

# Dietary fat intake and nutritional status indicators of primary school children in a low-income informal settlement in the Vaal region

Oldewage-Theron W, Director of the Research Centre of Sustainable Livelihoods, Vaal University of Technology  
Napier C, Associate Professor, Postgraduate Research, Department of Food and Nutrition, Durban University of Technology  
Egal A, Senior Researcher, Centre of Sustainable Livelihoods, Vaal University of Technology

Correspondence to: Carin Napier, e-mail: carinn@dut.ac.za

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## Abstract

**Background:** The objective of this study was to examine growth indicators, serum cholesterol, high-density lipoprotein (HDL) and low-density lipoprotein (LDL) cholesterol and triglyceride levels, as well as dietary fat intakes usually associated with cardiovascular disease (CVD) risk in healthy primary school children.

**Method:** The respondents in this study included a convenience sample of 97 primary school children aged 6-13 years from a selected school. Anthropometric measurements (weight and height) and three 24-hour recall questionnaires were completed for each child. Registered nurses drew blood from the vena cephalica of seated children after an eight-hour fast.

**Results:** The results of this study indicated that stunting, underweight and thinness were prevalent in this group of children. The prevalence rate for stunting (12.5%) was lower than the national prevalence rate of 20%, whereas the prevalence rate for underweight (15.1%) was higher than the national prevalence rate of 10%. Overweight was prevalent in only 1% of the sample, and more so in boys (2.3%) than girls (0%). None of the children in this study were obese. Serum cholesterol, HDL cholesterol and triglyceride levels were within the normal range. However, the mean serum LDL cholesterol levels were very high. The total dietary fat intakes showed significant relationships with total dietary cholesterol ( $r = 0.324$ ,  $p$ -value = 0.001), linolenic acid ( $r = 0.605$ ,  $p$ -value < 0.0001) and linoleic acid ( $r = 0.831$ ,  $p$ -value < 0.0001) intakes.

**Conclusion:** In this poor community the dietary intake patterns showed a balanced macronutrient intake, despite a low energy intake, when compared with the estimated average requirements. The low energy intake was reflected in the prevalence of stunting, underweight and thinness, with a very low prevalence of overweight and no obesity. Furthermore, most of the serum lipid profiles reflected a low risk of these children acquiring CVD.

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## Introduction

It is estimated that by 2020, coronary heart disease (CHD) and strokes will be the first and second leading causes of death globally.<sup>1</sup> Although CHD is rare in black South Africans [it accounts for only 6% of all forms of cardiovascular disease (CVD) in the black South African population<sup>2,3</sup>], a large percentage of the black population has been subjected to urbanisation, which has led to the adoption of a more Western lifestyle, with lower levels of physical activity, as well as lower carbohydrate and fibre intakes, and higher fat intakes. This has resulted in significant increases in lifestyle diseases,<sup>1,4</sup> and specifically, to an increased susceptibility to CVD in this population.<sup>5</sup>

Unfortunately, not only adults are affected by CHD. Cardiovascular risk factors are frequently observed in children who reside in urban areas.<sup>6</sup> However, in most instances, CHD will present in adulthood.<sup>7</sup> High intakes of dietary fat and certain fatty acids, such as trans-fatty acids (TFA), have been confirmed as risk factors for the acquisition of CHD.<sup>8</sup> In both children and adults, serum lipid concentrations

usually relate to the type and quantity of dietary fat consumed.<sup>8</sup> Furthermore, overweight and obesity are also associated with increased serum lipids during childhood.<sup>9</sup> A public health concern is the increasing incidence of overweight and obesity among children in both developed and developing countries.<sup>10</sup> Although stunting and underweight remain the most common nutritional disorders among children in South Africa, overweight is an emerging problem. A survey carried out in 2005 revealed that among children aged one to nine years, 10% were overweight and 4% were obese.<sup>11</sup> Childhood obesity is almost always associated with CHD risk factors, such as dyslipidaemia and hypertension.<sup>10</sup> Obesity in childhood has a strong association with serum triglyceride, cholesterol, high-density lipoprotein (HDL) and insulin levels, as well as hypertension.<sup>7</sup> Although a specific CHD risk factor may not be present in the overweight child, at least one risk factor is present in most obese children. Children with more than one of these undesirable serum levels may be at higher risk of developing the early stages of atherosclerosis.<sup>7,9</sup>

Total dietary fat and saturated fatty acid (SFA) intakes are linked to obesity, undesirable serum cholesterol levels and CHD.<sup>9,12</sup> The World Health Organization (WHO)/Food and Agriculture Organization (FAO) recommends a balanced diet, with fat contributing < 30% of the total energy intake for children older than two years.<sup>13,14</sup> However, it is not only the quantity of dietary fat that is important, but also the quality. It is important that both adults, and children older than two years, should follow the dietary fat quality guidelines in order to reduce the incidence and prevalence of future chronic diseases.<sup>15,16</sup> A decrease in total dietary fat consumption may facilitate a reduction in SFA intake and could have a beneficial effect on the serum lipid profile, as well as result in weight loss.<sup>8</sup> It is important to investigate the intakes of the quantity and quality of dietary fat in children, in order to prevent CHD in adulthood.<sup>17</sup>

The main aim of this study was to examine growth indicators, serum cholesterol, HDL and low-density lipoprotein (LDL) cholesterol and triglyceride levels, as well as dietary fat intakes usually associated with CVD risk in healthy primary school children in a peri-urban informal settlement in the Vaal region. This region is a polluted, industrial area, situated approximately 70 km south of Johannesburg. The informal settlement has a population of 6 179. Ninety-three per cent of the population is unemployed, and 46.1% of households live in poverty.<sup>18</sup>

## Methods

### Ethics

This study was approved by the University of the Witwatersrand's medical ethics committee for research on human beings (M03-05-66). The protocol was submitted in accordance with the Medical Research Council's guidelines for research on humans. Caregivers of children aged 6-13 years gave consent to participate in this study.

### Study population and sampling

The respondents in this study included a convenience sample of 97 primary school children aged 6-13 years (representing 20% of the total number of pupils attending the selected school) who consented to participate in the study, and who had written parental consent. The children attended an intentionally selected public school (n = 478); the only school in the informal settlement. The sample comprised both genders, and was made up of 55.7% girls (n = 54) and 44.3% boys (n = 43). The mean age of the children was 8.7 years.

### Data collection and analysis

#### *Data enumerators*

Eleven third-year and postgraduate food and beverage management students from the Vaal University of Technology were recruited and trained as fieldworkers to assist in the completion of the questionnaires and the taking of anthropometric measurements. Qualified nursing staff collected the blood samples.

#### *Anthropometric indices*

Anthropometric measurements included body weight and height, measured according to standard procedures.<sup>19</sup> Body weight, recorded in underwear and without shoes, was determined to the nearest 0.1 kg on two new portable Philips® electronic bathroom scales (model HF350). Height was measured to the nearest 0.5 cm with a Scales® 2000 portable stadiometer. All measurements were recorded twice and the average of the two measurements was determined.

#### *Dietary assessment*

A structured 24-hour recall questionnaire, previously validated in a study carried out in the same community, was used. The questionnaire was tested for face validity in a group of 10 people from the community, as well as content validity by nutritionists at a tertiary institution in the region.<sup>20</sup> It was administered to each child, with the caregiver present on three different days (one day in a weekend and two weekdays), by the trained fieldworkers in order to obtain quantitative, descriptive information about dietary intake patterns. A 24-hour recall questionnaire is a retrospective assessment of dietary intake. Multiple recalls should be obtained in order to obtain a more reliable intake report. A limitation of the 24-hour recall questionnaire is that it tends to underestimate the amount of an individual's intake owing to day-to-day variation.<sup>21</sup> This method was nonetheless used because of the advantages of speed and ease of administration, especially in children of this age group.<sup>21</sup> Food models were used to quantify portion sizes and describe the food items to the subjects. The average intake of the various nutrients was calculated over the three days.

#### *Biochemical indices*

During an information session, before the measurements were taken, the children were asked to fast, and were verbally reminded of this again, the day before the biochemical measurements were taken. A poster with the data collection dates, procedures and requirements was displayed in the school lobby for at least two weeks prior to the data collection period.

Registered nurses, wearing disposable polyethylene gloves, free of talc or any other coatings, drew blood from the vena cephalica of seated subjects after an eight-hour fast, using a Vacutainer® needle, and with minimal use of tourniquets. The blood was placed on ice, until separated, within two hours of the blood collection. A qualified registered medical technologist continuously audited the separation procedure. Serum and plasma were stored at -80°C until analysis.

All blood parameters were analysed according to standard protocol in the biochemical analysis laboratory at the tertiary institution. Total cholesterol, HDL cholesterol, as well as triglycerides, were analysed by means of the colorimetric method on a Konelab® analyser. The coefficient of variation (CV) between runs was 1.2-2.8% for all serum variables analysed. The LDL cholesterol was calculated by means of the Friedewald formula.<sup>22</sup> The levels selected as cut-off

points were specifically relevant to children.<sup>23</sup> The children were served breakfast immediately after blood collection.

#### Statistical analyses

All the results were reported for the boys and girls combined, except for the anthropometric results, because there are characteristic differences between boys and girls. Z-scores or standard deviations were used as reference values defining fixed points as an indicator of deviation from the mean in a group of children. Body mass index (BMI) for age reference data were used to identify and categorise children with high obesity levels.<sup>21</sup>

Anthropometric data were analysed according to the latest WHO growth standards,<sup>24</sup> using the WHO AnthroPlus<sup>®</sup> version 1.0.2 statistical software.<sup>25</sup> Stunting was defined as height-for-age Z-score < -2 standard deviation (SD) (severe stunting < -3 SD), thinness as BMI for age Z-score < -2 SD (severe thinness < -3 SD), and overweight as > +2 SD (obesity > +3 SD).<sup>24</sup>

Dietary intake data were analysed by a registered dietitian using the Foodfinder<sup>®</sup> version 3 software programme, based on the South African food composition tables,<sup>26</sup> and developed by the Medical Research Council. Daily nutrient intakes were reported as means and standard deviations. Frequencies were used to determine the percentage of subjects with nutrient intakes < 100% of the dietary reference intakes (DRI),<sup>27</sup> specifically the estimated average requirements (EAR), and the adequate intake (AI) when no EAR values were available. EAR values were used in this study as they are recommended for use in groups of a specific gender, at a certain life stage, and they reflect the estimated requirements of 50% of individuals in the group, whereas the recommended dietary allowance (RDA) values are used for individual intakes, and should not be used for groups.<sup>27</sup>

All the biochemical data were captured on a Windows Excel<sup>®</sup> spreadsheet, and cleaned before analysis on the Statistical Package for Social Sciences (SPSS), version 17.0, statistical programme. Means and standard deviations (SD) of the biochemical measurements were calculated for the total group, and compared with reference values.

Pearson correlations were conducted in order to determine the association between the serum levels for cholesterol, HDL, LDL and triglycerides, as well as dietary total fat, cholesterol, trans fatty acids (TFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), SFA, linoleic acid and linolenic acid intakes.

## Results

Tables I-III present the anthropometric results. The results in Table I indicate that only three (3.1%) children in the group were of low height for their age, or severely stunted (< -3 SD) according to the WHO growth standards, and nine (9.4%) were stunted ( $\geq$  -3 SD and < -2 SD)<sup>24</sup>, a condition that is indicative of chronic insufficient food and nutrient intake and/or frequent infections.<sup>28</sup> More boys (n = 8, 19.1%) than girls (n = 4, 7.5%) were stunted.

**Table I: Anthropometric status: prevalence of stunting and severe stunting**

Height-for-age cut-off points	Classification	Girls (n= 54) n, %	Boys (n=42) n, %	Total group (n=96) n, %
<-3 SD	Severely stunted	1, 1.9	2, 4.8	3, 3.1
$\geq$ -3<-2 SD	Stunted	3, 5.6	6, 14.3	9, 9.4
Mean $\pm$ SD		-0.58 $\pm$ 1.12	-1.03 $\pm$ 1.12	-0.78 $\pm$ 1.13

Low weight for age (underweight) was observed in seven (17.1%) boys and seven (13.4%) girls. Two (4.9%) boys and two (3.8%) girls were also severely underweight (Table II). Underweight is most frequently caused by acute insufficient food and nutrient intake.<sup>28</sup>

**Table II: Anthropometric status: prevalence of underweight and severe underweight**

Weight-for-age cut-off points	Classification	Girls (n=52) n, %	Boys (n=41) n, %	Total group (n=93) n, %
< -3 SD	Severely underweight	2, 3.8	2, 4.9	4, 4.3
$\geq$ -3 < -2 SD	Underweight	5, 9.6	5, 12.2	10, 10.8
Mean $\pm$ SD		-0.62 $\pm$ 1.17	-0.97 $\pm$ 1.12	-0.78 $\pm$ 1.16

The BMI for age (thinness and wasting) results in Table III show that none of the children were severely thin and that only five (5.2%) were thin or wasted. However, three (3.1%) of the children were at risk of being overweight, with only one (1.0%) already overweight. Two (3.8%) girls and one (2.3%) boy were at risk of being overweight. Only one of the boys was overweight, whereas no girls were overweight. None of the children in the sample were obese. The majority of children (n = 87, 90.7%) were of normal weight.

**Table III: Anthropometric status: prevalence of thinness, overweight and obesity**

BMI-for-age cut-off points	Classification	Girls (n=54) n, %	Boys (n=43) n, %	Total group (n=96) n, %
< -3 SD	Severely thin and wasted	0, 0	0, 0	0, 0
$\geq$ -3 < -2 SD	Thin and wasted	3, 5.7	2, 4.7	5, 5.2
$\geq$ -2 < +1 SD	Normal weight	49, 90.5	39, 90.7	87, 90.7
$\geq$ +1 < +2 SD	Risk of overweight	2, 3.8	1, 2.3	3, 3.1
$\geq$ +2 SD < +3 SD	Overweight	0, 0	1, 2.3	1, 1.0
$\geq$ +3 SD	Obese	0, 0	0, 0	0, 0
Mean $\pm$ SD		-0.37 $\pm$ 0.94	-0.53 $\pm$ 0.97	-0.44 $\pm$ 0.95

Table IV presents the dietary intake results. Although the mean ( $\pm$ SD) energy intake of 4 943  $\pm$  2 362 kJ was very low, the other mean macronutrient intakes showed that it was sufficient when compared to the EAR for children aged 9-3 years old. The contribution of macronutrients to the total energy intake showed a balanced diet, with 60.5% carbohydrates (including dietary fibre), 12.6% protein and 26.8% dietary fat, compared to the guidelines of 45-65% carbohydrates, 10-30% protein and 25-35% fat.<sup>27</sup> However, according to WHO guidelines for the prevention of chronic disease, no more than 30% of the total energy should be contributed by

**Table IV:** Analysis of 24-hour recall: daily mean intakes of the children (n = 97)

Nutrient and unit of measure	Mean $\pm$ standard deviation	Estimated average requirements	World Health Organization recommendation <sup>13</sup>	Contribution to total energy intake (%)
Energy (kJ)	4 943 $\pm$ 2 362	<sup>a</sup> 8 476/ <sup>b</sup> 7 833		
Total protein (g)	37 $\pm$ 18	18 $\infty$		12.6
Plant protein (g)	21 $\pm$ 10			7.2
Animal protein (g)	16 $\pm$ 14			5.4
Total fat (g)	35 $\pm$ 26		30% of total energy intake	26.8
Saturated fatty acids (g)	9.6 $\pm$ 7.2		$\leq$ 10% of total energy intake	7.3
Monounsaturated fatty acids (g)	10.9 $\pm$ 9.2		No restriction	
Polyunsaturated fatty acids (g)	10.5 $\pm$ 10.6		6-10% of total energy intake	8.0
Essential linoleic acid (n-6) (g)	10.0 $\pm$ 10.5	<sup>a,c</sup> 12/ <sup>b,c</sup> 10	(n = 6) 5-8% of total energy intake	7.6
Essential linolenic acid (n-3) (g)	0.2 $\pm$ 0.2	<sup>a,c</sup> 1.2/ <sup>b,c</sup> 1.0	(n = 3) 1-2% of total energy intake	0.2
Cholesterol (mg)	125.4 $\pm$ 187.2			
Carbohydrates (g)	165 $\pm$ 75	100		56.1
Dietary fibre (g)	13 $\pm$ 7	<sup>a,c</sup> 31/ <sup>b,c</sup> 26		

Estimated average requirement for active boys and girls aged 9-13 years

a = boys, b = girls, c = adequate intake

**Table V:** Biochemical measurements: serum lipid concentrations

Variable	Normal range <sup>28</sup>	Mean $\pm$ standard deviation; n = 97	% with serum lipids > cut-off points
Triglycerides	< 1.69 mmol/l	1.7 $\pm$ 9.2	1.0%
Total serum cholesterol	< 4.40 mmol/l	3.5 $\pm$ 0.8	10.2%
HDL-cholesterol	> 0.91 mmol/l	1.1 $\pm$ 0.3	28.6% (< cut-off point)
Low-density lipoprotein cholesterol	<2.85 mmol/l	4.2 $\pm$ 2.0	95.9%

dietary fat, in comparison with the 26.4% contribution in this sample of children. The recorded percentages of SFA, PUFA, MUFA, TFA and n-6 essential fatty acid (EFA) intakes were in line with the WHO recommendations, while total fat intake (26.4%) and percentages of n-3 fatty acid intake (0.2%) were in line with the recommended WHO goal of < 30% and < 1-2%, respectively.<sup>13</sup> However, the mean essential linoleic acid intake showed a sufficient intake for girls, but an insufficient intake for boys, whereas the dietary intake of the essential linolenic acid was very low compared to the EAR.<sup>27</sup>

Normal mean values for serum cholesterol, triglycerides and HDL-cholesterol were found in this sample of children (Table V). The mean triglyceride levels may, however, indicate a marginal risk for increased serum triglycerides. Only one (1.0%) of the children was found to have an abnormal triglyceride level. Although the mean HDL-cholesterol level was within the normal range, 28.6% of the children had abnormal HDL-levels. Furthermore, the mean LDL-cholesterol levels were very high in 95.9% of the children, thus indicating a risk for CVD. However, HDL and LDL cholesterol levels should not be interpreted in isolation as the HDL:LDL ratio is a

better indicator of CVD risk than the individual levels of HDL and LDL cholesterol. In this group of children, the HDL:LDL ratio was 0.26, which indicates a low risk (0.22–0.30).<sup>29</sup>

## Discussion

This study examined growth indicators, serum lipid parameters, as well as dietary fat intakes in healthy primary school children in a very low-income peri-urban informal settlement in the Vaal region. The motivation for this study was the high CVD mortality rate globally, and in South Africa. Despite the effect on body mass, dietary fat intake in children is important because the atherosclerotic process commences in childhood, and may lead to a risk of CVD in adulthood.<sup>1,7,9</sup>

The results of this study indicated that stunting, underweight and thinness were still more prevalent than overweight, despite the rapid increase in overweight and obesity in children globally.<sup>12</sup> The prevalence rate for stunting (12.5%) was lower than the national prevalence rate of 20%, whereas the prevalence rate for underweight (15.1%) was higher in this study, compared with the national prevalence of 10%, as reported by the National Food Consumption Survey for children aged one to nine years.<sup>11</sup> Overweight was prevalent in only 1% of the sample, compared with 10% nationally, and more so in boys (2.3%) than in girls.<sup>11</sup> None of the children in this study were obese. These findings are not consistent with other studies carried out in South Africa. Another study, conducted in 2003 and assessing 1 282 children aged three to 14 years, found that overweight was significantly higher among girls (15.5%), compared to boys (4.9%) aged 9.1-14.9 years.<sup>30</sup> Similar findings were observed in a recent study among children aged 9-13 years in QwaQwa, where 15.7% of the girls and 12% of the boys were

overweight. Obesity was also prevalent in 2.9% and 2.8% of the girls and the boys, respectively. However, the findings of the QwaQwa study were consistent with the findings of this study in terms of stunting: 14.1% of the QwaQwa children were stunted, compared to 12.5% in this study.<sup>31</sup> The growth indicators indicated both chronic (stunting) and acute (underweight and thinness) inadequate energy and nutrient intakes in this group of children. This was confirmed by the low mean energy intakes (51-56% of EAR).<sup>27</sup> Population-based, food-based dietary guidelines recommend that all children should eat a variety of foods to meet their nutritional needs, and they should also consume adequate energy to support growth and development, and maintain a healthy body weight.<sup>9</sup> Furthermore, the consumption of a balanced diet, providing 45-65% carbohydrates, 25-35% fat and 10-30% protein, is recommended for children.<sup>32</sup> In this study, the mean dietary intakes showed sufficient intakes for all the macronutrients, despite a low energy intake, when compared with EAR. The contribution to total energy intake ratios for all the macronutrients was within the recommended ratios. However, a mainly carbohydrate-rich diet, with more plant than animal protein, was consumed.<sup>33</sup>

To prevent the development of chronic diseases in children and adults, the WHO guidelines recommend a total fat intake of < 30% of total energy intake, with SFA contributing a maximum of 10% total energy, and TFA and PUFA < 1% and 6-10% of total energy intake, respectively.<sup>13</sup> It is further recommended that the EFA, linoleic acid (n-6) and alpha-linolenic acid (n-3), should contribute 5-8% and 1-2% of the total energy, respectively. These EFA not only have a positive effect on blood lipid concentrations, but are also needed for growth and development in children, as well as for the important role they play in the nervous system and the formation of hormones.<sup>34</sup> Linoleic acid is usually the most readily available EFA in the diet, as its main source is vegetable oils, such as sunflower oil, soybean and maize oil, and nuts and seeds. However, globally, in most countries children receive insufficient intakes, except in the USA and India. A reason for this may be that the main food sources such as fish (sardines, mackerel, herring, salmon and anchovy), linseed and rapeseed oil and walnuts do not form part of the children's daily diet.<sup>35</sup> The same trend was observed in this study, where the diet of the children met the guidelines for linoleic acid (7.6%), but had a very low intake of linolenic acid (0.2%), and thus did not meet the WHO guidelines or EAR. This was further reflected in the 20 food items most commonly consumed by this group of children, where there is no fish in the diet, but sunflower oil is consumed, when added to stiff, soft and crumbly maize meal porridge, as well as to fried eggs. These items appeared first, third, tenth and seventeenth, respectively, on the list of 20 foods most commonly consumed by children.<sup>33</sup>

Overweight and obesity are associated with increased blood lipids that present during childhood, and increase the risk of acquiring CHD in adulthood.<sup>9</sup> In this study, mean serum cholesterol and HDL cholesterol levels were within the normal range. However, the mean serum triglyceride level was marginal, and a very high LDL cholesterol

level was prevalent. The HDL:LDL ratio was within the normal range (0.22-0.30),<sup>29</sup> indicating a low risk of CVD, despite the large percentage of children with abnormally high LDL cholesterol (95.9%) and low HDL cholesterol (28.6%) levels. There were no significant relationships between dietary energy, fat intakes and serum lipids in this group of children, which was contrary to a finding in a group of Taiwanese children, where significant relationships existed in both adults and children.<sup>8</sup> However, in this study, the total dietary fat intake of 26.8% was lower than the total dietary fat intake in the Taiwanese study. It ranged from 30.8-35.8% of the total energy intake in the rural and urban regions, respectively. Furthermore, the mean total serum and HDL cholesterol levels were higher, and the mean serum triglycerides and LDL cholesterol levels were lower in the Taiwanese children,<sup>8</sup> when compared to the children in this study. In this study, a significant relationship existed between total dietary cholesterol intake and BMI for age ( $r = 0.233$ ,  $p\text{-value} = 0.022$ ).<sup>8</sup> Other studies have shown that an average intake of SFA < 10% of total energy intake is associated with a mean serum cholesterol level < 5.17 mmol/l, indicating a low risk of acquiring CHD.<sup>36</sup>

Theoretically, the children in this study should have a low risk of CVD, as their mean total SFA intake was 7.3% of the total energy intake, and the mean daily dietary cholesterol intake was  $125.4 \pm 187.2$  mg, with a mean serum cholesterol level of  $3.5 \pm 0.8$  mmol/l. Only 10.2% of the children had raised cholesterol levels, but these were mostly within the borderline range (8.2%). Only two children (2%) had elevated cholesterol levels of more than 5.17 mmol/l.<sup>23</sup> None of the children in this study were obese, and only 1% overweight. This further reduced the risk of CVD.

## Conclusion

The quantity and quality of dietary fat intakes relate to the serum lipid profile in children and adults. Dietary fat and fatty acid compositions have been documented as CHD risk factors.<sup>8</sup> In this poor community, the dietary intake patterns showed a balanced macronutrient intake, despite a low energy intake when compared with EAR.<sup>27</sup> The low energy intake was further reflected in the prevalence of stunting, underweight and thinness, with a very low prevalence of overweight and no obesity. Serum risk factors for CVD were observed in very few children in this study. It can be concluded that in this poor community, undernutrition is still more prevalent than overnutrition. The dietary fat intake pattern also showed favourable features when compared to the WHO guidelines for fat intakes,<sup>13</sup> except for a low linolenic acid intake. Sufficient fat intakes not only contribute to the energy density of the diet, but also contribute the fat-soluble vitamins and EFA that further protect against the development of CVD. Intervention studies in this poor community should focus on addressing undernutrition, with specific attention to increased energy and linolenic acid intake, through strategies that improve overall food consumption patterns and their impact on dietary intakes. This will require multi-level strategies such as those aimed at self-efficacy for healthy eating and the home environment, as described by Hermstad et al.<sup>12</sup>

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