.in/docs/Act-Book-Eng_B.pdf.
- Jacob AM, Pruthvish S, Sastry NB, Kunnnavil R, Shankarappa M. An explorative study of the differences in feeding patterns of children with and without disabilities in a rural community in Karnataka. *Indian J Community Health* 2019;31:248-52.
- Yabanci N, Selim K, Isil S. The relationship between height and arm span, mid-upper arm and waist circumferences in children. *Ann Hum Biol* 2010;37:70-5.
- WHO-BMI for age (5-19 years) [Internet]. World Health Organization, Geneva; 2007 [cited 2020 Sep 02]. Available from: https://www.who.int/growthref/who2007_bmi_for_age/en/.
- Sudha V, Mohan V, Anjana MR, Krishnaswamy K. Dr. Mohans Atlas of Indian Foods. 1st ed., vol 1. Chennai: Dr. Mohan's Healthcare Products Pvt. Ltd; 2013. p. 104.
- Krishnaswamy K, Sesikiren B, Laxmaiah A, Vajreswari A. Dietary Guidelines for Indians -A Manual [Internet]. 2nd ed.. Hyderabad: National Institute of Nutrition; 2010. 96 p. Available from: <http://ninindia.org/dietaryguidelinesforinwebsite.pdf>.
- Sung WJ, Kim WJ, Hwang Y, Kim JS, Lim SH, Hong BY. Body composition of school-aged children with disabilities. *Pediatr Int* 2020;62:962-9.
- Polfuss M, Sawin KJ, Papanek PE, Bandini L, Forseth B, Moosreiner A, *et al.* Total energy expenditure and body composition of children with developmental disabilities. *Disabil Health J* 2018;11:442-6.
- Yamanaka E, Inayama T, Ohkawara K, Okazaki K, Kita I. The association between obesity and sedentary behavior or daily physical activity among children with Down's syndrome aged 7-12 years in Japan: A cross-sectional study. *Heliyon* 2020;6:e04861. doi: 10.1016/j.heliyon. 2020.e04861.
- Hakime Nogay N. Nutritional status in mentally disabled children and adolescents: A study from Western Turkey. *Pak J Med Sci* 2013;29:614-8.
- Neyestani TR, Dadkhah-Piraghaj M, Haydari H, Zowghi T, Nikooyeh B, Houshyar-Rad A, *et al.* Nutritional status of the Iranian children with physical disability: A cross-sectional study. *Asia Pac J Clin Nutr* 2010;19:223-30.
- Kilpinen-Loisa P, Pihko H, Vesander U, Paganus A, Ritanen U, Mäkitie O. Insufficient energy and nutrient intake in children with motor disability. *Acta Paediatr* 2009;98:1329-33.
- Ukegbu PO, Ukegbu AU. Assessment of nutritional and health status of institutionalized blind adolescent students in Umuahia, Abia State. *Sky J Med Med Sci* 2014;2:79-84.