Methodology

Determination of nutrient adequacy of the food catered in the child care homes (CCHs) of Sunsari district

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A R T I C L E   I N F O

S U M M A R Y

Malnutrition continues to be a primary cause of ill health and mortality among school age orphan and vulnerable children in developing countries. Objective: Determination of nutrient adequacy of the food catered in the child care homes of Sunsari district. Methods: Weighing method was used for determining the amount of food eaten. T-test and bivariate spearman correlation coefficients were used to compare the nutrient intake with respective RDA and to determine the association between nutrient intake and malnutrition respectively. Results: The study revealed, 33.82% and 17.39% of study population were stunted and underweight respectively. Equal percentages (7.81%) of study population were overweight and thin. Probability of calorie and protein adequacy was found in 52.94% and 89.71% of study population in CCHs. Calcium intake of all children and adolescent were found to be below their RDA. Cereals contributed the highest amount by weight (355.3 g) and proportion (39%) to the total diet for the study population in CCHs. Fruits 1% (12.9 g) and additional oil 2% (20.9 g) made a small contribution to the study population dietary intake. Fish and eggs were completely lacking in their diet. Probability of iron inadequacy was found in 80.9% of study population in CCHs.

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1. Introduction

Good nutrition contributes to productivity, economic development, and poverty reduction by improving physical work capacity, cognitive development, school performance, and health by reducing disease and mortality. It is estimated that good infant and child nutrition leads to 2–3% growth annually in the economic wealth of developing countries. Additionally addressing malnutrition in early life can increase lifetime earnings by 20%. Alternatively, poor nutrition perpetuates the cycle of poverty and malnutrition through three main routes: direct losses in productivity from poor physical status and losses caused by disease linked with malnutrition; indirect losses from poor cognitive development and losses in schooling; and losses caused by increased health care costs [1].

Nutritional status is the condition of the body resulting from the intake absorption and utilization of food [2]. Nutrition related disorders can be caused by an insufficient intake of food or of certain nutrients, by an inability of the body to absorb and use nutrients, or by overconsumption of certain foods [3].

Asia is home to the largest number of orphans worldwide, where 60–80 million children are orphans [4]. In 2003, 87.6 million orphans were identified in Asia, while sub-Sahara Africa had a total record of 43.4 million orphans [5].

The political situation has left over 5000 children homeless and of those children 50% may be HIV positive and many more ill. 2.6 million Children are working in Nepal, and nearly 5% of those working are in the cruelest forms of work (according to the Orphan Children Welfare Center – Nepal) [6].

The distribution of orphan children in households was varied by sub regions. Therefore, orphan welfare programs should be focused on those regions with higher proportions of orphans [7].

Souza et al. (2010) Defined nutritional requirement as the amount of nutrients and energy available in foods that a healthy individual should ingest to meet his or her normal physiological requirements and prevent deficiency symptoms (means for similar population groups). The main types of malnutrition seen in Nepal are protein-energy malnutrition, iodine deficiency disorders, iron deficiency anemia and vitamin A deficiency [8,9].

2. Objectives

2.1. General objectives

Determination of nutrient adequacy of the food catered in the CCHs of Sunsari district.

2.2. Specific objectives

1. To assess the food intake and nutrient intake of children and adolescent in CCHs.
2. To compare the nutrient intake by the children and adolescent with Recommended Dietary Allowance (RDA).
3. To determine the association between nutrient intake and malnutrition.

3. Material and methods

This was a descriptive study that compared nutrient intake of children and adolescent with their respective RDA. For the purpose of the study, full time resident children and adolescent in CCHs belonging to age group 1–17 years were taken. Five CCHs were selected for the study. These were Dharan, Itahari, Singiya and Duhabi in Sunsari district. Children and adolescent who were full time residents of CCHs were included for study.

3.1. Sampling techniques

Study was carried out by using the census technique.

3.2. Data collection

The amounts of foods consumed in different meals by children and adolescent were assessed. The weighing method was used to obtain the amount of foods consumed for breakfast, lunch and supper by staying whole day in CCHs. This process was done by using pre-structured steps for three consecutive days. Following are the measure steps done for estimating raw amount of ingredient consumed by each child:

1) Firstly the raw ingredients used for cooking food and utensil used for cooking were weighted before cooking.
2) After food was cooked, weight of cooked food was measured by subtracting weight of container from total weight of cooked food with container. The loss in weight should be considered as water loss and all ingredients should be considered as uniformly mixed.
3) To estimate the amount of portion of each food the utensil used to serve the child was displayed and amount of food it can hold was recorded. Fraction of food was obtained by dividing weight of food in each portion by total weight of cooked food, (Fraction = amt. of potion/wt. of cooked food). This was used to obtain the amount of each raw ingredient present in each portion of food (amount of used raw ingredient for cooking × fraction).

The ingredients of the foods consumed and their volumes or quantities were used to generate carbohydrate, protein, visible fat, calcium and iron by using the food composition table of Nepal. The averages were compared with corresponding RDAs recommended by ICMR (2010).

Anthropometric measurements of children and adolescent were taken by weighing and measuring their height as well as verifying their ages by filling in date of birth from the CCHs' records.

3.3. Data analysis

The data were input in Microsoft Excel 2010 and processed for the statistical analysis. Statistical analysis of the data was performed using the SPSS version 20.0. Nutrients were compared with RDA and percentage of RDA was calculated. Student t-test was used to determine significant difference between nutrient intake and respective RDA. Bivariate correlation, Spearman correlation coefficients were used to determine the association. Anthropometry was used to determine the nutritional status of the children and adolescent. Z-scores were generated and used to assess the nutritional status of children and adolescent. The children and adolescent were classified into categories of nutritional status using the NCHS/WHO as a reference data (WHO, 2006).

4. Results

The study was carried out in five CCHs of Sunsari district. Out of them two were (CCH 1,5) were from Dharan, three (CCH 2,3,4) were from Ithari, Singiya and Duhabi respectively. The participants in the study were children and adolescent from 1 to 17 years of age. The results of the survey are presented in the following heading:

4.1. Demographic characteristics of children and adolescent

Table 1 shows that the percentage of study children and adolescent was 25%, 36.8%, 14.7%, 19.2% and 4.4% from CCH 1, CCH2, CCH 3, CCH 4 and CCH 5, respectively. Out of total 68 participants, 45.6% (31) were boys and 54.4% (37) were girls. Majority of children and adolescent (32.4%) were of 13–15 years age and one fourth of total study subjects were in age group 7–9 years.

The study shows that most of the children and adolescent were staying in CCHs since more than 3 years. Of total children and adolescent, 89.7% were non-vegetarian, 10.3% were vegetarian.

Table 1

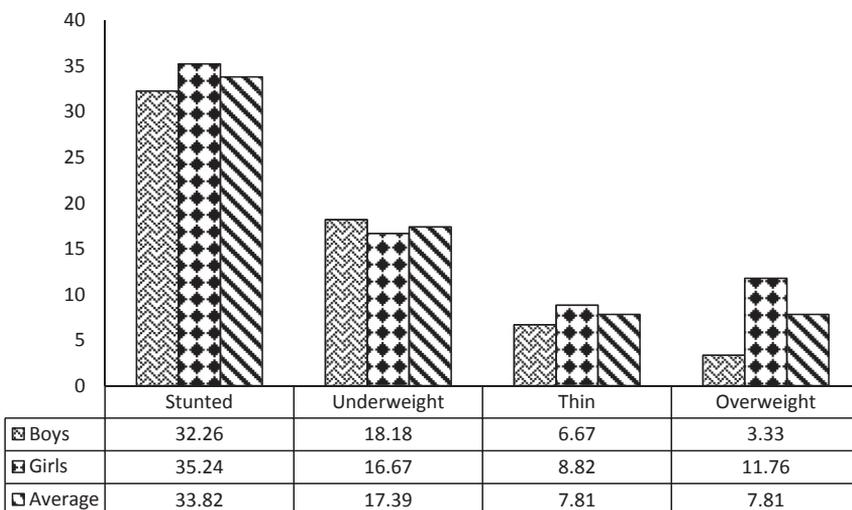Distribution of children and adolescent according to CCHs, gender and age group (N = 68).

Frequency				
	Location	Boys	Girls	Percentage
CCH 1(N = 17)	Dharan	11	6	25%
CCH 2(N = 25)	Itahari	10	15	36.8%
CCH 3(N = 10)	Singiya	3	7	14.7%
CCH 4(N = 13)	Duhabi	5	8	19.2%
CCH 5(N = 3)	Dharan	2	1	4.4%
Total(N = 68)		**31(45.6%)**	**37(54.4%)**	**100%**
Age group		Frequency		Percentage
1–3yrs		2		3%
4-6yrs		4		5.9%
7-9yrs		17		25%
10—12yrs		13		19.2%
13—15yrs		22		32.3%
16—17yrs		10		14.7%

4.2. Nutritional status of the children and adolescent

From the study, prevalence of underweight among children below 10 years of CCHs was found to be 17.39%. The prevalence of chronic malnutrition or stunting was found to be 33.82%, Prevalence of thin and overweight ware found to be same 7.81%. Girls had a higher prevalence of stunting (35.24%) in comparison to boys (32.26%). On the other hand boys had a higher rate of underweight (18.18%) than girls (16.67%). Wasting rate was higher among girls (10.1%) than boys (8.7%).The prevalence rate of overweight was 3.33% in boys and 11.76% in girls (see Fig. 1).

4.3. Food intake by the children and adolescent in CCHs

The children in CCHs who attended school away from the CCHs had three meals (lunch, mid-day meal and dinner) in a day during school days and four meals (morning meal, Lunch, mid-day meal and dinner) during the holiday.

	Stunted	Underweight	Thin	Overweight
⊠ Boys	32.26	18.18	6.67	3.33
⊞ Girls	35.24	16.67	8.82	11.76
◻ Average	33.82	17.39	7.81	7.81

Fig. 1. Overall bar diagram of malnutrition by sex.

The cereals food group contributed the highest amount by weight (355.3 g) and proportion (39%) to the total diet for the children and adolescent in orphanages. Fruits 1% (12.9 g) and additional oil 2% (20.9 g) made a small contribution to the study population in CCHs dietary intake. Fish and eggs were completely lacking in the CCHs' diet. The children and adolescent included in the study had monotonous diets, with few animal products, fats, fruits and vegetables other than green leaves (see Table 2).

4.4. Dietary intake result

Present study has found that average calorie intake was 1035 ± 347.6 kcal/day of children 1−3 years which was 97.67% of RDA. Similarly average protein (31.6 ± 13.89 gm/day), visible fat (5.94 ± 4.023 gm/day), calcium (195.26 ± 47.67 gm/day) and Iron (8.96 ± 5.71 gm/day) intake were 189.22%, 22%, 32.54% and 99.56% of RDA respectively of children 1−3 years. Difference between mean calorie, protein, visible fat, calcium, and iron intake with their respective RDA were statistically not significant ($p > 0.05$), this result may show that intake of nutrient by children (1−3 years) have high probability of nutrient adequacy.

Average calorie intake per day (1621.46 ± 234.12 kcal) of 4−6 years children was 120.11% of estimated RDA; corresponding values for protein and visible fat intake were 234.68% and 39% respectively. Average daily calcium and iron intake were 48.59% and 133.77% of RDA respectively. Average daily visible fat and calcium intake of study subject in age 4−6 years were significantly ($p < 0.05$) less than estimated RDA. Similarly average daily protein and iron intake were significantly higher than estimated corresponding RDA at $p < 0.05$.

Average calorie intake per day (1918.97 ± 282.65 kcal) of 7−9 years children was 113.55% of estimated RDA; corresponding values for protein and visible fat intake were 182.78% and 72.7%, respectively. Average daily calcium and iron intake were 47.94% and 101.81% of RDA, respectively. Average daily visible fat and calcium intake of study subject in age 7−9 years were significantly ($p < 0.05$) less than estimated RDA, similarly average daily protein intake was significantly higher than estimated corresponding RDA, at ($p < 0.01$).

Average calorie intake per day of boys and girls (10−12yrs) was (2440.79 ± 514.1) and (2138.1 ± 249.22) respectively which were 111.45% and 106.37% of the estimated RDA. Corresponding values for protein and visible fat daily intake by boys (10−12yrs) were 171.88% and 138.63%, respectively (see Table 3).

Average calcium and iron consumption by boys (10−12yrs) were 31.66% and 8.7% of RDA respectively. Similarly for girls of 10−12 years mean daily consumption of protein, visible fat, calcium and iron were 138.63%, 44.23%, 25.89% and 46.3% of estimated RDA respectively. Average daily protein intake by boys and girls in age group 10−12 years were significantly ($p < 0.05$) more than estimated RDA. Corresponding values for visible fat and calcium intakes by boys and girls were significantly ($p < 0.05$) less

Table 2
Food intake by the children and adolescent in CCHs.

Food Groups	Amount consumed from each food group (g)	Percentage contribution to the total diet
Cereal	355.3	39%
Root and tuber	125.1	14%
Vegetable	139.0	15%
Fruit	12.9	1%
Meat	65.7	7%
Egg	3.7	0
Fish	0.0	0
Pulses	58.0	6%
Milk	53.3	6%
Oil	20.9	2%
Sugar	9.7	1%
miscellaneous	71.7	8%
Total	**915.3**	**100**%

Source: Swindale and Bilinsky (2006) [10].

Table 3
Nutrient intake by 10–12 years children and adolescent.

	Sex	Intake	RDA	% of RDA	t	P
Calorie(kcal)	Boy	2440.79 ± 514.1	2190.00	111.45%	1.38	0.21
	Girl	2138.1 ± 249.22	2010.00	106.37%	1.149	0.314
Protein(g)	Boy	68.58 ± 20.3	39.90	171.88%	3.995	0.005*
	Girl	56.7 ± 9.53	40.90	138.63%	3.823	0.019*
Vis. Fat(g)	Boy	17.23 ± 6.82	35.00	49.23%	−7.375	0.000*
	Girl	15.48 ± 7.95	35	44.23%	−5.492	0.005*
Calcium(mg)	Boy	253.28 ± 45.17	800	31.66%	−34.235	0.000*
	Girl	207.14 ± 16.95	800	25.89%	−66.457	0.000*
Iron(mg)	Boy	17.99 ± 5.02	21	85.7%	1.697	0.134
	Girl	14.83 ± 3.39	32	46.3%	−8.032	0.001*

than estimated RDA. The mean iron daily intake by girls (10–12yrs) was significantly ($p < 0.05$) less than estimated RDA.

Study found that calcium intake by all studied samples were very low than essential RDA (see Fig. 2).

Average daily calorie intake of boys and girls (13–15yrs) were (2273.8 ± 414.96) and (2186.32 ± 335.32) respectively which were 82.68% and 93.83% of the estimated RDA. Corresponding values for daily protein and visible fat intake by boys (13–15 years) were 122.8% and 121.83% respectively. Average calcium and iron consumption by boys (13–15 years) were 35.9% and 57.3% of RDA respectively. Similarly for girls (13–15 years) mean daily consumption of protein, visible fat, calcium and iron were 121.83%, 57.7%, 35.02% and 69.3% of estimated RDA respectively. Average daily protein intake by boys and girls in age group 13–15 years were significantly ($p < 0.01$) more than estimated RDA. Corresponding values for visible fat, calcium and iron intakes by boys and girls were significantly ($p < 0.01$) less than estimated RDA (see Table 4).
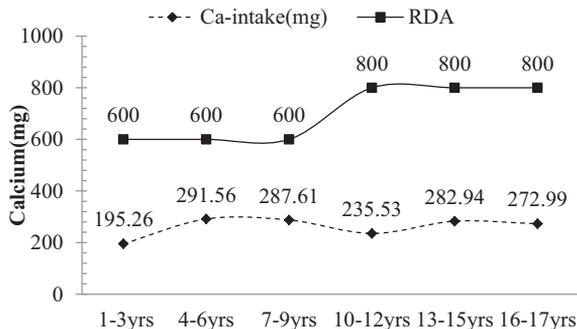

Fig. 2. Diagram of calcium intake.

Table 4
Nutrient intake by 13–15yrs children and adolescent.

	Sex	Intake	RDA	% of RDA	t	P
Calorie(kcal)	Boy	2273.8 ± 414.96	2750.00	82.68%	−3.443	0.009*
	Girl	2186.32 ± 335.32	2330.00	93.83%	−1.545	0.148
Protein(gm)	Boy	66.78 ± 10.93	54.30	122.8%	3.424	0.009*
	Girl	63.23 ± 9.94	51.90	121.83%	4.154	0.001*
Vis. Fat(gm)	Boy	25.88 ± 12.1	45	57.51%	−5.086	0.001*
	Girl	23.08 ± 11.99	40	57.7%	−5.089	0.000*
Calcium(mg)	Boy	286.91 ± 92.45	800	35.9%	−16.65	0.000*
	Girl	280.19 ± 81.87	800	35.02%	−22.891	0.000*
Iron(mg)	Boy	18.34 ± 6.1	32	57.3%	−6.724	0.000*
	Girl	18.71 ± 4.75	27.00	69.3%	−6.286	0.000*

Average daily calorie intake of boys and girls (16−17yrs) were (2763.34 ± 747.56) and (2208.05 ± 450.73) respectively which were 91.5% and 90.49% of the estimated RDA. Corresponding values for daily protein and visible fat intake by boys (16−17 years) were 131.11% and 59.1%, respectively. Average calcium and iron consumption by boys (16−17 years) were 38.81% and 574.68% of RDA respectively. Similarly for girls (16−17 years), mean daily consumption of protein, visible fat, calcium and iron were 115.39%, 46.63%, 32.12% and 65.38% of estimated RDA, respectively.

Average daily visible fat intake by girls in age group 16−17 years were significantly ($p < 0.01$) less than estimated RDA. Corresponding values for calcium intakes by boys and girls were significantly ($p < 0.05$) less than estimated RDA. Mean daily intake of iron by girls (16−17 years) was significantly ($p < 0.05$) less than estimated RDA. Mean calcium intake by girls was significantly ($p < 0.01$) less than the RDA values in the age groups 10−12 years and 13−15 years; Iron intake was found to be 14.83, 18.71 and 17 mg in girls of 10−12, 13−15 and 16−17 years respectively (see Fig. 3).

Overall the study shows that out of 68 study subjects, 32 (47.06%) had low probability of calorie adequacy and 36 (52.94%) had high probability of calorie adequacy. Only 7 (10.29%) out of total study subject had low probability of protein adequacy and 61 (89.71%) had high probability of protein adequacy. Adequacy of visible fat intake was high in 8 (11.8%) and low in 60 (88.24%) of total study subject.

All study subjects had low probability of calcium adequacy. Out of total study subject 19.1% had high percentage of adequacy of iron intake and 80.9% of study subjects had low percentage of iron adequacy (see Table 5).

Fig. 4 shows that the average calorie intake was slightly higher compared to their respective RDA intake up to age 4−12 years. The mean calorie intake by 13−17 years was found to be less than respective RDA.
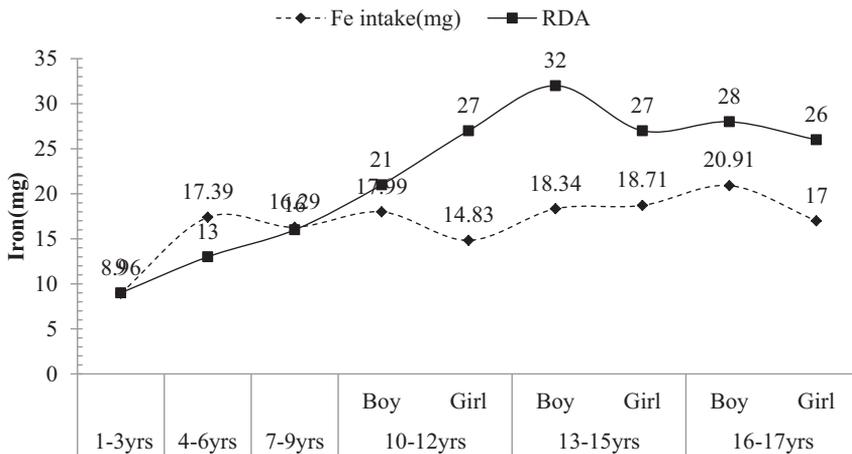

Fig. 3. Iron intake variation with age.

Table 5
Nutrients intake of study subjects as percentage of RDA.

Nutrients	Percentage of intake of RDA	
	≥100	<100
Calorie	36(52.94%)	32(47.06%)
Protein	61(89.71%)	7(10.29%)
Visible fat	8(11.8%)	60(88.24%)
Calcium	Nil	68(100%)
Iron	13(19.1%)	55(80.9%)

Fig. 4. Bar Diagram of energy intake.

Fig. 5 shows that mean intake of visible fat was lower than essential RDA, use of additional fat was found to be low.

4.5. Correlation

The Table 6 shows that proportion of stunted children and adolescent was inversely and significantly (p < 0.05) correlated with study population's energy intake. This shows that if energy intake was higher than the chance of stunting would be lower. The proportion of stunted children and adolescent was positively and significantly (p < 0.05) correlated with children and adolescent's calcium intake. It represented that if calcium intake will increase than the prevalence of stunting may also be increase. Similarly thinness was positively and significantly correlated with visible fat intake.
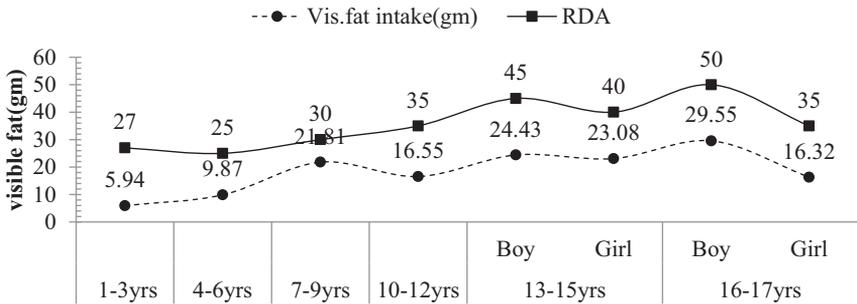

Fig. 5. Diagram of visible fat intake.

Table 6
Correlation coefficient between nutrient intake and malnutrition among children and adolescent in CCHs.

Nutrient			BMI for age	
	Stunting	Underweight	Thin	Overweight
	r	r	r	r
Energy	−0.208*	0.005	0.035	0.014
Protein	−0.145	0.181	0.021	0.000
Visible fat	0.038	−0.005	0.226*	−0.116
Calcium	0.232*	−0.108	0.031	−0.124
Iron	−0.154	−0.361*	0.203	0.103

KEY: p<0.05*
Iron intake was inversely and significantly (p < 0.05) correlated to the prevalence of underweight.

5. Discussion

From the study, prevalence of underweight among children below 10 years of CCHs was found to be 17.39%. Sherif (2016) in Ethiopia found that prevalence of underweight (16.3%) which is slightly lower than present study [11]. Similarly 13% underweight was found in orphan of Intervida Children home of Dhaka [12]. Finding indicates that prevalence of underweight was higher than children of Ethiopia and Dhaka.

The prevalence of chronic malnutrition or stunting was found to be 33.82%, which is higher than the prevalence of primary school children in eastern Nepal i.e. 21.5% [13]. The discrepancies could result from differences in socio-economic differences between CCHs and also existing nutritional or other care and support programs.

Prevalence of thin and overweight ware found to be same 7.81%, which is very lower than prevalence of thinness found in orphans and vulnerable children of Ethiopia i.e. 18.2% [11] and overweight found in orphans of Bangladesh i.e. 21.74% [12]. From this study it was found that stunting was higher and underweight was lower in girls. The reason might be due to higher physical activity of boys than girls.

A study done in Adolescent School Girls of West Bengal, India showed that overall prevalence rates of underweight, stunting and thinness were 27.9%, 32.5% and 20.2% respectively [14]. It was found that prevalence of underweight and thinness of Indian girls was higher than Nepalese girls of CCHs. Similar study was done in Kavre district showed that overall prevalence of underweight, stunting and thinness was 31.98%, 21.08% and 14.94% respectively, in adolescent girls [15]. The overall prevalence of stunting and thinness were found to be 46.6% and 42.4% respectively among rural adolescent of Darjeeling [16].

5.1. Food intake by the children and adolescent in CCHs

The children and adolescent included in the study had monotonous diets, with few animal products, fats, fruits and vegetables other than green leaves. Same diet was provided to the preschool age children of Nigeria [17]. Similar finding was also found in Kenya, children in orphanages have cereal food group contributed the highest amount and eggs were completely lacking in orphanages diet [18].

Difference between mean calorie, protein, visible fat, calcium, and iron intake with their respective RDA were statistically not significant ($p > 0.05$), this result may show that intake of nutrient by children (1—3 years) have high probability of nutrient adequacy. Muhammad and Md (2010) indicate that orphan children of age groups 7—9 years had calorie, protein, fat, calcium and Iron intake 2270 kcal, 65 gm, 73 gm, 826 mg and 31 mg respectively in Dhaka city of Bangladesh which was comparatively higher than present study [12].

Study found that calcium intake by all studied samples were very low than essential RDA. In India one study indicated that calcium intake by boys in all the orphanages in Udaipur was significantly low in all age groups, expect for calcium intake in 4—6 year old [19]. Similarly study in Kuala Lumpur on adolescent also reported that calcium intake was less than RNI [20]. Survey found that the intake of milk and milk product was very poor. This may be due to low budget of CCHs. They depend upon donation and cannot buy essential nutritive food. Choudhary et al. (2010) had reported that calcium intake by Indian's girls (10—12 years) were significantly ($p < 0.05$) less than estimated RDA [21]. Similarly calcium intake do not met the requirement of children and adolescents in residential care facilities in Durban [22].

Iron intake by study samples was found to be lower than RDA among children and adolescent (10—17yrs), though requirement of iron increases with age, intake by subjects were found to be roughly in same range. This may be due to lack of knowledge about nutrient requirement.

It was found that intake of calorie and protein are comparatively higher than the micronutrient like calcium and iron whereas the finding on orphan children's of Jammu and Kashmir indicated that nutrient intake was deficient for all nutrients when compared to RDA [23]. Intake of calcium and additional fat is very poor. This may be due to lacking of milk and dairy product, fruit and green vegetables in diet. Protein and calorie intake was found to be higher, this may be due to excess use of cereal product in each meals. This finding shows that higher protein intake by children and adolescent

in CCHs was from cereal sources rather than major sources of protein like meat and pulses. That may cause the lack of essential amino acid. That may be reason of chronic malnutrition.

The mean calorie intake by 13–17 years was found to be less than respective RDA. This may be due to their tight daily schedule and greater physical activity. Use of additional fat was found to be low. This may show the risk of fat soluble vitamins deficiency. It was found that the use of cooking oil was maximum same types, may result deficiency of essential fatty acids.

Iron intake was inversely and significantly ($p < 0.05$) correlated to the prevalence of underweight. Study in Indonesia on pregnant woman found that consumption of one or more tablets (200 mg ferrous sulfate and 0.25 mg folic acid) per week by women during pregnancy was associated with increased neonatal weight [24].

6. Conclusions

Probability of calorie adequacy was in 52.94% of children and adolescent and protein adequacy was very high among all, whereas the percentage of visible fat and calcium intake was very low. The probability of iron adequacy was higher among children below 10 years and was lower in adolescent above 10 years. Prevalence of stunting was very high i.e. 33.82%. Underweight was found to be in 17.39% of children and adolescent. Equal percentage (7.81%) of children and adolescent were overweight and thin. Energy and iron intake were inversely and significantly ($p < 0.05$) correlate with stunting and underweight respectively. Calcium intake was positively and significantly ($p < 0.05$) correlated with stunting of children and adolescent. Ignorance about micronutrients and protective foods prevailed in CCHs.

Conflicts of interest

None.

Acknowledgments

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