Dietary Energy Intakes of Sudanese Pregnant Women

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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 41 years) 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 41 years) 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.

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

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>EAR 1,2</th>
<th>Mean amount of intake</th>
<th>Comparison to DRI</th>
<th>Comparison to EAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (Kcal)</td>
<td>2149</td>
<td>2295.88 ± 505.07</td>
<td>&lt; DRI</td>
<td>&lt; EAR</td>
</tr>
<tr>
<td>14-18 yrs</td>
<td>2820</td>
<td>&lt; DRI</td>
<td>&lt; EAr</td>
<td></td>
</tr>
<tr>
<td>19-50 yrs</td>
<td>2855</td>
<td>&lt; DRI</td>
<td>&lt; EAR</td>
<td></td>
</tr>
<tr>
<td>Protein(g)</td>
<td>50</td>
<td>137.23 ± 42.56</td>
<td>&lt; DRI</td>
<td>&lt; EAr</td>
</tr>
<tr>
<td>Carbohydrate (g)</td>
<td>135</td>
<td>271.01 ± 95.48</td>
<td>&gt; DRI</td>
<td>&gt; EAr</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>-</td>
<td>80.74 ± 27.36</td>
<td>&lt; DRI</td>
<td>-</td>
</tr>
<tr>
<td>14-18 yrs</td>
<td>94</td>
<td>&lt; DRI</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>19-50 yrs</td>
<td>95</td>
<td>80.69 ± 28.12</td>
<td>&lt; DRI</td>
<td>-</td>
</tr>
</tbody>
</table>

3. Protein EAR is 0.88g/ kg bodyweight for reference women 57Kg.(41) page 1330
4. Carbohydrates EAR is 135g (41) page 1330

<table>
<thead>
<tr>
<th>Nutrient Intake</th>
<th>Adequacy</th>
<th>No. of</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy(Kcal)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14-18 yrs</td>
<td>Inadequate</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Adequate</td>
<td>1</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td>19-50 yrs</td>
<td>Inadequate</td>
<td>61</td>
<td>81.3</td>
</tr>
<tr>
<td>Adequate</td>
<td>14</td>
<td>18.7</td>
<td></td>
</tr>
<tr>
<td>Protein(g)</td>
<td>Inadequate</td>
<td>63</td>
<td>77.8</td>
</tr>
<tr>
<td>Adequate</td>
<td>18</td>
<td>22.2</td>
<td></td>
</tr>
<tr>
<td>Carbohydrate(g)</td>
<td>Inadequate</td>
<td>19</td>
<td>23.5</td>
</tr>
<tr>
<td>Adequate</td>
<td>62</td>
<td>76.5</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Nutrient/Day</th>
<th>Income</th>
<th>Education</th>
<th>Family size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Kcal/day</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Protein g/day</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat g/day</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrates g/day</td>
<td>+</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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/UNU/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].

Esmailzadeh 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 Alkhalfa 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 before and after. 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 Alkhalfa. 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 personal habits of the mother [5-8]. Partial correlations between incomes, pregnant women education 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 AlKhalfa. 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.

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[33] Food and Nutrition Board (FNB). Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids

Volume 2 Issue 10, October 2013
www.ijsr.net


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