



UNIVERSITI PUTRA MALAYSIA

***ANEMIA AND ASSOCIATED FACTORS AMONG SCHOOL CHILDREN IN
MAKKAH PROVINCE, SAUDI ARABIA***

ALTALHI ROAA OMAR M

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**ANEMIA AND ASSOCIATED FACTORS AMONG SCHOOL CHILDREN IN
MAKKAH PROVINCE, SAUDI ARABIA**

By

ALTALHI ROAA OMAR M

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfillment of the Requirement for the Degree of Master of Science**

August 2016



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DEDICATION

This thesis is dedicated to:

- ❖ My mother Nawal Hefny my father Omar Al-Talhi and my uncle Ghazi Hefny whose without their support and encouragement, this dissertation would not be possible.
- ❖ To my Sisters Raniya Al-Talhi, Rotana Al-Talhi and my brother Rayan Al-Talhi.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

ANEMIA AND ASSOCIATED FACTORS AMONG SCHOOL CHILDREN IN MAKKAH PROVINCE, SAUDI ARABIA

By

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August 2016

Chairman : Zuriati bt Ibrahim, PhD
Faculty : Medicine and Health Sciences

Anemia among children is considered as moderate public health problem in Saudi Arabia and among the most important public health problems around the world. This cross sectional study aimed to determine the prevalence of anemia and its associated factors among 7 to 9 years old schoolchildren in Makkah province of Saudi Arabia.

A questionnaire was utilised to assess the socio demographic characteristics, body weight status, food security status, dietary intake and hemoglobin level of the respondents. Weight and height of the respondents were measured and body mass index (BMI) was computed to assess the body weight status. The food security status was assessed using a 10-item questionnaire by Radimer/Cornell Hunger and food insecurity. The dietary intake was assessed using two days 24-hour dietary recall by the parents /guardian of the respondents. The dietary intakes data were analysed using Nutritionist Pro software and the mean intakes of the macro and micronutrients were compared with Dietary Reference Intake (DRI). The Hemoglobin level (Hb) was measured by automated hematology counters method. Five-ml of venipuncture blood were drawn by a trained nurse. The cut-off point for $Hb < 11.5$ g/l was diagnose anemia. Body weight status was assessed using Anthroplus software v1.0.4 to determine BMI for age. A total of 240 primary schools students with equal distribution of boys and girls were recruited through multi stage cluster sampling.

The mean age (\pm SD) of the respondents was 7.98 ± 0.80 years. More than half mean (54.2 %) of the respondents had families with monthly household income more than the average (> 13106 SAR). Majority of the respondents (87.9%) had 2 to 4 siblings. Furthermore, more than half of the respondent's fathers (52.1%) and mothers (55.0%) had education at tertiary level. Majority of the respondents (88.3%) had household size between four to six people. Mean for body weight, height and BMI were; 24.75 ± 6.95 kg, 1.19 ± 0.08 m and 17.17 ± 3.24 kgm^{-2} respectively. Majority of the respondents (67.1%) were classified as normal, 16.7% overweight, 13.3% obese and only 2.9% thinness. The mean for total energy, carbohydrate, fat and protein intake were 1239 ± 193 kcal, 181.09 ± 26.42 g, 38.05 ± 8.88 g, 40.78 ± 6.10 g respectively. The

determined mean for vitamin B12, vitamin B6, vitamin A, iron, folic acid and calcium of all the respondents were 2.09 ± 0.72 mg, 0.86 ± 0.23 mg, 206.16 ± 67.41 mg, 9.81 ± 2.36 mg, 279.13 ± 72.82 mg, 571.25 ± 149.29 mg respectively.

The prevalence of anemia was 18% for all respondents with higher prevalence noted among girls (20.8%) as compared to boys (15.0%). A significant association was observed between anemia with vitamin B12, folic acid and protein. Most of the households (97.5%) were considered food-secured. There was significant difference ($t=2.608$, $p<0.05$) in the mean value of Hb level between boys (12.56 ± 1.05 g/l) and girls (12.23 ± 0.91 g/l). Using Binary Logistic Regressions Test, there were significant relationships ($p<0.05$) between vitamin B12 (OR=0.45, 95% CI: 0.26-0.78), folic acid (OR=0.99, 95%CI: 0.98-0.99) and protein intake (OR=1.09, 95%CI: 1.03-1.16) with anemia.

Logistic regressions model for anemia status indicated that intake of vitamin B12, folic acid and protein were the significant determinants of anemia status. High prevalence of anemia among school children in Saudi Arabia requires great attention from related authorities. Thus, implicates for a proactive planning for preventive measures and implementation of intervention program on nutrition and health that emphasise on the dietary intakes.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

ANEMIA DAN FAKTOR YANG BERKAITAN DIKALANGAN KANAK-KANAK SEKOLAH DI WILAYAH MEKAH, ARAB SAUDI

Oleh

ALTALHI ROAA OMAR M

Ogos 2016

Pengerusi : Zuriati bt Ibrahim, PhD
Fakulti : Perubatan dan Sains Kesihatan

Anemia dalam kalangan kanak-kanak dianggap sebagai masalah kesihatan awam yang sederhana di Arab Saudi dan antara masalah kesihatan awam terpenting di seluruh dunia. Kajian keratan rentas ini bertujuan untuk menentukan prevalens dan faktor yang menyumbang kepada anemia dalam kalangan kanak-kanak yang berusia antara 7-9 tahun di wilayah Mekah, Arab Saudi.

Borang soal selidik telah digunakan untuk menilai ciri-ciri sosio-demografi, status berat badan, status keselamatan makanan, pengambilan diet dan tahap hemoglobin responden. Berat badan dan ketinggian responden telah diukur dan indeks jisim badan (BMI) telah dihitung untuk menilai status berat badan. Status keselamatan makanan telah dinilai menggunakan soal selidik 10-item Kelaparan dan kekurangan makanan oleh Radimer/Cornell. Pengambilan diet dinilai menggunakan ingatan diet 24 jam selama 2-hari oleh ibu bapa responden. Data pengambilan diet dianalisis menggunakan perisian "Nutritionist Pro" dan min pengambilan makro dan mikronutrien dibandingkan dengan Pengambilan Rujukan Diet. Tahap Hemoglobin (Hb) diukur dengan kaedah automatik kaunter hematologi. Sebanyak 5ml darah punktur vena telah diambil oleh jururawat terlatih. Nilai normal untuk tahap hemoglobin Hb <11.5 g/l digunakan untuk mendiagnosis anemia. Perisian v1.0.4 *Anthroplus* telah digunakan untuk menentukan status berat badan menggunakan pengkelasan BMI-untuk-umur. Seramai 240 pelajar sekolah rendah dengan pengagihan sama rata lelaki dan perempuan telah diambil melalui persampelan kelompok pelbagai peringkat.

Purata umur responden adalah 7.98 ± 0.80 tahun. Lebih daripada separuh (54.2%) responden mempunyai keluarga yang berpendapatan isi rumah melebihi purata bulanan (>13106 SAR). Hampir semua responden (87.9%) mempunyai bilangan adik-beradik seramai 2-4 orang. Tambahan pula, lebih separuh daripada bapa (52.1%) dan ibu (55.0%) responden adalah berpendidikan tinggi. Majoriti responden (88.3%) berada dalam saiz isi rumah antara empat hingga enam orang. Purata berat badan, ketinggian dan BMI responden adalah, 24.75 ± 6.95 kg, 1.19 ± 0.08 m dan 17.17 ± 3.24 kgm⁻² masing-

masing. Majoriti responden (67.1%) telah diklasifikasikan sebagai normal, berat badan berlebihan 16.7%, 13.3% obes dan 2.9% kurus. Min bagi jumlah pengambilan tenaga, karbohidrat, dan lemak serta protein masing-masing ialah 1239 ± 193 kcal, 181.09 ± 26.42 g, 38.05 ± 8.88 g, 40.78 ± 6.10 g. Min yang ditentukan untuk vitamin B12, vitamin B6, vitamin A, zat besi, asid folik dan kalsium semua responden masing-masing ialah 2.09 ± 0.72 mg, 0.86 ± 0.23 mg, 206.16 ± 67.41 mg, 9.81 ± 2.36 mg, 279.13 ± 72.82 mg, 571.25 ± 149.29 mg.

Prevalens anemia adalah 18% untuk semua responden dengan prevalens lebih tinggi dicatatkan berlaku dalam kalangan kanak-kanak perempuan (20.8%) berbanding kanak-kanak lelaki (15.0%). Perkaitan ketara diperhatikan antara anemia dengan vitamin B12, asid folik dan protein. Kebanyakan isi rumah (97.5%) telah dianggap sekuriti makanan. Terdapat perbezaan ketara ($t=2.608$, $p<0.05$) dalam nilai min tahap Hb antara kanak-kanak lelaki (12.56 ± 1.05 g/l) dan perempuan (12.23 ± 0.91 g/l). Terdapat satu hubungan yang signifikan ($p<0.05$) antara pengambilan vitamin B12 (OR=0.45, 95% CI: 0.26-0.78), asid folik (OR=0.99, 95%CI: 0.98-0.99) dan protein (OR=1.09, 95%CI: 1.03-1.16) dengan anemia menggunakan Ujian Regresi Logistik Perduaan.

Model regresi logistik bagi status anemia menunjukkan bahawa pengambilan vitamin B12, asid folik dan protein adalah penentu penting status anemia. Prevalens anemia yang tinggi dalam kalangan kanak-kanak sekolah di Arab Saudi memerlukan perhatian yang lebih daripada pihak berkuasa berkaitan. Oleh itu, ia melibatkan perancangan dan pelaksanaan proaktif program intervensi dalam pemakanan dan memberi penekanan kepada pengambilan diet.

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I certify that a Thesis Examination Committee has met on 18 August 2016 to conduct the final examination of Altalhi Roaa Omar M on her thesis entitled "Anemia and Associated Factors among School Children in Makkah Province, Saudi Arabia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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LIST OF ABBREVIATIONS

BMI	Body Mass Index
BMR	Basal Metabolic Rate
DRI	Dietary Reference Intake
EI	Energy Intake
Hb	Hemoglobin
IDA	Iron Deficiency Anemia
Kcal	Kilocalorie
MLR	Multivariate Logistic Regression
RBC	Red blood cell
SAR	Saudi Arabia Riyal
USD	United States Dollar
V	Vitamin
WHO	World Health Organization
WSFS	World Summit on Food Security



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CHAPTER 1

INTRODUCTION

1.1 Background

Anemia among children is considered as one of the most important public health problems in both developed and developing countries (McLean *et al.*, 2009). It is now one of the most widespread medical problems because it affects the growth, academic performance (Kemmer, Novotny, Gerber, & Ah Ping, 2009) and have a significant impact on the health and nutritional status of school children (Gari, 2008). Around 305 million children among school-aged around the world suffer from anemia (McLean *et al.*, 2009).

Anemia occurs when the number of the red blood cells is not enough to meet the body physiological requirements, and this happens when the level of hemoglobin is less than 11.0 g/dl (WHO, 2011). Anemia is known as a low hemoglobin concentration in the blood (Agho *et al.*, 2008).

The insufficient of iron intakes is the most common reason for anemia prevalence worldwide and infections that affect the hemoglobin level can also be another reason for anemia (WHO, 2011). In addition, McLean *et al.*, (2009) showed that 50% of anemia were caused by iron deficiency. However; this ratio can vary between regions, demographic groups and conditions. Some tropical diseases affect the hemoglobin level of children living in warm areas such as malaria and leishmaniasis which causes a decline in the hemoglobin level (Al-Hashem, 2006).

Furthermore, there are other causes of lower blood Hb concentrations including cancer, HIV and micronutrient deficiencies, folate, riboflavin, copper, vitamin A and vitamin B12 (McLean *et al.*, 2009).

The prevalence of anemia reported by the World Health Organisation (WHO) among 192 Member States was 48.8%. According to WHO report (2009), the prevalence of anemia was highest in the preschool age (47.4%) while the prevalence of anemia among school children was 25.4% (McLean *et al.*, 2009). In 2013, the prevalence of anemia among school children in Riyadh region, Saudi Arabia was 22.3% (Gad *et al.*, 2013). As observed in Table 1.1 the prevalence of anemia was considered as moderate public health problems (McLean *et al.*, 2009).

Table 1.1: Public health significance of different prevalence of anemia according to (WHO)

Prevalence of anemia (%)	Public health significance
≤4.9	No public health problem
5.0-19.9	Mild public health problem
20.0-39.9	Moderate public health problem
≥40	Severe public health problem

Adapted from (McLean *et al.*, 2009)

Most of the studies conducted in Saudi Arabia focused on the iron deficiency anemia and nutritional status among children less than six years of which very limited studies were conducted among school-age children (Gari, 2008). Children of early school (aged 7-8) is a critical stage of development that forms the foundation of school children's future learning and wellbeing (Unicef, 2014). A review study indicated that school children aged 7 to 9 who were anemic in early childhood remain to have poor cognitive and motor development and school achievement into middle childhood (Grantham-McGregor & Ani, 2001). Furthermore, unhealthy eating habits such as eating few fruits and vegetables and more fast foods appear to be prevalent among school children in early years thus, nutritional problems in the school age children may carry into adulthood (Gari, 2008).

A study by Gari (2008) reported that the prevalence of anemia among female elementary school in northern Jeddah, Saudi Arabia was 35.8%. The prevalence of anemia was 11.6% by hemoglobin concentration and 15% by hemoglobin concentration and hematocrit values in Saudi high altitude area (Abou-Zeid *et al.*, 2006).

Indeed, anemia is said to be associated with many factors including sex, age, ethnic background, environmental factors, anthropometric measurements and dietary intake (Agho *et al.*, 2008). The prevalence of anemia among people living in high residential areas that are above the sea level is observed to be lower because of the increased hemoglobin concentration level among the population of these areas (WHO, 2011). Furthermore, parent's education, dietary intake and family income are the foreteller of anemia (Assefa *et al.*, 2014).

Many studies demonstrated that the socio-demographic factors are associated with anemia status among children (Assefa *et al.*, 2014; Al-Mekhlafi *et al.*, 2008; Abou-Zeid *et al.*, 2006; Abalkhail & Shawky, 2002). Body weight status was associated with anemia (Mikki *et al.*, 2011; Sudhagandhi *et al.*, 2011). Food insecurity could also be related with anemia particularly among children (Pasricha *et al.*, 2010). While dietary intake the most common factor that has association with anemia status. The major cause of anemia reported were deficiency in vitamin B12 and folate intake (Balarajan *et al.*, 2012; Milman, 2011).

Generally, several factors have been identified to be associated with anemia status among school-aged children, despite some results still being inconclusive. Those factors included socio-demographic factors (age, gender, parents' educational level, household income, number of children and household size) dietary intake (carbohydrate, protein, fats, energy, vitamin B6, vitamin B12, vitamin A, calcium, folic acid and iron), body weight status (weight, height and BMI for age) and food security. Some possible risk factors that affect anemia status have been somewhat neglected in some research. Potential associations between anemia status with dietary intake and food security have not been adequately investigated in recent research in Saudi Arabia, despite the prevalence of anemia among school-aged children becoming of concern.

Some international studies (Mohamed & Hussein, 2015; Assefa *et al.*, 2014; Kokore *et al.*, 2013; Ngui *et al.*, 2012; Mikki *et al.*, 2011) were published about anemia among children worldwide including prevalence and factors associated with it, but there is no such reliable data available on anemia in Makkah province of Saudi Arabia.

1.2 Problem Statement

Anemia is one of the most prevalent health problems among children that is associated with increased risk of morbidity and mortality. About 25% of world school age children was reported to affected with anemia (Kraemer & Zimmermann, 2007).

In Asian countries, the prevalence of anemia among school children aged 7 to 12 years old in rural peninsular Malaysia was reported to be 48.5% (Al-Mekhlafi *et al.*, 2008). In India, the prevalence of anemia among students aged 8 to 16 years was found to be 52.88% (Sudhagandhi *et al.*, 2011). While in Istanbul the prevalence of anemia among school children aged 6 to 10 years was reported to be 28.9 % (Gur *et al.*, 2005).

In northern Africa in Kenitra Morocco among school students (6 to 16 years) the prevalence of anemia was 12.2% (El Hioui *et al.*, 2008), and 30.3% among school children aged 5 to 11 years in west African Abidjan (Kokore *et al.*, 2013). Therefore, anemia is considered as a major health problem in most of developing countries.

In Jeddah the western region of Saudi Arabia anemia prevalence was found to be 20.5% among 6 to 12 years school children (Abalkhail & Shawky, 2002). While in Riyadh region the prevalence of anemia among school children (5 to 12 years old) was up to 22.3% (Gad *et al.*, 2013). According to classification of anemia as a public health problem (McLean *et al.*, 2009), the prevalence of anemia among school children in Riyadh and Jeddah region is considered as a moderate public health problem. The prevalence of anemia among school children in Saudi Arabia varies between the regions because Saudi Arabia is the largest country in southwest Asia with a population (29 million people) (CDSI, 2010) of different ethnicities and different lifestyles.

Children's health such as fatigue shortens attention span, poor cognitive development, difficulty with concentration; lethargy and increased mortality were the consequences

of anemia. Anemic children usually perform poorly on reading, vocabulary and other tests hence represents a major public health problem (Agho *et al.*, 2008).

Furthermore, anemia might be as a disease per se or as a result of other disease. Symptoms of anemia such as fatigue, shortens attention span and others can all be due to failure to provide enough oxygen to the blood tissues therefore causing imbalance between the provision and oxygen consumption in tissues to occurrence (Pirker, 2010). Other symptoms of anemia are headaches, nausea, anorexia, listlessness and dimness of vision (Kemmer, Novotny, Gerber, & Ah Ping, 2009).

Considering the high prevalence of anemia among school children in Saudi Arabia and the consequences of anemia that affects growth and development of children, it is imperative to understand the risk factors to this problem. Studies had found that many factors including socio demographic, environment and social may be associated with anemia. Nevertheless, there is limited national published data focused on the association between anemia with nutritional status and dietary intake aspects. Thus, this study aimed to determine the prevalence of anemia and it's associated socio demographic, body weight status, food security and dietary intake factors.

1.3 Research question

This study aims to answer the following research questions:

1. What is the prevalence of anemia among children aged 7-9 years in Makkah?
2. What is the socio demographic characteristics, body weight status, food security status and dietary intake of the respondents?
3. Is there any difference in terms of body weight status, dietary intake and Hb level between boys and girls respondents?
4. Is there any difference in body weight status and dietary intake between anemic and non-anemic groups?
5. Is there any association between socio demographic characteristics, body weight status, dietary intake and food security with anemia among respondents?
6. What are the determinants of anemia among respondents?

1.4 Objectives

1.4.1 General objective

To determine the prevalence of anemia and its associated factors among school children age 7-9 years in Makkah, Saudi Arabia.

1.4.2 Specific objectives

- i.** To determine the prevalence of anemia among the respondents.
- ii.** To determine socio demographic profiles, body weight status, food security, and dietary intake among the respondents.
- iii.** To determine the difference of body weight status and dietary intake between anemic and non-anemic boys and girls.
- iv.** To determine the association between socio demographic characteristics, body weight status, food security and dietary intake with anemia among the respondents.

1.5 Null Hypotheses

Ho1: There is no significant difference of body weight status, dietary intake, Hb level between boys and girls respondents.

Ho2: There is no significant difference in terms of body weight status and dietary intake between anemic and non-anemic groups

Ho3: There is no significant association between socio demographic characteristics, body weight status, food security and dietary intake with anemia among the respondents

Ho4: There is no significant contribution of socio demographic characteristics, body weight status, food security and dietary intake with anemia status of the respondents.

1.6 Conceptual framework of the study

Figure 1.1 shows the conceptual framework of the current study. The framework of this study comprises of four group risk factors including; socio-demographic (age, gender, parents educational level, household income, number of children and household size), dietary intake (carbohydrate, protein, fats, energy, vitamin B6, vitamin B12, vitamin A, calcium, folic acid and iron), body weight status (weight, height and BMI for age) and food security may be associated with anemia through Hb level among children age 7 to 9 years in Makkah.

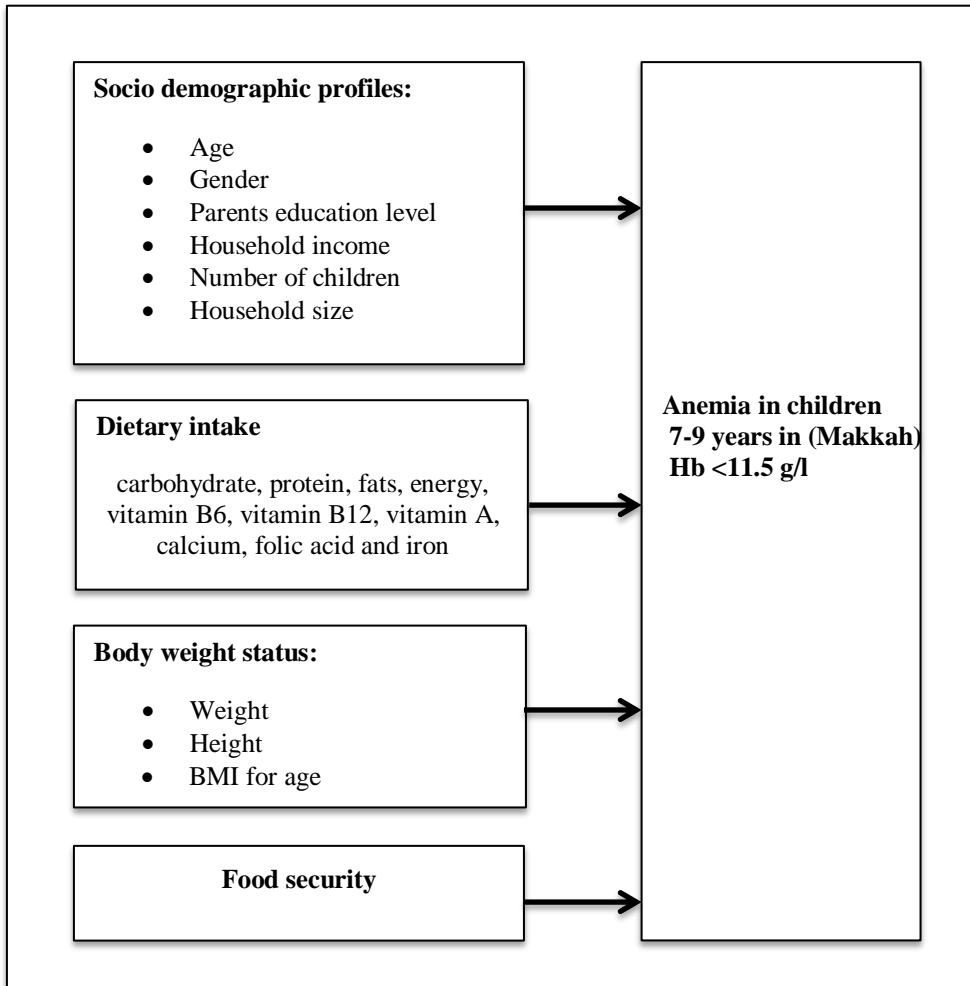


Figure 1.1: Conceptual framework

1.7 Significance of the study

The current study will contribute to the body of knowledge on factors contributing to anemia among school-aged children. The findings from this study will serve as a baseline data for future study in similar context. This study would inform the nutrition practitioners and other healthcare professional on planning the intervention program related to nutrition and anemia.

1.8 Conceptual and operational definitions

1.8.1 Anemia

Anemia is defined as the shortage in the number of red blood cells needed to meet the physiological requirement and carry oxygen (WHO, 2011). In this study, anemia was determined when the level of hemoglobin concentration is lower than 11.5 (WHO, 2011).

1.8.2 BMI for age

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults defined as the weight in kilograms divided by the square of the height in meter's (kg/m²) (Organization, 2006). The BMI for age as index of child growth was calculated using Anthro plus software v1.0.4 (Organization, 2009) and classification of BMI for children was obtained using the Z score (WHO, 2007).

1.8.3 Dietary intake

The dietary intake assessed in this study refers to all the foods and beverages consumed by respondents that were obtained through two days 24 hour dietary recall with the respondents' parents. The macronutrients (carbohydrates, protein and fats) and the micronutrients (vitamin B6, vitamin B12, vitamin A, calcium, folic acid and iron) were analysed.

1.8.4 Food security status

Food security status was defined according to World Summit on Food Security (WSFS), "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life" (WSFS, 2009)(p.1). In the current study, the food security status was determined using a 10-item questionnaire by Radimer/Cornell Hunger and food insecurity. Food insecurity can affect health and nutritional status and is related to lower macro and micronutrient intakes, lower intake of fruits and vegetables and lack of diet diversity.

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