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DIETARY DETERMINANTS OF STUNTING AND ANAEMIA AMONG PRE-ADOLESCENTS IN MOROCCO

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ABSTRACT

Morocco is undergoing nutrition transition with more than one third of women and children presenting anaemia while about 20% of children under the age of 15 years have stunted growth. Meanwhile the prevalence of obesity is increasing yearly by 0.5 to 1 point among women. Many nutritional strategies have been proposed but none has been implemented. Nutrition education and food based strategies are by far the most sustainable. Dietary diversity is used for the assessment of diet quality and food security. Morocco is still suffering from a heavy burden of many micronutrient deficiencies and child stunting. The purpose of the study was to assess dietary diversity by comparing a dietary diversity score (DDS) and a weekly food frequency score (WFFS) and study their relationship to anaemia and stunting in school-age children in the province of Kenitra (Morocco). A stratified random sample of 263 pupils with average age of 12.9 ± 0.9 years including one-third from rural schools were administered a weekly food frequency questionnaire. A health team assessed the anthropometric status and blood haemoglobin levels. Dietary diversity was appraised with two types of indices: a dietary diversity score (DDS) based on the number of food categories consumed over a week, and a weekly food frequency score (WFFS) which also takes into account the frequency of food intake. The DDS was significantly higher in rural than in urban children, whereas the WFFS was lower, in rural children owing primarily to less frequent intake of fruits and vegetables than in the urban children. Maternal level of instruction was also positively associated with a higher consumption of fruits and vegetables and milk, and with a higher WFFS. Both indices were significantly associated with stunting but not with anaemia. In conclusion, these results suggest that diet quality is associated with height status and food diversity indices that take food frequency into account may provide a better reflection of diet quality.

Key words: Dietary diversity, anaemia, stunting, Morocco

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INTRODUCTION

Malnutrition is widespread in Morocco, like in many other developing countries and Africa in particular. The 1990-1991 survey on living standards in Moroccan households reported a stunting rate (height-for-age z-score <-2.0) of 23.9% among children under the age of 11 [1]. Among pre-school age children, the rate went from 28.3% in 1990 to 23% in 1998 [2]. The most recent national study, conducted in 1998, also revealed that 5.4% of adults are underweight [3], while isolated studies reveal the progression of obesity in adulthood, especially among women, with the nutritional transition experienced by the population in Morocco [4]. Micronutrient deficiencies are also widespread: 31.6% anaemia [5] and 40.9% vitamin A deficiency [6] among pre-school age children.

Stunting suggests chronic malnutrition and is evaluated by low height for age. Wasting is an acute form of malnutrition and is evaluated by a low body mass index (BMI) for age. In both cases, the cut-off point is a Z score <-2.0. Anaemia occurs when the haemoglobin count is abnormally below the threshold value. For school-age children, the threshold of 12 g/dl is recommended by WHO/UNICEF/UN [7, 21].

In developing countries, iron deficiency, the major cause of anaemia can affect mental development of 40 to 60% of children aged 6 to 24 month. Severe anaemia leads to the death of 60,000 pregnant women per year. Iron deficiency anaemia (IDA) lowers productivity with heavy economic losses attaining 2% of GNP [8].

Studies on the prevalence of malnutrition in school-age children are almost non-existent in Morocco, while the relationship between stunting or iron deficiency and learning ability has been shown elsewhere [9-10].

A varied diet rich in fruits and vegetables is among the strategies recommended by WHO in its recent report on diet and health in order to prevent both deficiencies and chronic diseases linked to nutrition [11]. An indicator of quality of food intake, dietary diversity is an assessment tool that has been used in industrialized countries for close to two decades. Indeed Kant *et al*.[12] have already revealed that dietary diversity is a determinant of nutritional status in US population in National Health and Nutrition Examination Survey (NHANES) II. Dietary diversity is not a new concept, but its practice is more recent, at least in developing countries [13]. It can be defined as the number of different foods or groups of food consumed over a period of time, most often in a day or in a week [13]. Studies associating dietary diversity with nutritional status and growth in particular have mainly involved pre-school-age children in developing countries [13] and a positive association has generally been observed [14-16].

There have been some recent studies that focused on adults as well as children over the age of 5 years. The work of Torheim in Mali, for example, reported a positive correlation between dietary diversity and the mean nutrient adequacy score in subjects aged 15 to 45 years old [17]. The only study that includes school-aged children was carried out in Iran by Mirmiran in 2004 [18] and it reported that in subjects aged 10 to

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18 years, a more diversified diet was associated with higher body mass index (BMI). Studies exploring the relationship between dietary diversity and stunting or anaemia in pre-adolescents are scanty. Some confounding factors such as urban/rural or family education need to be investigated.

The objectives of this study were to: 1) Evaluate nutritional status in terms of stunting, wasting and anaemia in school children in this region ok Kenitra, Morocco 2) Assess the dietary diversity by operational indices and discuss their validity and their association to nutritional status; and 3) Compare the different food diversity scores between urban and rural settings.

METHODS

Population and study subjects

This study constitutes the preliminary step in a screening project for developmental delays in school-age children in the province of Kenitra in northwest Morocco. The sample of pupils was stratified for municipalities and schools. From a list of all the schools, a systematic sampling was done in urban areas but for rural schools it was rather a covenant sampling based on the advice of the education responsible according to the affinity and eventual cooperation of the directors of schools.

Of the seven schools in the sample, four were drawn from the urban network of municipalities of Kenitra and three belonged to the rural area out of a total of 10 municipalities and 50 elementary schools including the 6th grade. All the children in their last year of school were invited to join the study. The study group was aged from 12 to 16 years old. The study includes a total of 306 children out of a total of 5,616 at the same grade level in the province.

Variables and data collection

With the agreement of the public health and education authorities in the region, the students' parents were made aware of the study by the school principals. The contact visit of the study team was conducted one week prior to the date set for data collection, which took place between May 15 and June 15, 2002. The study involved the administration of a questionnaire to the students and their parents in addition to a psycho-educational assessment of the children. A clinical examination was performed by a medical team and blood samples were drawn for haemoglobin evaluation. Finally anthropometric measurements of the children were taken by nurses.

General questionnaire

This questionnaire was tested and validated in an urban school. The staff were trained by a nutritionist one week before the survey. During the interview, the questionnaire was administered by trained doctoral candidates and allowed the researchers to collect a variety of information about the child and his/her family, as well as on food frequency. Demographic and socioeconomic data were obtained from the children and their parents or guardians. The variables included were age, sex and ranking of the child in the family, parents' level of education, as well as household size. Level of education was defined by a score ranging from 0 to 3, according to an ascending scale (0: no education; 1: elementary; 2: secondary; 3: post- secondary).

Questionnaire on food frequency

The food frequency questionnaire (FFQ), based on food groups, was administered to the child and her or his parent and covered the previous week. Food categorization in this study was structured to highlight the different forms of malnutrition assessed. In fact stunting, like anaemia, can be a manifestation of several deficiencies [19]. Thus, foods are classified according to their nutritional composition. The following 12 categories of foods were listed: meat, poultry, fish, legumes, green and other vegetables, fruits that are a source of vitamin C, other fruits, cereals and derivatives, dairy products, fats, sweets and sweetened tea.

Anthropometry

The students' height and weight were measured according to standard techniques [20], using a flat balance platform scale (SECA 750) and a mechanical measuring tape (SECA 206). The indices of nutritional status selected were body mass index (BMI) and height for age, evaluated according to NCHS/WHO reference values [21].

Biochemical and health parameters

This part of the protocol was defined in collaboration with the Regional Chief Physician, who is in charge of the public health physicians assigned to the targeted schools, as well as with those in charge of the medical analyses laboratory.

The children were examined by the physician and in cases where infectious disease was suspected, urine and stool samples were collected in order to diagnose and treat these conditions without delay, though these children remained in the study. A 5-ml blood sample was drawn from the vein in the elbow crease in vacutainer tubes containing EDTA, for automated blood analysis and for colorimetric haemoglobin (Hb) count. After each lot of samples was drawn, the blood was transported to the laboratory in isothermic containers.

Data processing and analysis

Calculation of dietary diversity indices

In many developing countries, for lack of specific food guidelines with nutritionally adequate servings, the majority of studies have used the counting of food groups alone to estimate diet quality based on diversity [13]. Such a dietary diversity score has been validated in Malian adults [14]. This dietary diversity score (DDS) is used in this study. Based on the presence or absence of consumption in the food category, as recalled for the last week, a code of 0 or 1 was assigned and tallied to give the DDS, with a maximum possible score of 12. A partial dietary diversity score (PDDS) was also calculated by excluding the 3 categories of foods that could be considered superfluous (sweets, sweetened tea and fats).

Superfluous "Fats" should not be perceived as undesirable but because the major food guides do not incorporate them in food categories, they are included in the

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superfluous category. Their role in growth and their caloric density is undeniable and this categorization is more mechanical than physiological.

In addition, another index of dietary diversity was calculated to take into account the weekly food frequency, which was called the Weekly Food Frequency Score (WFFS). For each item the WFFS score is the number of times the child consumed this item during a previous week. Every child was asked how often he/she consumed last week the different foods: A score from 0 to 7 was affected in the ascendant order of 0 for not consumed, 1 for once a week and 7 for every day. These scores was summed up to get the food category scores and then added together to have the WFFS.

This index was calculated for each of the 12 food categories as well as for four major groups: meat, fruits and vegetables, cereal products, and milk. This choice of 4 groups is in accordance with most food guides in particular to Canada's Food Guide [22]. Thus, red meats, poultry, fish and legumes, sources of protein and iron, were grouped together in the "meat" group. Similarly to the DDS, a partial food frequency index (PFFS) was calculated to exclude fats, sweets and sweetened tea which were not recommended in the food guidelines and cited here as superfluous.

Meat and fish were separated due to their difference in nutritional composition in regard to the nature of Fatty acid composition. In addition, fruits that are a source of vitamin C are separated from other fruits because of the concern for iron bioavailability.

Statistical analyses

Statistical analyses were carried out using the Epi Info 2000 software [23] including the Nutstat module for the calculation of the Z-scores of the anthropometric indices and Statistica [24]. In addition to the descriptive statistics, t- test, chi-square and ANOVA were applied.

RESULTS

There were a total of 306 subjects, 263 of whom answered the food frequency questionnaire (FFQ). Only those who answered the FFQ were considered in this article.

The lack of answer to a food frequency questionnaire is mainly due to the child’s or parent’s inability to remember. Files with incomplete answers were also discarded.

In this sample, 97 of children the students or 37% were from rural areas.

Characteristics of the sample

Table 1 shows that the average age of the children was 12.9 years ± 0.9 and that the number of boys and girls in the sample was balanced, with 49.5% girls. On average, the observed children were in the third birth order. The average size of the households was 7.7 individuals with a higher value in rural areas, where parents' level of education is lower.

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Food frequency

Table 2 shows the proportion of subjects who ate each of the food categories at least twice the previous week. Cereals and tea consumption came first. The foods eaten least often are legumes in urban areas with 31% and fish in rural areas with 49% consumption among the subjects. The other food groups were eaten at least twice a week by over 50% of the children.

Dietary diversity and frequency indices

Total and partial indices in urban and rural children

Table 3 presents the means of DDS and of partial and total WFFS in urban and rural children. The DDS, whether total or excluding superfluous items, was significantly higher in rural than urban school children (p=0.009). Rural children may eat a variety of foods during a week but with less frequency. Food diversity is mainly concentrated in one or two days after the market day. The week of the intervention is the period before harvest (lack of cash), nevertheless legumes and milk were still produced for immediate consumption but not for sale. This rural area is not wealthy and individual land ownership is less than 5 ha on average. The only WFFS food group showing a high and significant urban-rural difference is that of fruits and vegetables (score of 8.3 in rural children and 10.6 in urban children). This difference is in large part responsible for the significantly higher total WFFS in the urban group. The WFFS for meat tended to be higher in urban children, but not the WFFS for the whole group of meat with substitutes. Legumes are more often consumed in rural than in urban households.

The highest WFFS was for the group of superfluous items and the lowest, for milk and dairy products, in both urban and rural children.

Relationship among the indices

Obviously there was a high correlation between the total indices and those that simply exclude superfluous foods. It is noted that the association between food group frequency scores and the total indices – DDS or WFFS –was higher than that among the food group scores. Correlation coefficients are r=0.45 for DDS/WFFS and r=0.36 when superfluous items are omitted in both indexes. As might be expected, food group frequency scores were more closely correlated with total WFFS than with total DDS (with or without superfluous items); but it is interesting that frequency scores for the meat group, for fruits and vegetables, and for milk and dairy products were significantly correlated both with DDS and with WFFS, although the correlation coefficients were lower with DDS than with WFFS. The fruits and vegetables frequency score showed the highest correlation with the WFFS without superfluous items (r=0.80), and the milk and meat groups were second and third (r=0.61 and 0.54, respectively). The meat group was the most highly correlated with the DDS (r=0.34), whereas cereal products and superfluous items were not correlated with DDS.

Parents' education and dietary diversity

Parents' level of education was associated with the children's food frequency scores, but not with the DDS. The overall consumption for fruits and vegetables, as well as

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dairy group, increased with paternal or maternal level of education. Tables 4a and 4b show the results for mothers and fathers, respectively. In the case of mothers but not of fathers, the total WFFS (without superfluous items) was also significantly higher with higher education.

Nutritional Status

Chronic under nutrition expressed by stunting involved one fourth of the sample with 26% of girls and 24% of boys as shown on Table 5.

Concerning current malnutrition, 10% of girls and 8% of boys showed symptoms of body wasting. Concerning anaemia, 33.3% of boys were anaemic versus 32.1% of girls. These differences of proportions were not significant at all and so were the means by gender.

Dietary diversity and malnutrition

Dietary diversity indices according to nutritional status indicators are shown in Table 6. There was no significant difference observed between anaemic and non-anaemic or wasted versus non-wasted children for any dietary diversity or frequency score. No trend could be detected either. Some differences were observed between stunted and non-stunted children. Mean DDS and fish weekly frequency score were significantly higher in stunted than in non-stunted children. However, non-stunted children had a slightly higher total WFFS (without superfluous items) but not significant ($p=0.06$), and tended to have a higher frequency score for milk. This effect of stunting on dietary score does not persist when controlling for either area of residency ($F=1.3$ and $p=0.25$) or parent education ($F= 2.22$ $p= 0.08$) as performed by ANOVA/MANOVA.

DISCUSSION

Dietary diversity is a measure of dietary quality, as it is predictive of micronutrient adequacy [13], and therefore, of food security in terms of quality rather than quantity. However, there is still much debate as to what indices to use, what food categories, and for how long a reference period.

Indices of dietary diversity

The observation of 263 pre-adolescents in rural or urban areas revealed that their diet is relatively diversified since the mean dietary diversity score (DDS) was 10 out of a maximum of 12 (food categories) and a total weekly food frequency score (WFFS), without superfluous foods, of 28 from a maximum of 64.

It is not easy to compare these results on dietary diversity with the studies reported by Ruel (2002) since they did not use the same food groups or the same reference period. In fact, this problem has been raised by Ruel [13]. The selection of food categories depends in part on the study objectives, the period of observation and local food habits. A reference period of seven days was chosen because it includes the market day (weekly *souk*), which has a considerable influence on intake, in particular of vitamins A and C, as we observed in a 1988 study [25].The adequacy of dietary intakes increased by 60% on the day of the *souk*. As for food categories, in the present study poultry and eggs are combined as common sources of protein. In their study,

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Tarini *et al.* [24] grouped eggs together with dairy products. They reported an average DDS of 5 (out of 11 food groups) in children aged 2 to 4 years in Niger over a period of 9 days. They also found a weak, but significant relationship between DDS and the children's anthropometric status [26].

These results are comparable to those of Ogle *et a*l. on adult Vietnamese women [27]. Their average DDS was 9 out of a maximum of 11 over a seven-day period [11]. It should, however, be noted that the food groups were not the same because of different contexts.

With the additional index of dietary diversity, which includes food frequency (WFFS), more information is derived than with the DDS, which does not take food frequency into account. These scores seem complementary and indeed both have their value. Even when using the DDS alone, some kind of breakdown by food groups is essential to identify the differences between diversified and non-diversified diets [28]. The drawback presented by the total WFFS is that a high score can be achieved even when a limited number of food groups are consumed if there is a high frequency of consumption of some groups. It is therefore essential to present the partial WFFS by food groups as well. For instance, mean DDS was significantly higher in rural than in urban children (with or without superfluous items). However, the WFFS was significantly higher in urban children and, when considering the partial scores, it can be seen that there was no food group for which the frequency of consumption was higher in rural children. Indeed, the WFFS for fruits and vegetables was significantly higher, and that for meat tended to be higher in urban as compared to rural children. This suggests a better quality of diet in the urban areas of the study when not only the presence but also the frequency of the food groups is taken into account. The DDS may overestimate the dietary quality in rural areas where the diet is known to be more monotonous than in cities. In fact during this season of cereal harvest (for market exchange), food security is more important than the other season where only cereals and tea are the main foods eaten in low income families. However, the weekly food frequency scores need to be validated against quantitative food intake data. Hence In this period of the year, food insecurity may be seen in quantity rather than quality.

When food is eaten from a common pot, as is usually the case in this population, individual intake is not easily quantified, and this was a major reason for resorting to non-quantitative assessment. Counting the number of mouthfuls and assessing their average weight could be used to validate semi-quantitative food scores [26], but this is a costly and invasive approach, and there is the risk of altering normal intake patterns. It was observed also that the total WFFS (without superfluous items), and the partial scores for fruits and vegetables, and for milk, were significantly higher among children whose mothers were better educated. When mothers had at least secondary level of education, the consumption frequency of fruits and vegetables increased by 50% compared to mothers without any education. Parents' level of education may be confounded with rural-urban residence since the level of education is higher in cities.

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Nutritional Status

The fact that girls seem to be more stunted and anaemic may be due to early pubertal maturation in girls than boys. There is a fall in the age that corresponds to the 3rd and 97th percentiles for onset of puberty in girls while the ages at these percentiles remain practically unchanged in boys [29]. During sexual maturation the growth rate of children need extra iron to cope with haemoglobin ratio increase. Tanner staging of children was not considered for cultural reasons. Moreover the presence of a parent is an obstacle to measure pubic hair or breast size in this environment. This limitation could be overcome by health and sex education in schools. These modules, therefore, remain weak especially in rural areas.

Dietary diversity and nutritional status

Anaemia and stunting

No significant relationship could be observed between any dietary diversity score and the anaemic status of the children, not even meat, vitamin C fruits, or tea. While meat proteins and vitamin C are enhancers of non-heme iron absorption, tea however inhibits assimilation. Or since more than 90% of the children drink tea every day, it is not considered a statistical dependant variable in this study. Fruit consumption is quite low in the study area and in 1999, the food expenditure share for fruits and vegetables was only 15%, regardless of total household expenditures; this is lower than the budget share for items of poor nutritional value (coffee, soft drinks, alcohol) [3]. There was no difference in the frequency score for legumes, most likely because consumption was low at the time of the survey, which was conducted during summer. Current malnutrition as reflected by stunting was not related significantly to any of the dietary diversity scores.

The rate of anaemia was reported previously in these children and tended to be higher in the urban area and that maternal education was a protective factor. On the other hand anaemic children were more likely to be stunted [31]. An inverse association between dietary diversity and anthropometric nutritional status was detected only in the case of stunting. However, opposite results were observed with DDS and WFFS. While DDS (without superfluous items) was significantly higher in stunted children, total WFFS (also without superfluous items) was significantly higher in the non-stunted children. Furthermore, the WFFS for fish was significantly higher in stunted children. This likely reflects the substitution of sardines for meat for economic reasons, particularly in rural areas, where the rate of stunting was double compared with the urban sample [30]. These apparently paradoxical findings could be better explained with a multivariate analysis model, but sample size precluded such analyses. Nonetheless, the DDS by itself did not appear as a reliable index of dietary quality in the rural sample of school children.

The strengths of this study were the population targets which are scarcely observed and the two different nutritional status that were assessed (anaemia and growth). However, this study also has limitations such as the lack of food intake reports and the length of the period (a week) concentrated in only one season. This may not reflect the real consumption behaviour especially in the rural area where food consumption is related to the season.

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CONCLUSION

In this study the diet is relatively diversified according to the dietary diversity score. This one has been validated in other contexts, but it has proven to be of little relevance in the framework of the study of school children in Morocco with regard to anaemia and growth assessment. The other index WFFS which takes frequency into account is associated with stunting but not body wasting.

In the absence of quantitative measurements of food intake, the concept of dietary diversity could inform on nutritional quality and could be a valuable tool for nutrition education and dietary guidance.

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Table 1: Children's socio-economic status in urban and rural areas

	Total+ Mean± SD	Urban schools	Rural schools	P value
Age (years)	12.90 ± 0.9 (n=262)	13±1	12.97±0.68	0.77
Rank of birth	3.26 ± 2.20 (n=222)	3.3±2.0	3.26±2.34	0.89
Household size (number of people)	7.72 ± 3.89 (n=260)	6.76±2.13	8.95±5.58	0.00001
Fathers' education*	0.93± 0.90 (n=244)	1.12±0.89	0.41±0.68	0.001
Mothers' education*	0.36± 0.65 (n=244)	0.48±0.75	0.05±0.28	0.0001

+ N= 263 with 130 girls and 133 boys.

*No schooling = 0; Primary school = 1; Secondary level = 2; Post secondary = 3.

Table 2: Percentage of children consuming a food category more than twice a week

	Rural (%)	Urban %)	P value
Meat	73	75	0.74
Fish	49	52	0.71
Poultry	74	66	0.19
Legumes	58	31	0.00001
Green vegetables	76	83	0.23
Fruits Vit C	89	76	0.01
Other Fruits	55	58	0.57
Milk	79	77	0.68
Cereals	93	97	0.11
Fat	73	75	0.74
Sweeties	81	79	0.71
Tea with sugar	99	93	0.03

Table 3: Dietary diversity indices in urban and rural areas

	Observed Maximum score	Total N=263	Rural N= 97	Urban N= 166	P value
Dietary diversity score (DDS)	12	10.21±1.26	10.89±1.17	10.01±2.39	0.009
DDS without superfluous items	9	7.61±1.07	8.20±0.94	7.49±1.58	0.04
Total weekly food frequency score (WFFS)	64	42.01±12.83	41.90±9.68	44.91± 9.47	0.015
WFFS without superfluous items	48	27.43±9.18	27.03±7.11	29.51±7.35	0.011
WFFS meat & substitutes	28	8.22±3.18	8.35±2.96	8.12±2.90	0.57
WFFS meat only	7	2.41±1.55	2.19±1.16	2.53±1.73	0.09
WFFS fish only	7	1.80±1.56	1.88±1.64	1.75±1.51	0.53
WFFS fruit & vegetable	21	9.71±4.68	8.27±3.68	10.64±4.94	0.0001
WFFS milk & dairy	7	4.16±2.77	4.17±2.69	4.11±2.76	0.93
WFFS cereal products	7	6.44±1.65	6.23±1.97	6.58±1.42	0.12
WFFS superfluous items	21	15.11±4.68	14.86±4.49	15.39±4.57	0.38

Table 4a: Mothers' education and dietary diversity in school children

	No schooling (N=188)	Primary school level (N=36)	Secondary level or higher (N=26)	P value*
	Mean±SD	Mean±SD	Mean±SD	
Weekly food frequency score (WFFS)	41.7±11.6	44. 8±11.5	45.1±16.4	0.18
WFFS without superfluous items	27.1± 8.1a	29.0±8.1b	31.30±12.4c	0.05
Dietary diversity score (DDS)	10.11±2.1	10.02±2.1	9.8±3.0	0.74
DDS without superfluous items	7.5±1.6	7.38±1.7	7.5±2.3	0.81
WFFS meat & substitutes	8.2±3.1	8.07±3.4	8.7±3.3	0.73
WFFS fruits & vegetables	9.0±4.4a	10.71±4.1b	13.5±5.4c	0.00
WFFS milk & dairy	3.9±2.7 a	4.6±2.7 b	5.3±2.4 c	0.04
WFFS cereal products	6.5±1.5	6.69±1.2	6.3± 1.7	0.72
WFFS superfluous items	15±4.6	16.38±5.1	15.0±4.1	0.27

*ANOVA Means with a different superscript letter are significantly different

Table 4b: Father's education and dietary diversity in school children

	No schooling (N=188)	Primary school level (N=36)	Secondary level or higher (N=26)	P value*
	Mean±SD	Mean±SD	Mean±SD	
Weekly food frequency score (WFFS)	40.42±11.68	43.73±11.29	44.03±13.04	0.18
WFFS without superfluous items	26.15±8.61	28.67±7.86	29.02±9.18	0.11
Dietary diversity score (DDS)	10.17±2.23	10.13±1.81	9.96±2.50	0.92
DDS without superfluous items	7.55±1.75	7.63±1.37	7.49±1.95	0.97
WFFS meat & substitutes	8.3±3.35	8.04±3.26	8.16±2.79	0.63
WFFS fruits & vegetables	8.71±4.43a	10.14±4.76b	10.66±4.73b	0.03
WFFS milk & dairy	3.72±2.79a	3.90±2.71a	4.96±2.61b	0.01
WFFS cereal products	6.37±1.79	6.75±1.03	6.54±1.42	0.44
WFFS superfluous items	14.71±4.40	15.09±5.28	15.73±4.48	0.48

*ANOVA Means with a different superscript letter are significantly different

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Table 5: Nutritional status of Children

	All	Boys	Girls	P value*
HAZ score	-1.12±1.15	-1.09±1.23	-1.18±1.03	0.53
Stunting %	25.00	24.00	26.00	0.70
BMIZ score	-0.44±1.12	-0.41±1.10	-0.47±1.15	0.67
Wasting %	8.36	8.00	10.00	0.57
Haemoglobin (g/dl)	12.40±1.20	12.36±1.24	12.46±1.14	0.54
Anaemia %	32.5	33.3	32.1	0.89

* Means are compared by t-test and proportions by Chi-square test.

Table 6: Dietary diversity indices, anaemia and stunting

	Anaemic (n=76)	Non-anaemic (n=187)	P value	Stunted (n=63)	Non-stunted (n=200)	P value
DDS	10.44±1.28	10.49±1.24	0.80	10.66±1.20	10.4±1.29	0.17
DDS without superfluous items	7.80±1.01	7.83±1.09	0.82	8.06±0.96	7.75±1.08	0.03
WFFS	44.42±10.08	43.54±9.44	0.51	42.18±9.66	44.34±9.59	0.13
WFFS without superfluous items	28.66±7.33	28.60±7.38	0.95	26.98±7.34	29.14±7.29	0.06
WFFS meat	2.47± 1.62	2.31±1.31	0.43	2.18±1.53	2.50±1.53	0.17
WFFS fish	1.68±1.36	1.94±1.77	0.21	2.13±1.76	1.65±1.40	0.04
WFFS fowl	2.18±1.71	2.46±1.79	0.24	2±0.90	2.36±1.92	0.16
WFFS legumes	1.76±1.80	1.68± 1.93	0.76	1.45±1.44	1.82±1.95	0.18
WFFS meat & substitutes	8.40±3.46	8.11±2.64	0.47	7.77±2.54	8.34±3.02	0.19
WFFS vegetable	4.07±2.65	3.97±2.62	0.76	3.79±2.49	3.95±2..70	0.63
WFFS vitamin C fruits	3.47± 2.43	3.28± 2.33	0.77	3.25±2.14	3.40±2.46	0.62
WFFS other fruits	2.17±2.34	2.55± 2.37	0.56	1.97±1.67	2.05±1.64	0.09
WFFS fruit & vegetable	9.72± 3.91	9.81±4.98	0.89	7.77±2.54	8.34±3.02	0.26
WFFS milk & dairy	4.08±2.65	4.20±2.78	0.74	3.62±2.74	4.34±2.72	0.08
WFFS cereal products	6.42±1.67	6.46±1.64	0.95	6.40±1.75	6.48±1.61	0.69
WFFS fats & oils	4.57±2.93	4.55±2.94	0.95	4.79±2.96	4.48±2.93	0.48
WFFS sweets	4.53±2.68	4.02±2.89	0.19	3.60±2.81	4.37±2.82	0.07
WFFS tea with sugar	6.64±1.4	6.36± 1.82	0.24	6.80±1.07	6.34±1.85	0.07
WFFS superfluous items	15.75±4.81	14.94±4.40	0.19	15.20±4.71	15.20±4.50	1.00

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