International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064

Dietary Energy Intakes of Sudanese Pregnant Women

Sohair Ali Mohammed Shommo

University of Khartoum, Faculty of Education, Home Science Department-Nutrition and Dietetics, Saudi Arabia

Abstract: ***Purpose:*** ***To determine dietary energy intake of pregnant Sudanese women in their third trimester, with focus on macronutrients fat,, carbohydrates, and protein and their contribution to dietary energy. Methods and Materials: Dietary intake of pregnant women (n=81) in their third trimester (15 to 41years) attending Omdurman Maternity Hospital, Khartoum State was assessed by 3-days 24-hour dietary recall sheet. Diets consumed were converted to nutrients using Nutri-survey software package. Database was modified from other food composition tables. RDA values were based on FAO/WHO/UNU reference values. Results: Energy and carbohydrates intakes were significantly lower than the RDA (P<0.000). Adequacy of intake was 40%, 69.2%, 32.1%, 66.7% for energy, protein, and fat, respectively. Contribution to total energy was 20% by protein, 55% by carbohydrate and 25% by fat.*** ***Conclusion:*** ***Energy and carbohydrates intake were inadequate by pregnant Sudanese mothers in their third trimester. This might probably affect birth weight. Therefore intake of energy from carbohydrates should be increased.***

Keyword: Macronutrient, Pregnancy, Health, development, Sudan

1. Introduction

Nutrient intakes values (NIVs) during pregnancy vary around the world. Developing countries often have limited access to scientific and economic resources to modify existing NIVs to meet their population specific requirement objectives when set in their national policies [1]. Pregnancy increases nutritional demand for fetal growth and development [2-8]. Nutritional imbalance(s) could cause detrimental effects to the pregnant woman by influencing pregnancy outcome [5].

A well nourished woman needs only a small amount of additional energy during pregnancy as the body adapts to the increased energy requirements and becomes more energy efficient through reduced physical activity and a lowered metabolic rate. Contrary to this, Bothwell (2000) reported that many women in developing countries restrict their food intake during pregnancy to have smaller infants on the premise that smaller infants will carry a lower risk of delivery complications [6]. An extra intake of 300 kcal/day above that recommended for non-pregnant women is recommended for pregnant women [7].

The recommended dietary allowances (RDA) of the USA recommend an additional 30 g. protein/day to the 44g. Suggested for non-pregnant women while the Canadian RDA recommends 5 g/day during the first trimester, 20 and 25 during the second and third trimesters respectively. The FAO (1994) recommends an extra 6 g/day for pregnancy whether the diet is of low fiber content (47 g/day) or high fiber content (54 g/day).

Fat contribution to the total energy requirements was suggested as 25%. The fat should contain adequate amounts of omega-3 and omega-6 fatty acids needed for brain growth, structure and function [8]. At present, data on dietary intakes of pregnant women in Sudan is very scarce. Therefore, the aim of this study is to provide a baseline data on the intake of essential nutrients by a random sample of pregnant mothers in their third trimester attending Omdurman Maternity Hospital, Khartoum State. Review of nutritional studies on dietary assessment indicates the importance of recording nutrients intake and food habits among pregnant and lactating women and their consequences on the mothers and newborns. Nutrition during pregnancy is related and varies according to socioeconomic, cultural, and demographic factors [3-8]. The contribution of macro-nutrients (carbohydrates, fats and proteins) to DEC ranked carbohydrate as the highest source of energy (65.7 percent) followed by fat (21.9 percent) and then protein (12.4 percent). These contributions to total energy were in line with the WHO/FAO guidelines for a balanced diet by energy-yielding macronutrients [9-11].

Information about nutritional status of pregnant women in Sudan is limited. Only one clinically based study [12] has been carried out in 2000 on a group of 200 pregnant women of different socioeconomic backgrounds in Omdurman Province, Khartoum State. Mean intakes reported were: 2072 kcal, 83.3g protein, 330g carbohydrates, and 46.5g fat. A significant relationship was found between energy intake and socioeconomic status. Another study was conducted by Nyuar et al (2012) to determine the daily intake of essential micro- and macronutrients in Sudanese women, with specific focus on dietary fat and essential fatty acids, and compare the dietary intakes of internally displaced women with those of the non-displaced population. Subjects were displaced southern (n=44) and non-displaced southern (n=30) and northern (n=39) Results have shown that carbohydrates provided over 60% of dietary energy for all the Sudanese women groups. The displaced women had significantly lower intake of energy (1744 ± 344 kcal/d). The study concluded that Sudanese diet was less diverse and differences in energy and nutrients intakes between groups were due to the amounts of food consumed [13].

2. Materials and Methods

2.1 Subject Selection

Participants in this study were 83 pregnant mothers (15 to 41years) in their third trimester of pregnancy. The population we studied was relatively homogeneous.

Individuals who happened to be available at the time of data collection (83) were asked to join the study.

2.2 Dietary Intake

Only 81 mothers completed 24-hour dietary recall for 3 days and the average daily intake was calculated. About 35 local recipes were formulated according to average amounts used by different Sudanese cooking methods. We converted diets consumed to nutrients using Nutri-survey program (www. nutrisurvey. De) [14], BLS, updated 1999, version BLS II.3). The BLS is based on several national and international food tables. Database was modified from other food composition tables [15-21]. RDA values were based on reference values according to FAO/WHO/UNU (2004)a and FAO/WHO/UNU(2004)b [22-23].

2.3 Statistical Analysis

The statistical software SPSS (version 16) was used for data analysis. Descriptive results were expressed as frequencies and percentages. Results were expressed as mean ± Standard deviation (mean ± SD). Statistical correlations were also done to test the relation between dietary intake and some socioeconomic factors. Partial correlations were examined using Spearman's rank correlation tests. Statistical significance was taken as $p < 0.05$.Statistical tests for. Categorial data was also interpreted using Pearson Chi-Square Tests to test the relationship between maternal and newborn baby parameters. Dietary intake adequacy was classified using EAR cut of point .into: adequate >EAR, inadequate <EAR.

3. Results

Amount of macronutrients daily intakes of the pregnant mothers and their statistical analysis as percentage of dietary reference intake (DRI) are presented in Table 1. Daily mean intakes of Energy for all pregnant mothers was 2149 kcal and according to age groups s of 14-18 years and 19-50 years were 22.96 (81%DRI) and 2137 (75%DRI), respectively. Protein 68.61g (96.64 % DRI) and carbohydrates 271(154.86 % DRI).

Fat daily mean intake was 80.74±27.36 g and according to age groups s of 14-18 years and 19-50 years 81.37±16.67 g (86.56 ± 17.73%DRI) and 80.69±28.12 (84.94±29.56%DRI) g, respectively.

Table 2 reveals daily intake of nutrients in relation to estimated average requirements (EAR) and dietary reference intake. Fat and proteins mean intakes was lower than DRI whereas carbohydrates was higher.

Risk of inadequacy of nutrients intake with reference to EAR is shown in Table 3 shows energy intake was insufficient among 83.3% (<2820 Kcal) and 81.3% (<2855 Kcal) of the pregnant women in the age groups 14-18yrs and 19-50yrs, respectively. Protein intake was adequate among 82.3 %(> 50g/day) and carbohydrates was adequate among 76.5 %.%(>135g/day)

Table 4 shows partial correlations between maternal dietary intake of studied mothers and income, education and family size.

Here was an overall pattern for positive correlations between dietary intake and socioeconomic factors. Results show a positive correlation between incomes, pregnant women education and. macronutrients intake. Negative correlation was found between macronutrients intake and family size.

Table 1: Nutrients intake (Mean±SD) compared with DRI

Nutrient	*DRI* [1,2]	*No.*	*Mean±SD*	*Mean Intake as % of DRI*	*95% CI*	*P-value*
(all subjects) Energy(Kcal)	-	81	2149.28 ± 626.36	-	1910.78 - 2187.78	0
14-18 yrs	2820	6	2295.88 ± 505.07	81.41± 17.91	1665.83 - 2725.92	0
19-50 yrs	2855	75	2137.55 ± 636.41	74.87± 22.29	1891.12 - 2183.97	0
Protein[3](g)	71	81	68.61 ± 21.28	96.64± 29.97	-62.77	0
CHO[3](g)	175	81	271.01 ± 95.48	154.86± 54.56	149.89 - 192.12	0
Fat[4] (g)	-	81	80.74 ± 27.36	-	-12.1	0
14-18 yrs	94	6	81.37 ± 16.67	86.56 ±17.73	-37.26	0.041
19-50 yrs	95	75	80.69 ± 28.12	84.94 ±29.56	-12.94	0

1. FAO/WHO/UNUa: Energy in human nutrition, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004.
2. FAO/WHO/UNUb. Energy requirements during pregnancy, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004.
3. Dietary Reference Intakes (DRIs): Recommended Intakes for Individuals, Total Water and Macronutrients Food and Nutrition Board, Institute of Medicine, National Academies page 1324
4. Fat DRI 30% Total energy DRI 95g (19-50yrs) 2855 and 94 g for 14-18 yrs 2820

Table 2: Nutrient intakes compared with reference intakes DRI and EAR

Nutrient	*EAR* [1,2]	*Mean amount of intake*	*Comparison to DRI*	*Comparison to EAR*
Energy (Kcal)		2149		
14-18 yrs	2820	2295.88 ± 505.07	< DRI	< EAR
19-50 yrs	2855	2137.55 ± 636.41	< DRI	< EAR
Protein(g)[3]	50	137.23 ± 42.56	< DRI	> EAR
Carbohydrate (g)[4]	135	271.01 ± 95.48	> DRI	> DRI
Fat (g)	-	80.74 ± 27.36	< DRI	-
14-18 yrs	94	81.37 ± 16.67	< DRI	-
19-50 yrs	95	80.69 ± 28.12	< DRI	-

1. FAO/WHO/UNU[a]: Energy in human nutrition, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004.
2. FAO/WHO/UNU[b]. Energy requirements during pregnancy, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004.
3. Protein EAR is 0.88g/ kg bodyweight for reference women 57Kg.(41) page 1330

4. Carbohydraates EAR is 135g (41) page 1330

Table 3: Risk of inadequate nutrient intake with reference to EAR

Nutrient Intake	*Adequacy*	*No. of*	*%*
Energy(Kcal)			
14-18 yrs	Inadequate	5	83.3
	Adequate	1	16.7
19-50 yrs	Inadequate	61	81.3
	Adequate	14	18.7
Protein(g)	Inadequate	63	77.8
	Adequate	18	22.2
Carbohydrate(g)	Inadequate	19	23.5
	Adequate	62	76.5

Table 4: Partial correlations between maternal dietary intake of studied mothers and some socioeconomic factors

Nutrient/Day	*Income*	*Education*	*Family size*
Energy Kcal/day	+	+	–
Protein g/day	+	+	–
Fat g/day	+	+	–
Carbohydrates g/day	+	–	–

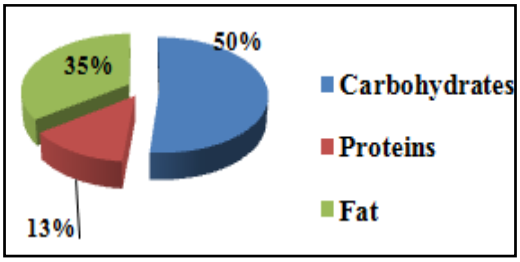

Figure 1: Macronutrients contribution to total energy

Figure 1 shows sources of total energy. Average energy contribution was 50% for carbohydrates, 13% for protein, and 35% for fat.

4. Discussion

The daily calorie intake of pregnant women was 2149 Kcal which was significantly lower than the FAO/WHO/UNUa RDA. Our results were lower than some studies [24-26] and higher than others [27-28]. Sandra et al (2001) reported that many African women consume less than the recommended daily caloric intake. Between 5 to 20 percent of women in various African countries are underweight. She also found that pregnant women in industrialized countries weight gain on average twice as much as pregnant women in Africa [28].

Esmaillzadeh et al carried out a study to assess the food consumption pattern and nutrient intakes of pregnant women residing in Maku-the west north of Iran [29]. In this cross-sectional study, 284 pregnant women (142 from urban area and 142 from rural areas) participated. Dietary intake data was collected using both 24 h recalls and a food frequency questionnaire for 3 months. All women consumed adequate amount of energy, protein, thiamin and niacin (> 75% RDA).

Bonham et al conducted a study titled Contribution of fish to intakes of micronutrients important for fetal development: a dietary survey of pregnant women in the Republic of Seychelles. Pregnant women (n=300) were recruited at their first visit to an antenatal clinic. At 28 weeks' gestation subjects completed a 4 d diet diary (n=273) and intakes were analyzed using dietary analysis software. Mean (SD) energy intake was 9.0 (2.5) MJ/d and fat intakes were higher than UK recommendations for almost two-thirds of the cohort [30].

This study assessed important nutrients for pregnant women that are needed for fetal growth and development: energy, protein, carbohydrates, and fat [2-6]. Our results of energy intake go in line with most recent reports of energy intake in Sudan. A very recent study conducted by Nyuar et al(2012) has shown a higher value than our results(50%) for carbohydrates which provided over 60% of dietary energy for all subjects included [13]. The average Sudan national had a daily dietary energy consumption (DEC) of 2180 Kcal per person in 2009. Rural and urban areas had similar daily DEC levels of 2140 and 2270 daily Kcal per person, respectively.[11]. Furthermore, agreement of results in this study with other studies, 2147 Kcal/day(31), 2170 Kcal(1990-1992), 2330 Kcal (1995-1997), and the most recent 2260 Kcal (2001-2003). This increase in energy consumption might probably be due to increased fat 60, 69, 69 g/day for the years 1990-1992, 1995-1997, and 2001-2003 respectively [32]. In contrast was older studies 1983 Kcal/day [33] which is lower than our result.

Macronutrients contribution for energy agree with acceptable macronutrient distribution ranges stated by Food and Nutrition Board, Institute of Medicine, National Academy: Fat 25-35carbohydrates 45-65 %, and proteins 10-35 % total energy [34].

Fat intake contribution is shown to be at the highest limit despite low energy intake of pregnant mothers in this study. This might be attributed to daily increase intake of fat. The contribution of macro-nutrients (carbohydrate, fat and protein) to daily energy consumption according to the recent national survey compared to our results ranked carbohydrate as the highest source of energy (65.7 vs 50%) followed by fat (21.9 vs 35%) and then protein (12.4 vs 13%). These contributions to total energy were in line with the WHO/FAO guidelines for a balanced diet by energy-yielding macronutrients [10-11].

Comparison of our results with an earlier singular study [12] shows higher calories and fat. Less protein and carbohydrates energy contribution percentages results in our study compared to Alkhalifa (13 vs 16 %, 50 vs 63.71%), respectively. Furthermore, protein intake was below WHO (DRI =71 gm/day), American and Canadian RDA, recommended intakes [35]. The RDA for protein in pregnancy increases by about 10 g higher than non-pregnant. The Canadian Recommended dietary intake is an additional 5 g/day in the first trimester, 20 g /day for the second, and an additional 25 g/day in the third trimester [8].

Our result was in contrast with the Sudanese habitual consumption of carbohydrates especially table sugar. Per capita daily calorie intake from sugar is 194 Kcal which accounts for 8.58% of total per capita daily consumption 2260 Kcal. Higher value was obtained from other starch food such as wheat and is almost tripled comes from sorghum (308 Kcal; 13.6% and 670 Kcal 29.6%) (2001-

2003) [36]. Sugar and sweet consumption is 194 Kcal; but pregnant mothers in this study did not satisfy all needs [32, 36]. This might be due to economic factors nausea and other disturbances that might occur during pregnancy such as pregnancy diabetes. Decrease in carbohydrates consumption compared to an older study [12] might be attributed to economical reasons since the cost of sugar increased in 2004 to 1 SDG instead of 0.75 SDG at time Alkhalifa conducted her research (1999).

By the end of pregnancy the mother gains about 4 kg of fat, mainly in the subcutaneous adipose tissues. The larger part of this fat is stored during the middle trimester .It provides an energy surplus to be used mainly during the period of lactation. Repeated pregnancies are one of the common predisposing factor to obesity, besides essential fatty acids are important to the growth of the fetus. The brain is largely made of lipid material [8]. Sudanese consume vegetable oils especially, peanut, sesame and corn in high amounts in cooking foods compared to saturated fatty acids which can be obtained from animal sources. Sudanese food habits include presence of local and traditional stew called "Tabikh" a constant dish or more than a dish per meal in most of the Sudanese meals especially lunch. This is prepared from ingredients that contain high fats and oils. This contributes to the very high intake of fats as mentioned before. Fat contributes to 25 % of the total energy requirements [8].

Nyuar et al (2012) concluded in their study that Sudanese diet was less diverse and differences in energy and nutrients intakes between groups were due to the amounts of food consumed [13]. In contrast to our result was Alkhalifa. She found that fat intake was lower than our results 46.5± 0.2 gm (55.9% of RDA 83.3). Sudanese per capita daily fat consumption increased after 2000 according to FAO Statistics [32, 36]. This might be attributed to changes in eating habits. As reported by Musaiger 2004, food consumption patterns and dietary habits in the Eastern Mediterranean region have changed markedly during the past 4 decades. There has been an increase in per capita energy and fat intake in all countries. He also reported that over the same period, daily per capita fat intake showed notable increases, ranging from 13.6% in Sudan to 143% in Saudi Arabia. It is probable that the high consumption of foods rich in fats and calories and the sedentary lifestyle among most communities in this Region played an important role in the rise of obesity. This is particularly true with the great shift from traditional foods to more westernized foods, which are characterized by high fat, high cholesterol, high sodium and low fiber [37].

Apart from the dietary intake, nutrition is highly dependent on economic status, social and cultural environment, and personal habits of the mother [5-8]. Partial correlations between maternal dietary intake of studied mothers and income, education and family size, (Table 4) there was an overall pattern for positive correlations between dietary intake and socioeconomic factors. Results show a positive correlation between incomes, pregnant women education and. macronutrients intake. Negative correlation was found between macronutrients intake and family size. Our results were confirmed by Al Khalifa (2000), who found that economic aspects and education levels have major influence on the adequacy of diet consumed. Similar to our study, many nutrients were found to be significantly related to many socioeconomic factors according to AlKhalifa. She has found that the strongest correlation was between husband income and occupation with calories intake during the second and third trimesters [12].

5. Conclusion

It is concluded that energy and carbohydrates intakes were significantly lower than the RDA. ($P<0.000$). Protein intake was lower and fat intake was higher. Good nutrition, nutrition education and counseling are crucial for maternal and newborn health. Pregnancy creates a special metabolic demand for high- quality nutrients. With careful food selection, it is possible to obtain most of the recommended levels of nutrients. Sudan being one of the developing countries has not yet set any dietary recommended dietary allowances or intakes, therefore like other developing countries we refer to WHO /and FAO RDAs, which are suitable to most of the countries in the world.

6. Recommendations

Energy intake should be increased from carbohydrates and decreased from fats. Dietary intake using 24-hour dietary recall can be used for short-term or long-term dietary recall, and for estimating partial or complete diets. However, to make a more comprehensive study, we suggest a population-based study using food record methods that can be a more accurate method of assessing dietary intake using representative samples from different States of Sudan. Promoting appropriate diets and healthy lifestyles through nutrition education programs; further research on dietary intakes during pregnancy are strongly recommended.

7. Acknowledgements

This work was supported by a scholarship from the German DAAD Research Fund which provided the real support that enabled the author to step over financial difficulties and finalize this research. This manuscript is done for academic purposes.

References

[1] King JC, Garza C. Harmonization of nutrient intake values. Executive summary. Food Nutr Bull 2007; 28(suppl):S3-12. (Medline)
[2] Ritchie KD and King JC: Part One: Nutrient recommendations and dietary guidelines for pregnant women in: Nutrition and Health: Handbook of Nutrition and pregnancy. Edited by: Couch SC Elliot H. and Philipson EH. Humana press. USA, 2008. Pages: 3-64.
[3] Passmore R and Eastwood MA. Part VI Diet and Physiological Status in: Human Nutrition and Dietetics 8th ed. ELBS & Churchill, UK, 1986. Pages:575-87
[4] Sukkar MY, Pregnancy and preinatal physiology,Chapter 15 in: Sukkar MY, El Munshid H, and Ardawi MSM Concise Human Physiology 2nd ed, Blackewell Scientific Publications, Oxford UK, 2000. pages. 301-11

[5] Kontic-Vucinic O, Sulovic N, Radunovic N. Micronutrients in women's reproductive health: I. Vitamins. Int J Fertil Womens Med. May-Jun 2006; 51(3):106-15. (Medline)
[6] Bothwell, T.H. (2000): Iron requirements in pregnancy and strategies to meet them. Am J Clin Nutr. 72 supp l):257S–64S. (Medline Whitney, EN, Cataldo, CB, Rolfes SRLife Cycle Nutrition: Pregnancy and Lactation in Understanding Normal and Clinical Nutrition 5th ed. West Wadsworth ITP, An International Thompson Publishing Company-London UK. 1998. Pages: 584-613.
[7] Whitney, EN, Cataldo, CB, Rolfes SRLife Cycle Nutrition: Pregnancy and Lactation in Understanding Normal and Clinical Nutrition 6th ed. West Wadsworth ITP, An International Thompson Publishing Company-London UK. 2002. Pages: 463-494.
[8] National Research Council, Food and Nutrition Board. Recommended dietary allowances 9th ed. Washington, DC, National Academy of Sciences, 1980.
[9] National Research Council (1989): Recommended dietary allowances.10th ed. National Academy Press, Washington, DC
[10] Sudan Integrated Food Security, Information for Action (SIFSIA), Southern Sudan Commission For Census Statistics And Evaluation And Central Bureau of Statistics. Food And Nutrition Security Assessment In Sudan Analysis of 2009 National Baseline Household Survey Internet: http://www.fao.org/sudanfoodsecurity (accessed 11 February 2013)
[11] AlKhalifa FA. Nutritional assessment of pregnant Sudanese women. MSc Thesis, University of Khartoum, 2000.
[12] Nyuar Kot B, Khalil Akh, and Crawford MA. Dietary intake of Sudanese women: A comparative assessment of nutrient intake of displaced and non-displaced women. Nutr Health 2012. 21[2]:131-144, PMID 23275454.
[13] Erhardt J. Nutrisurvey for Windows, Dietary Analysis Package. Copyright ©2004. Only for non commercial use; University of Indonesia, SEAMEO-TROPMED, 2004. Available from website: www.nutrisurvey.de.
[14] Abdelmuti OMS. Biochemical and nutritional Evaluation of famine food of the Sudan. A Thesis submitted in partial fulfillment of the requirement for the A Thesis submitted in partial fulfillment of the requirement for the Degree of Philosophy in Faculty of Agriculture, University of Khartoum, 1991.
[15] Ahmed AEN. Evaluation of the Major and Minor Nutrients in some Sudanese food items A Thesis submitted in partial fulfillment of the requirement for Master Degree in Science and Education, Faculty of Education, University of Khartoum. 1998.
[16] Ahmed BI. Famine food in eastern regions of the Sudan. A Thesis submitted in partial fulfillment of the requirement for the Degree of Masters in Sciences (MSc) in Faculty of Agriculture, University of Khartoum, 1995.
[17] Dirrar HA. The Indigenous Fermented Food of the Sudan. A study in Africa food and Nutrition; CAB International, Cambridge University Press UK, 1993.
[18] Food and Agriculture Organization (FAO). Food composition Table for use in Africa, FAO Rome, 1968.
[19] FAO. Food composition Table for use in East Africa, Food and Agriculture Organization Rome, 1972.
[20] Buss C, Nunes MA, Camey S, Manzolli P, Soares RM, Drehmer M, Giacomello A, Duncan BB, Schmidt MI. Dietary fibre intake of pregnant women attending general practices in southern Brazil. The ECCAGE Study. Public Health Nutr. 2009 Sep; 12(9):1392-8.
[21] FAO/RNE. Nutrition country profile for the selected countries of the Near East Region, Sudan FAO/RNE, Cairo, 1995.
[22] FAOa: Food security statistics-Sudan, FAO, 2008. Internet: http://www.fao.org/countryprofiles/index. (accessed 5 May 2007)
[23] Siega-Riz AM, Bodnar LM, Savitz DA. What are pregnant women eating? Nutrient and food group differences by race. Am J Obstet Gynaecol 2002;186(3):480-6
[24] FAO. Food balance sheet. Food and agriculture organization Rome, 1998.
[25] Fowles ER, Murphey C. Nutrition and mental health in early pregnancy: a pilot study. J Midwifery Women's Health. 2009 Jan-Feb; 54[1]:73-7.
[26] Tawfeek HI, Abdulla JN, Rasheed AH. Maternal dietary intake and pregnancy outcomes in Baghdad, Iraq. Food and Nutr Bull. vol. (20); 2 no. 2 179-182. The United Nations University, 1999.
[27] Sandra L, Huffman .L, Zehner ER, Harvey P, Martin L, Piwoz E, Ndure, KS, Combest C, Mwadime R, Quinn V. Prevalence and Causes of Maternal Malnutrition in Africa, Chapter 1 in Essential Health Sector Actions to Improve Maternal Nutrition in Africa. Publication of the Regional Centre for Quality of Health Care at Makerere University in Uganda and LINKAGES. The Academy for Educational Development. Washington, DC 2001 pages 2-18. Available on Website: www.linkagesproject.org (accessed 25 May 2007).
[28] Esmaillzadeh A, Samareh S, Azadbakht L. Dietary patterns among pregnant women in the west-north of Iran. Pak J Biol Sci. 2008 Mar 1; 11(5):793-6.
[29] Bonham MP, Duffy EM, Wallace JM, Robson PJ, Myers GJ, Davidson PW, Clarkson TW, Shamlaye CF, Strain JJ. Habitual fish consumption does not prevent a decrease in LCPUFA status in pregnant women (the Seychelles Child Development Nutrition Study). Prostaglandins Leukot Essent Fatty Acids. 2008 Jun; 78(6):343-50.
[30] FAO/WHO/UNUa: Energy in human nutrition, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004.Internet: http://www.Fao.org/docrep/007/y5740e/5740eOF.htm, (accessed 14 December 2007.
[31] FAO/WHO/UNUb. Energy requirements during pregnancy, Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Paper Series, No. 1. Rome, 2004 Internet: http://www.Fao.org/docrep/007/y5686e/y5686e00.htm (accessed December 2007.
[32] Ahmed, Nasreldin. Energy in food offered to Sudanese medical students and their energy expenditure. Sudan Med J 1970; 18 [1]:31.
[33] Food and Nutrition Board (FNB). Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids

(Macronutrients). A Report of the Panel on Macronutrients, Subcommittees on Upper Reference Levels of Nutrients and Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Food and Nutrition Board, Institute of Medicine, National academies Press, Washington DC, 2005. Internet: http://www.nap.edu/catalog.php?record_id=10490 (accessed 22 Feb2013)

[34] WHO/FAO/UNU. Protein and Amino Acids requirements in human nutrition, Report of a Joint FAO/WHO/UNU Expert Consultation, WHO technical series 935, WHO, Geneva-Switzerland, 2007. Internet: http://www.who.int/nutrition/publications/nutrecomm/en/index.html. (Accessed 14 December 2007).

[35] FAOb. Sudan country profile, FAO statistical yearbook, FAO, 2008. Internet: http://www.fao.org/countryprofiles/index. . (accessed 5 May 2007)

[36] Musaiger AO. Overweight and obesity in the Eastern Mediterranean Region: can we control it? Eastern Mediterranean health journal Nov. 2004; 18(6):780-93.

Author Profile

Sohair Ali Mohammed Shommo received the B.Sc. Human Nutrition and Dietetics, M. Sc degree in Human Physiology and Ph. D in Nutrition - University of Khartoum. During 1995-2009 have been working as staff member in University of Khartoum, Faculty of Education, Home, Science department(Nutrition and Dietetics section). Now she is in Secondment from University of Khartoum to Hail University, KSA.