ARTICLE

Nutritional status of disabled schoolchildren in Bloemfontein (2002 - 2003)

SAJCN 2007, Vol. 20, No. 1

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Objectives. To assess the nutritional status of disabled schoolchildren using anthropometric measures and dietary intake, and to compare estimated energy expenditure with energy intake and body weight.

Design. A descriptive, cross-sectional survey was undertaken.

Setting. The study was conducted at three Bloemfontein schools for disabled children (Tswellang: physically disabled, Pholoho: mentally disabled, Martie du Plessis: both mentally and physically disabled).

Subjects. Subjects included a random selection of 145 boys and girls aged 8 - 15 years.

Outcome measures. Standard methods were used to determine height, demi-span, knee-height, weight, mid-upper arm circumference and triceps skinfolds. A 24-hour recall combined with a food frequency questionnaire and 7-day weighed food record were used to determine usual dietary intake of day scholars and hostel scholars respectively. Resting energy expenditure (REE) was calculated for each child using Shöfield equations. Total energy expenditure (TEE) was calculated by multiplying the appropriate physical activity level (PAL) factor by REE.

Results. The high prevalence of stunting (weight-for-height < –2 standard deviations (SD)) (Tswellang 47.7%, Pholoho 37.3%), and underweight (weight-for-age < –2 SD) (Tswellang 29.8%, Pholoho 18.7%) was a matter of concern. Although median energy intake was slightly lower than the recommended intakes, median protein intake tended to be adequate, while micronutrient intake was low. Median energy intake determined by the 24-hour recall tended to be lower (Pholoho –769 kJ) or nearly the same (Tswellang 327 kJ) as the calculated TEE (PAL 1.2 - 1.8).

Conclusion. Nutrient density and texture of the children's diet should be monitored to improve nutritional status. In future studies more accurate methods should be used to determine energy intake and expenditure.

Adequate nutrition is a fundamental prerequisite for good physical health, motor and cognitive development.[1] Malnourished children can become adults with lower physical and intellectual abilities, lower levels of productivity and high levels of chronic illness and disability.[2] Feeding difficulty and malnutrition are common in disabled children and malnutrition may result in impaired growth and neurodevelopment, and impaired cardiorespiratory, gastrointestinal and immune functions.[3]

Surveys in developed countries have shown that disabled children and adolescents are vulnerable to poor nutritional care.[4] In contrast, far less information is available on the nutritional status of disabled children in developing countries where the situation is further complicated by widespread malnutrition among the general population.[5] In the routine health care of children with special needs, assistance with feeding is often not provided. Tse *et al*.[6] demonstrated that disabled children often experience problems with the intake of adequate energy and other nutrients. However fewer studies have investigated micronutrient deficiencies in disabled children.[7]

The actual dietary intake and anthropometric nutritional status of disabled children in Mangaung, Bloemfontein, have not been investigated. Therefore, the nutritional status of disabled black schoolchildren was assessed using anthropometric measures and dietary intake. Estimated energy expenditure was also compared with energy intake and body weight.

Subjects and methods

A descriptive, cross-sectional survey was undertaken. A stratified sample of 172 disabled boys and girls aged 8 - 15 years were selected from Martie du Plessis (school for both mentally and physically disabled, with a high number of children with learning difficulties including dyslexia, as well as children with Down's syndrome and cerebral palsy; few with eating problems); Pholoho (school for mentally disabled children including those with severe mental disability and cerebral palsy, Down's syndrome, fetal alcohol syndrome, epilepsy, and attention deficit hyperactivity disorder; 10% with eating problems); and Tswellang (school for physically disabled children, mainly with cerebral palsy, spina bifida, brittle bone disease, amputations, spasticity and athetosis; 25% with eating difficulties). Children with severe disabilities and unique nutritional requirements were excluded. All the children living in the hostels of Pholoho and Tswellang were included, while the day scholars (children living in the city) at both schools were randomly chosen, using the class lists. Because of absentees on days of the survey and consent not granted by the caregivers, 145 of the 172 selected children participated (Martie du Plessis: 13 day scholars, Pholoho: 42 day scholars and 23 hostel scholars, Tswellang: 26 day scholars and 41 hostel scholars).

Background information

Standardised questionnaires were used to determine information on gender, school grade, age and category of disability, including special aids used by the child.

Anthropometric measurements

Standard anthropometric measurements for able and disabled children were applied by two trained researchers at each school.[8,9] Mid upper-arm circumference (MUAC), triceps skinfold (TS) and knee height (KH) were taken on the right side, where possible.[8] Personnel from the different schools assisted. For children whose height could not be determined because of disability, the demi-span (2 times the distance from middle of sternal notch to finger tip)[10] and KH (black females 6 - 18 years: S (stature) = 46.59 + (2.02 KH), white females 6 - 18 years: S = 43.21 + (2.14 KH), black males: S = 39.60 + (2.18 KH), white males 6 - 18 years: S = 40.54 + (2.22)) were used to estimate height.[8] For children whose weight could not be determined because of disability, equations for estimating body weight from KH and MUAC were used.[8] Weight, height, MUAC, and TS were determined. All measurements were taken 3 times, and averages were calculated. Upper-arm muscle area (UAMA) and upper-arm fat area (UAFA) were calculated from MUAC and TS values using standard formulae for children.[8] Values of the National Centre for Health Statistics (NCHS) were used as reference standards for the interpretation of anthropometric values.[11] Minus 2 standard deviations (– 2 SD) below the reference median of the NCHS reference values for children refers to the *z*-score cut-off which compares with the values of the third percentile.[10] Weight-for-age (W/A), height-for-age (H/A) and weight-for-height (W/H) were classified as moderately depleted (< –2 SD) and mildly depleted (–2 SD - < –1 SD), normal (±1 SD) and excessive (> 2 SD).[12] For the purpose of this study the slightly above normal category (> 1 - 2 SD) was classified as normal. Percentiles of the NCHS were used to categorise MUAC and UAMA as low (< 15th percentile), normal (15 - < 85th percentile) and above normal (≥ 85th percentile). UAFA and TS were categorised as low (< 15th percentile), normal (15 - < 75th percentile) and above normal (≥ 75th percentile).[11]

Dietary intake

One 24-hour recall, combined with a food frequency questionnaire (FFQ),[8,9] was completed for each day scholar (Martie du Plessis N = 13, Pholoho N = 42, Tswellang N = 26) during a personal interview conducted by 2 trained researchers with the caregiver of the child. The 7-day weighed dietary records[8] were completed for all children living in hostels (Pholoho N = 23, Tswellang N = 41), by the same two researchers. They were standardised against each other to ensure that the information was interpreted consistently. The 24-hour recall combined with a FFQ interview was used to estimate portion sizes accurately. Portion sizes were estimated in millilitres and converted to grams, using the Medical Research Council (MRC) Food Quantities Manual.[13] The dietary data were analysed, using the MRC Food Composition database. Nutrient intakes were compared with the US Dietary Reference Intakes (DRIs).[14] The recommended dietary allowance (RDA) level of the DRIs were used, as well as the adequate intakes (AIs) for nutrients without RDAs.

Energy expenditure

Schöfield equations, which are also used by the World Health Organization for children up to 18 years, were used to calculate the resting energy expenditure (REE) of each child.[15] The estimated total energy expenditure (TEE) was calculated by multiplying REE by an appropriate physical activity level (PAL). PAL factors for children[15] that are adapted for disabled children[16] were used as a guide and categorised according to the children's aids: chair-bound/wheelchair 1.2, walk with crutch/difficulty 1.6, and walk and run normally 1.8.

Statistical analysis

Weight and height data were analysed using Epi-info (Epi-info Version 5:0, Atlanta, Ga) and all other analyses were done using SAS (SAS Institute, Cary, NY).

Descriptive statistics were used, namely frequencies and percentages to describe categorical data, and means, SDs and medians to describe continuous data. Spearman's correlations were calculated to describe the relationship between REE, TEE, body mass index (BMI), body weight and energy intake.

Ethical approval

The Ethics Committee of the Faculty of Health Sciences, University of the Free State approved the study. Written consent to participate in the study was obtained from the headmasters of the respective schools and the caregivers of the children.

Results

Lack of parental consent resulted in a small sample from Martie du Plessis (*N* = 13). Therefore the results from Martie du Plessis are given, but were not included in the comparison. Most subjects from Martie du Plessis (*N* = 13) were female (61.5%), in grades 2 - 5 (46.2%), and between 9 and 13 years of age (66.7%), and all had mental/learning disabilities. In the case of Pholoho (*N* = 65), half of the subjects were male (50.8%), most were in grades 2 - 5 (78.5%), 96.9% were between 9 and 13 years of age and most had mental/learning disabilities (97.0%) or physical disabilities (3.0%). In the case of Tswellang (*N* = 67), most subjects were male (73.1%), in grades 2 - 5 (61.2%), and were between 9 and 13 years old (71.6%), and all had physical disabilities. All subjects from the three schools fell within the 8 - 15-year age range.

The anthropometric data of the disabled children are shown in Table I and the *z*-score categories of the weight/height status in Table II. Underweight (W/A < –2 SD) was more prevalent in Tswellang (29.9%) than in Pholoho (18.8%), but this was not statistically significant (95% confidence interval (CI) –25.2% - 3.7%). Stunting (H/A < –2 SD) was significantly more prevalent in Tswellang (47.7%) than in Pholoho (37.3%), with a 95% CI of –47.8% - –6.4%.

Table III shows the percentage of children in different NCHS percentile categories for MUAC, TS, UAMA and UAFA. More children in Tswellang than Pholoho had lower values (< 15th percentile), namely MUAC 56.7% versus 44.4%, TS 23.9% versus 14.3%, UAMA 58.2% versus 55.6%, and UAFA 34.3% versus 22.6%.

Median nutrient intake is given in Table IV. Day scholars recorded slightly lower energy intake than the lowest RDA range (Pholoho 8 194 kJ, Tswellang 8 299 kJ). However the median total protein intake was higher than the lowest RDA range (Pholoho 57.1 g, Tswellang 59.5 g). The median energy and overall nutrient intake tended to be higher in hostel children (7-day record) than in day scholars (24-hour recall) in Pholoho, and lower for children living in hostels than day scholars at Tswellang. The median intake for most of the micronutrients was lower than the lowest value of the normal range of the RDA/AI, including calcium, selenium, vitamins A, C, B_{12} and folate. Fibre intake was also inadequate.

Table V shows energy intake based on the 24-hour recall combined with a FFQ for the children. The median energy intake of Pholoho children was lower than the median TEE (–769 kJ), while the median energy intake of Tswellang children was nearly the same as the median TEE (327 kJ).

Table VI gives correlations between BMI, weight, energy intake, TEE, and REE with *p*-values. The median weight had a high and significant correlation with TEE, and a high and significant correlation with BMI. However energy intake had a weak correlation with TEE, a very low correlation with body weight, and no correlation with BMI.

Discussion

Nutritional status of disabled children

The results of this study confirm that malnutrition is a major problem in disabled children.[4] Physically disabled children in Tswellang showed a tendency towards a higher prevalence of stunting and underweight, as well as slightly depleted (< 15th percentile) values for MUAC, TS, UAMA and UAFA than their mentally disabled counterparts in Pholoho, but the differences were not statistically significant. Feeding difficulty is often associated with undernutrition in disabled children, especially in those with neurological impairment,[17] specifically those with severe disabilities.[18] Although not investigated in this study, feeding problems could have contributed to reduced intake in some of the children.

Obesity is identified as a feature of a number of disabling conditions.[4] Although overweight was not identified as a general problem in this study, the mentally disabled children showed a slightly higher prevalence of normal to high W/A values.

Despite the high prevalence of stunting and underweight, the total median energy and protein intake met the RDA. A possible explanation is that although the energy requirements of most disabled children, especially those in wheelchairs, are lower than those of able children of the same age, energy expenditure may be increased by spasticity, athetosis, convulsions and recurrent infections.[7] As the specific condition of each child in this study was not determined, such conditions could have been present, thus contributing to higher energy requirements.

Over- and underestimation of food intake can occur when using the 24-hour recall method, but the use of combined dietary assessment methods increases accuracy.[19] In this study only one 24-hour recall was used, which can be regarded as a limitation. However great care was taken during 24-hour recall completion to include questions related to frequency of food intake so that usual daily food intake patterns could be determined. The probable over/underreporting was reflected in the weak correlations found between median energy intake, body weight and TEE. Furthermore the 7-day weighed record was used to determine the usual food intake of children living in the hostels. All children, including day scholars, receive a morning snack and lunch at the respective schools. The median energy and overall nutrient intake tended to be higher for hostel children (7-day record) than for day scholars (24-hour recall combined with a FFQ) at Pholoho, and lower for hostel children than day scholars at Tswellang.

At both schools the median intakes of most micronutrients were below the RDA/AI, especially for calcium, selenium, vitamins A, C, B_{12}, and folate.

Table I. Anthropometric data for disabled children aged 8 - 15 years in Mangaung

Characteristic	Number of subjects	Mean	SD	25th quartile	Median	75th quartile
Age (years)						
Martie du Plessis	13	12.7	2.3	11.2	12.1	14.6
Pholoho	65	11.7	1.4	11.0	11.7	12.8
Tswellang	67	11.7	2.0	9.6	11.5	13.3
Weight (kg)						
Martie du Plessis	13	44.3	22.1	28.0	40.5	54.0
Pholoho	65	33.7	12.8	27.5	32.0	38.0
Tswellang	67	31.1	11.5	23.1	30.0	39.6
Knee height (cm)						
Martie du Plessis	13	46.2	6.1	43.5	48.0	50.0
Pholoho	64	45.8	4.9	42.7	46.0	49.6
Tswellang	67	42.7	6.4	38.0	42.0	47.0
Height (m)						
Martie du Plessis	13	1.48	0.15	1.41	1.53	1.58
Pholoho	65	1.39	0.14	1.29	1.39	1.47
Tswellang	44	1.33	0.15	1.22	1.32	1.45
Demi-span (cm)						
Martie du Plessis	12	74.7	7.8	70.2	75.0	79.3
Pholoho	64	68.2	9.3	60.1	70.3	75.1
Tswellang	57	69.1	7.6	63.8	68.0	76.0
Body mass index (kg/m^2)						
Martie du Plessis	13	19.2	6.2	15.1	19.6	21.3
Pholoho	65	17.2	4.9	14.9	17.0	18.6
Tswellang	67	17.0	4.4	14.4	16.9	18.5
Mid upper-arm circumference (cm)						
Martie du Plessis	13	23.3	5.5	20.0	23.0	26.0
Pholoho	64	22.0	12.8	18.3	20.5	22.8
Tswellang	67	22.0	19.6	17.5	19.0	21.7
Triceps (mm)						
Martie du Plessis	13	15.6	14.4	7.6	11.2	16.0
Pholoho	63	11.2	5.1	7.8	9.6	14.0
Tswellang	67	9.3	4.0	6.5	8.3	10.9
Upper-arm fat area						
Martie du Plessis	13	16.5	14.2	7.9	12.2	18.5
Pholoho	63	11.6	9.0	7.0	8.4	13.8
Tswellang	67	9.7	9.2	5.3	7.3	10.3
Upper-arm muscle area						
Martie du Plessis	13	28.9	15.1	22.2	26.1	32.3
Pholoho	63	40.4	12.7	19.2	23.5	27.6
Tswellang	67	59.0	29.5	18.4	21.4	26.8

SD = standard deviation.

Table II. ***z*-score deviation from median National Centre for Health Statistics (NCHS) values in disabled children aged 8 - 15 years in Mangaung (*N* (%))**

SD from NCHS median	Martie du Plessis (*N* = 13)	Pholoho (*N* = 64)	Tswellang (*N* = 67)
Weight/age			
< –3	1 (7.7)	0 (0)	7 (10.5)
–3 - < –2	4 (30.7)	12 (18.7)	13 (19.4)
–2 - < –1	1 (7.7)	23 (35.9)	20 (29.9)
–1 - < 1	3 (23.1)	28 (43.8)	26 (38.8)
1 - < 2	3 (23.1)	0 (0)	0 (0)
≥ 2	1 (7.7)	1 (1.6)	1 (1.5)
Height/age			
< –3	1 (7.7)	6 (9.3)	21 (31.3)
–3 - < –2	1 (7.7)	18 (28.1)	11 (16.4)
–2 - < –1	5 (38.5)	16 (25.0)	16 (23.9)
–1 - < 1	4 (30.8)	22 (34.4)	18 (26.9)
> 1 - < 2	2 (15.4)	1 (1.6)	1 (1.5)
≥2	0 (0)	1 (1.6)	0 (0)
Weight/height			
< –3	0 (0)	0 (0.0)	3 (4.5)
–3 - < –2	0 (0)	1 (1.6)	1 (1.5)
–2 - < –1	1 (7.7)	2 (3.1)	6 (9.0)
–1 - < 1	1 (7.7)	12 (18.8)	13 (19.4)
> 1 - < 2	0 (0)	2 (3.1)	3 (4.5)
≥ 2	11 (84.6)	47 (73.4)	41 (61.1)

SD = standard deviation.

Table III. **Percentage of disabled children in different National Centre for Health Statistics (NCHS) percentile categories for anthropometric variables (*N* (%))**

Variables with NCHS percentiles	Martie du Plessis (*N* = 13)	Pholoho (*N* = 63)	Tswellang (*N* = 67)
Mid upper-arm circumference			
< 5	2 (15.4)	2 (3.2)	0 (0)
5 - < 15	2 (15.4)	26 (41.2)	38 (56.7)
15 - < 85	7 (53.8)	32 (50.8)	26 (38.8)
85 - < 95	1 (7.7)	1 (1.6)	1 (1.5)
≥ 95	1 (7.7)	2 (3.2)	2 (3.0)
Triceps skinfold			
< 5	2 (15.4)	0 (0)	0 (0)
5 - < 15	0 (0)	9 (14.3)	16 (23.9)
15 - < 85	9 (69.2)	51 (80.9)	47 (70.1)
85 - < 95	0 (0)	2 (3.2)	3 (4.5)
≥ 95	2 (15.4)	1 (1.6)	1 (1.5)
Upper-arm muscle area			
< 5	2 (15.4)	3 (4.8)	0 (0)
5 - < 15	3 (23.1)	32 (50.8)	39 (58.2)
15 - < 85	6 (46.1)	23 (36.5)	25 (37.3)
85 - < 95	0 (0)	0 (0)	0 (0)
≥ 95	2 (15.4)	5 (7.9)	3 (4.5)
Upper-arm fat area*			
< 5	2 (15.4)	0 (0)	0 (0)
5 - < 15	1 (7.7)	14 (22.6)	23 (34.3)
15 - < 75	7 (53.8)	37 (59.7)	37 (55.2)
75 - < 85	1 (7.7)	7 (11.3)	3 (4.5)
≥ 85	2 (15.4)	4 (6.4)	4 (6.0)

*N = 62 for Pholoho (missing value) and N = 142 for total.

Table IV. Median nutrient intake of disabled children living in the city and hostels, compared with dietary reference intakes

		Children living in city (24-hour recall and FFQ)			Children living in hostel (7-day weighed record)	
Nutrient	**DRI**	**Martie du Plessis (N = 13)**	**Pholoho (N = 42)**	**Tswellang (N = 26)**	**Pholoho (N = 23)**	**Tswellang (N = 41)**
Macronutrients						
Energy (kJ)	M: 7 316-9 572-13 238 F: 7 316-8 698-9 946	**6 043***	8 194	8 299	12 303	7 545
Total protein (g)	M: 19-34-52 F: 19-34-46	39.1	57.1	59.5	59.7	61.5
Plant protein (g)		19.9	30.4	36.4	37.8	38.5
Animal protein (g)		17.4	22.7	22.7	22.0	23.0
Total carbohydrate (g)	≥ 130	182.5	258.0	286.3	545.5	259.0
Total fibre (g)	25-31-38	10.8	16.1	21.7	20.3	25.1
Total fat (g)		60.2	51.4	48.6	45.1	45.1
SFA (g)		19.8	19.5	16.6	17.1	14.7
PUFA (g)		14.7	8.5	10.7	7.5	9.9
MUFA (g)		23.9	17.7	16.6	14.8	15.7
Cholesterol (g)		110.9	110.7	110.0	284.2	118.5
Micronutrients						
Calcium (mg)	800 - 1 300	**306.4**	**356.8**	**360.7**	**622.3**	**391.5**
Magnesium (mg)	130-240-410 130-240-360	162.8	239.8	333.0	286.9	350.8
Phosphorus (mg)	1 250	654.8	815.2	960.0	1 056.8	1 014.7
Iron (mg)	10-8-11 10-8-15	**7.3**	9.0	9.1	12.8	9.2
Zinc (mg)	5-8-11 8-5-9	5.5	9.0	8.2	7.5	9.7
Selenium (mg)	30-55	31.1	10.0	12.9	22.7	15.7
Vitamin A (RE)	400-600-900 400-600-700	**365.2**	**108.0**	**112.7**	**168.0**	**121.0**
Vitamin E (mg)	7-11-15	**4.6**	**4.3**	**3.9**	**5.2**	**3.1**
Vitamin D (µg)	5	**2.6**	**1.0**	**0.5**	**4.4**	**1.3**
Vitamin K (µg)	55-60-75	**37.5**	73.7	**11.7**	**19.0**	**4.9**
Vitamin C (mg)	25-45-75 25-45-65	**21.9**	**20.8**	**2.3**	**7.0**	**5.0**

Table IV. (continued) Median nutrient intake of disabled children living in the city and hostels, compared with dietary reference intakes

		Children living in city (24-hour recall and FFQ			Children living in hostel (7-day weighed record)	
Nutrient	**DRI**	**Martie du Plessis (*N* = 13)**	**Pholoho (*N* = 42)**	**Tswellang (*N* = 26)**	**Pholoho (*N* = 23)**	**Tswellang (*N* = 41)**
Thiamin (mg)	0.6-0.9-1.2 0.6-0.9-1.0	0.9	0.9	1.1	2.0	1.0
Riboflavin (mg)	0.6-0.9-1.3 0.6-0.9-1.0	1.0	0.6	0.7	1.0	0.7
Niacin (mg)	8-12-16 8-12-14	12.4	13.2	15.3	12.1	15.3
Piridoxin (µg)	0.6-1.0-1.3 0.6-1.0-1.2	0.8	0.9	0.8	1.1	1.0
Folate (µg)	200-300-400 200-300-400	**162.6**	**141.4**	**184.3**	**154.0**	**191.2**
Vitamin B_{12} (µg)	1.2-1.8-2.4	1.7	1.5	0.9	1.5	1.5
Biotin (µg)	12-20-25	12.0	17.1	19.2	21.2	20.0
Pantothenic acid (mg)	3-4-5	**2.2**	**1.8**	**2.2**	3.0	3.5

*Data given in bold are lower than DRIs.
DRI = dietary reference intakes; 2004;[14] FFQ = food frequency questionnaire; SFA = saturated fatty acids; PUFA = polyunsaturated fatty acids; MUFA = monounsaturated fatty acids; RE = retinol equivalent.

Literature suggested that deficiencies of calcium, iron, zinc, vitamin C and vitamin A may be unrecognised in disabled children.[7,23] Various micronutrient deficiencies were also identified in preschool children living in informal settlement areas, where a number of the disabled children in this study also live.[21]

The median fibre intakes were on the lowest range or below the recommended intake of 25 - 38 g. The health benefits of sufficient fibre intake are recognised and recommended for disabled children.[6]

Differences in median nutrient intake were observed, as determined using 7-day weighed records and 24-hour recalls, combined with a FFQ. The ideal would be to include biomarkers in an assessment of nutritional status,[22] but because of financial constraints these were not included in this study. Low micronutrient intake could lead to serious nutritional deficiency diseases and even compromise mental and physical functioning.[7] Inadequate micronutrient intake should therefore be addressed in disabled children.

Energy expenditure/ requirements of disabled children

General equations to calculate energy requirements or energy expenditure in disabled children are not available. The energy requirements and energy expenditure of disabled children vary and are disease-specific.[23] Physical activity level factors for disabled children are also not available. Over-and underestimation are relevant problems experienced with the use of formulae and equations, even in able children,[9] and indirect energy expenditure measurement in disabled children has been recommended.[24]

In this study, Schöfield equations were used to estimate REE and multiplied by adapted PAL factors to estimate TEE.[9,15] The results showed that energy intake tended to be lower than TEE, which is confirmed by the relatively high prevalence of stunting and underweight in children. This suggests that the disabled children who need aids to walk (crutches) or have other walking disabilities would have an increased energy requirement[7] that was not met.

Table V.	Energy intake and expenditure (24-hour recall) for disabled children (PAL 1.2 - 1.8)					
Energy	***N***	**Mean**	**SD**	**Minimum**	**Median**	**Maximum**
Martie du Plessis						
Energy intake (kJ)	11	6 879	3 428	3 652	5 759	15 914
REE	11	5 996	1 560	4 234	5 744	10 178
TEE	11	10 411	2 400	7 621	10 340	16 286
kJ intake – TEE	11	–3 533	2 572	–6 879	–3 580	265
Weight (kg)	11	49.0	20.7	25.0	50.0	103.0
BMI (kg/m^2)	11	20.5	5.7	14.2	19.7	35.3
Pholoho						
Energy intake (kJ)	41	7 854	2 778	4 342	8 181	15 145
REE	41	4 979	696	3 767	4 964	7 864
TEE	40	8 936	1 300	6 527	8 922	14 156
kJ intake – TEE	40	–994	2 569	–6 426	–769	4 597
Weight (kg)	41	34.1	15.0	18.1	32.0	115.0
BMI (kg/m^2)	41	17.4	5.6	12.8	17.0	49.3
Tswellang						
Energy intake (kJ)	26	8 310	2 853	3 683	8 299	16 044
REE	26	4 749	527	3 792	4 795	5 801
TEE	24	8 002	1 460	4 625	8 409	10 442
kJ intake – TEE	24	374	2 531	–6 199	327	5 603
Weight (kg)	26	29.9	9.6	13.9	29.8	61.4
BMI (kg/m^2)	26	16.5	4.4	9.9	16.7	33.0

SD = standard deviation; PAL = physical activity level; REE = resting energy expenditure; TEE = total energy expenditure; BMI = body mass index.

However the median energy intake had a weak correlation with TEE and a very weak correlation with median body weight, indicating that values for median energy intake may not have been estimated accurately. Spillage and regurgitation, which were not determined in this study, may also account for the discrepancy between intake and food measurement. These correlations can also suggest that formulae used to estimate body weight and/or height, or to calculate REE and TEE, were not accurate.

Malnutrition and specifically undernutrition is a matter of great concern in the disabled children of Mangaung and should be addressed. The nutrient density and texture of their diets should be monitored, and intake of vegetables and fruit should be encouraged.[25] Despite high prevalence of underweight and stunting, macronutrient intake was adequate, which could indicate overreporting or higher-than-normal energy requirements in some children. On the other hand, growth charts for disabled children were not used for interpretation of weight/height status in this study, therefore the condition could have contributed to the observation of stunting in some of the children. In some children micronutrient deficiency was also a matter of concern and could have far-reaching consequences for them.

Because of the use of available equations and PAL factors that were not specifically developed for disabled children with different disabilities, over-or underestimation of energy requirements could have occurred. The results suggest that more accurate equations for disabled children should be employed in future studies.

The financial assistance of the South African Sugar Association is acknowledged. The authors thank the 4th-year BSc (Dietetics) students who participated in the project, and the institutions and guardians who consented to the study.

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Table VI. Spearman's correlations between different parameters for disabled children

		BMI (kg/m²)		Weight (kg)		kJ		REE		TEE	
		Pholoho (*N* = 41)	Tswellang (*N* = 26)	Pholoho (*N* = 41)	Tswellang (*N* = 26)	Pholoho (*N* = 41)	Tswellang (*N* = 26)	Pholoho (*N* = 41)*	Tswellang (*N* = 26)	Pholoho (*N* = 40)†	Tswellang (*N* = 26)
BMI	*r*	1.0	1.0								
	p										
kg	*r*	0.71	0.67	1.0	1.0						
	p	< 0.001	< 0.001								
kJ	*r*	0.04	0.15	0.27	0.23	1.0	1.0				
	p	0.8	0.5	0.09	0.3						
REE	*r*	0.49	0.61	0.88	0.93	0.45	0.22	1.0	1.0		
	p	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.3				
TEE	*r*	0.49	0.33	0.87	0.68	0.48	0.37	0.99	0.79	1.0	1.0
	p	0.001	0.12	< 0.001	< 0.001	< 0.001	0.07	< 0.001	< 0.001		

*N = 41 for REE.
†N = 40 for TEE.
BMI = body mass index; REE = resting energy expenditure; TEE = total energy expenditure.

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