

Physical Activity Patterns of Pregnant Women in Rongo, Kenya

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Abstract: Women in poor rural communities often engage in heavy physical activity yet consume diets that are deficient in energy. Pregnant women often do not show an augmentation in kilocalorie intake yet continue with heavy physical work. Strenuous work may alter a pregnant woman's nutritional status and therefore increase her risk of morbidity, mortality and low gestational weight gain which is a key risk factor for low birth weight. This study aimed to investigate levels of physical activity among pregnant women attending antenatal clinic at Rongo Sub-District Hospital. Objectives of the study included determining socio-economic factors, determining physical activity patterns and energy expenditure. The study adopted a longitudinal design and comprehensive sampling was used to select a sample of 100 pregnant women for the study. Data was collected by use of structured questionnaires for socioeconomic, and IPAQ for physical activity data. Observation was carried out on 10% of the women to obtain physical activity data. Data was analyzed by use of Statistical Package for Social Sciences (SPSS). Descriptive statistics was used to describe other data. Pearson's Product Moment Correlation Coefficient was used to test for significant relationships between variables. Energy expenditure on physical activity was found to be averagely 1780 ± 500 std kcal/day. The pregnant women spent 14 hours a day on activity and dedicated most of their time per day on domestic work (37%) and least on economic activities (11%). The study fills the knowledge gap, for a study of this kind has not been done in this locality and is of benefit to future research work, various government departments, local and international agencies, the community and pregnant women. The government and health and nutrition organizations need to monitor pregnant women's activity patterns more closely in order to provide counselling as well as support to pregnant women.

Keywords: pregnant women, Rongo, Kenya, physical activity, domestic work, Employment.

INTRODUCTION

Rural women in developing countries carry out heavy burdens in the farm and home [1]. Of importance is the fact that these activities continue into pregnancy and are closely linked to energy intake. Studies done in both developed and developing nations suggest that strenuous work may alter a pregnant woman's nutritional status and, therefore, affect her risk of an adverse pregnancy outcome [2]. Maternal work in itself might have an effect on energy balance and pregnancy outcome because excess energy expenditure may further aggravate maternal malnutrition if calories are not taken in excess to meet the demands of work and pregnancy. According to WHO [3], over activity in poor nutrition settings has a negative impact on health.

Maternal energy expenditure is of importance. Women carry the burden of looking after everybody in the family and food production may be in their hands as well as other economic activities [4]. The women often engage in strenuous activities even during pregnancy yet consume diets low in energy [1, 2]. Women in

developing countries whose energy intake is 30% lower than males generally allocate about 30% more of their time to productive economic work [5]. Studies from both developed and developing countries suggest that strenuous physical activity may adversely affect energy balance in pregnant women [2].

The demands of pregnancy impose a serious strain on the woman's physical condition and her increased body size increases the energy requirements. The extra burden of heavy workloads among rural women further increases demands of energy and because of inadequate dietary intake of calories, there is inadequate weight gain leading to adverse pregnancy outcomes [2, 6]. A past analysis of dietary intake and anthropometric data found that women consume only 2/3 of the WHO recommended daily allowance for energy [7]. The average hours spent in a day on domestic work by people aged eight years and above in Kenya is 1.4 and 14.1 for males and females respectively [8]. Heavy physical work and reproductive

burden coupled with food insecurity lead to a decline in pregnant women's nutritional status.

METHODS

Research Design and Sampling

Longitudinal design was used for the study. Rongo Sub-District hospital was purposively selected for the study due to its credibility in offering antenatal services to the largest number of women in the Division [9]. Comprehensive sampling was used to obtain the required sample. A population of approximately 120 pregnant women that visit the hospital in a month constituted the study population[9].

The sample size was calculated as $P1 = 0.7 + 10\%$ according to FANTA sampling guide [10] recommendations to obtain a sample of 100 pregnant women. Because the same women were expected to visit the hospital the following month, one month was used as the right time frame to obtain the required sample. Each pregnant woman visiting the hospital was therefore selected for the study based on their consent.

Study Area

The study area was Rongo, Migori District situated approximately 30 km from Lake Victoria. The area was selected for study because the researcher was likely to build trusting relations with the participants during the study and also because data quality and credibility were reasonably assured.

Target Population

This study targeted pregnant women visiting Rongo Sub-district hospital for ante-natal clinic in their 2nd and 3rd trimesters up to 38 weeks gestation during the period between March to August of the year 2006. Women in their first trimester of pregnancy were not targeted because they do not present themselves for ante-natal checks and also because weight gain in the 2nd and 3rd trimesters is much more important to pregnancy outcome than weight gain in the 1st trimester [11]. The study included pregnant women who suffered manageable chronic illnesses or who were on some form of medication or treatment but excluded those who did not give consent, were hospitalized or bedridden, those who did not visit the hospital and those resident in the locality for less than six months.

Procedure

Research assistants were trained on data collection techniques and were given work instructions on how exactly to perform the interview. Researcher and one assistant visited the clinic for 30 working days to obtain the required sample of 100 pregnant women in their 2nd and 3rd trimesters. The pregnant women were followed over a period of six months to obtain physical activity patterns.

A face-to-face interview with a standardized semi structured questionnaire was administered to collect demographic data some of which were collected through observation. Physical activity patterns assessment was done using a self-reported modified 7-day short form of IPAQ and observation on 10% of the sample. Activities were later on categorized as productive work, economic work, domestic work, and personal care and leisure activities. Respondents were issued with personal activity questionnaires on the first meeting and women were asked to record the activities they engaged in and time that was taken for each activity over the period between waking up and going to bed. The women were given an explanation on how to fill in the questionnaire. Those who could not read and fill in were instructed to use a member of the family who would be able to do this.

A record of daily activities was kept by each subject for a period of 7 days. The women were given appointments to be visited at home exactly one week from the day of the recruitments. Each woman was given a code and details of how to reach them in their homes were recorded. Observers were later on present in the households of 10% (9) of the respondents to carry out 2-4 days observations from 7.00 am to 6.00 pm on activity of each of the women. The women were encouraged to engage in their normal activities and researcher accompanied them if excursions were made outside the home. A description of each activity and the time spent in that activity were recorded.

A Research Permit was issued by the Permanent Secretary Ministry of Education as clearance to carry out research. Permission was also sought from the Medical Officer of Health Migori District and Project administration was sought from the Medical Officer in Charge at Rongo Sub-District Hospital. The nature of the study was explained to the women and informed verbal consent was obtained from them. Participation was purely voluntary. Confidentiality of data was maintained by coding the information obtained from every participant and no names were used.

Data were coded and analysed by use of Statistical Package for Social Sciences (SPSS). Data from the physical activity questionnaire were summed within each item (sedentary, light intensity, moderate intensity and vigorous) to estimate total time spent in physical activity per week. Total daily physical activity (MET/min/day) was estimated by summing the product of reported time within each item by a MET value specific to each category of physical activity and expressed as a daily average MET score (where MET is metabolic equivalent). 1 MET = resting energy expenditure according to the official IPAQ scoring protocol where vigorous= 8 METS, moderate intensity= 4 METS, walking =3.3 METS [12]. All of the activity data were then assigned to a physical activity category;

economic, productive, domestic, personal care and leisure activities. Pearson's product moment correlation coefficient (r) was used to measure correlations between

physical activity levels, age, family size, occupation, morbidity, type of activity (P<0.05).

RESULTS

Table 1: Age distribution of the pregnant women

| Age (in years) | Frequency (N = 98) | Percent |
|-----------------|--------------------|---------|
| ≤ 19 | 35 | 36 |
| 20 – 24 | 31 | 32 |
| 25 – 29 | 17 | 17 |
| 30 – 34 | 07 | 07 |
| 35 – 39 | 05 | 05 |
| 40 – 44 | 02 | 02 |
| ≥ 45 | 01 | 01 |
| Total | 98 | 100 |

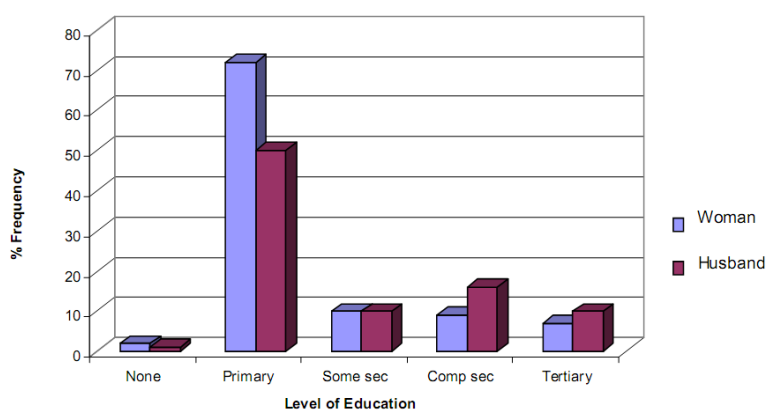


Fig-1: Highest education level of subjects and husbands



Fig-2: Employment status of subjects and husbands

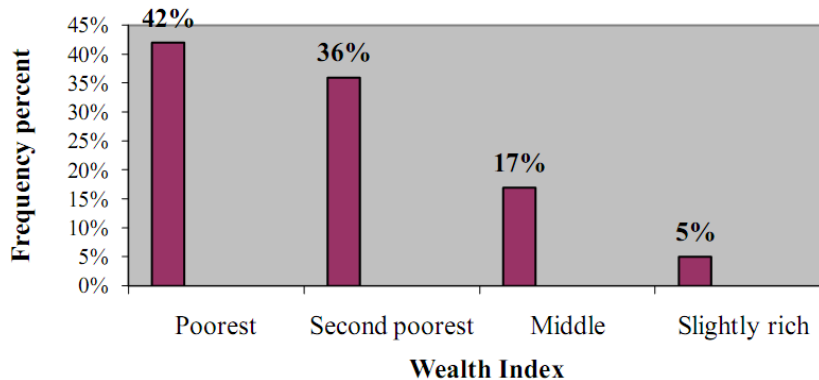


Fig-3: Women's household's wealth index

Table 2: A typical day's activity schedule of a pregnant woman

| Work description | Approx time began | Approx. time ended | Time spent (min) |
|--------------------------------|-------------------|--------------------|------------------|
| Waking up & praying | 5.30 am | 6.00 am | 30 |
| Spreading bed | 6.00 am | 6.15 | 15 |
| Washing face & brushing teeth | 6.15 am | 6.45 am | 30 |
| House cleaning | 6.45 am | 7.45 am | 60 |
| Shamba work (Weeding) | 7.45 am | 10.15 am | 150 |
| Collecting firewood | 10.15 am | 10.45 am | 30 |
| Washing clothes | 10.45 am | 11.45 am | 60 |
| Bathing | 11.45 am | 12 noon | 15 |
| Picking vegetables | 12.00 | 12.30 pm | 30 |
| Cooking lunch | 12.30 pm | 1.15 pm | 45 |
| Eating | 1.15 pm | 1.30 | 15 |
| Siesta | 1.30 pm | 2.00 pm | 30 |
| Washing dishes | 2.00 pm | 2.15 pm | 15 |
| Listening to radio | 2.15 pm | 3.45 pm | 90 |
| Going to the market | 3.45 pm | 5.15 pm | 90 |
| Preparing porridge | 5.15 pm | 5.45 pm | 30 |
| Taking porridge | 5.45 pm | 6.15 pm | 30 |
| Cooking supper | 6.15 pm | 7.15 pm | 60 |
| Helping children with homework | 7.15 pm | 8.15 pm | 30 |
| Eating | 8.15 pm | 8.45 pm | 30 |
| Washing dishes | 8.45 pm | 9.15 pm | 30 |
| Putting children to sleep | 9.15 pm | 9.45 pm | 15 |
| Sewing | 9.45 pm | 10.30 pm | 45 |
| Sleeping | 10.30 pm | 5.30 am | 420 |

Table 3: Physical Activity Measures (Time) of Pregnant Women.

| IPAQ category | Activity pattern | Activity | % of women (n= 85) | Time/per day (min) |
|--------------------|------------------|---------------------------------|--------------------|--------------------|
| Vigorous | Domestic | Cooking morning | 70.3 | 310.8 |
| | | Cooking evening | 76.5 | |
| | | Cooking both times | 67.2 | |
| | | Laundry | 45.9 | |
| | | Washing utensils | 45.9 | |
| | | Fetching firewood | 20.3 | |
| | | Cleaning house & compound | 66.4 | |
| | | Fetching water (river) | 47.8 | |
| | | Fetching water (dug wells) | 17.6 | |
| | | Farm work | 52.3 | |
| Moderate intensity | Production | Care of animals | 22.8 | 117.6 |
| | | Milking | 13 | |
| | | Employment& business activities | 23.7 | |
| Light intensity | Economic | Eating , grooming, toileting | | 72.6 |
| | | | | |
| Sedentary | Personal care | bathing | 100 | 134.4 |
| | | Resting in the afternoon | 70.5 | |
| | Leisure | Sitting/ chatting | 3.1 | 184.8 |
| | | Afternoon nap | 53.6 | |
| | | Listening to radio/TV | 47.6 | |
| | | Reading | 2.2 | |
| | | | | |
| Total | | | | 840 |

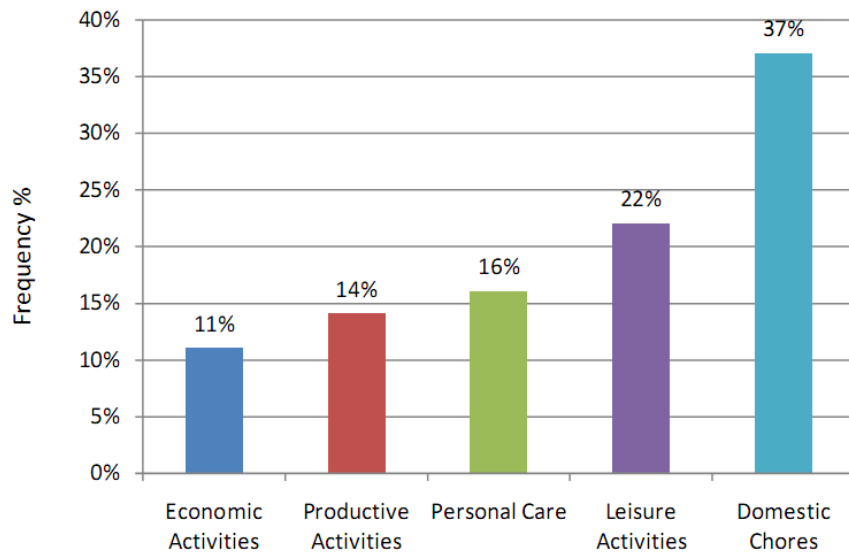


Fig-4: Women's Daily Activity Pattern

Table 4: Energy expenditure on physical activity by the women

| | Energy Expenditure Kcal/day | Std | N |
|---|--------------------------------|--------|----|
| Mean (self-reported data) | 1780.00 | 500 | 85 |
| Mean (observed data) | 1920.34 | 229 | 09 |
| 2 nd Trimester Mean (self-reported data) | 1659.62 | 337.55 | 28 |
| 3 rd Trimester Mean (self-reported data) | 1733.09 | 645.45 | 57 |

DISCUSSION

Socio-Demographic Factors

The social, economic and health factors that were considered include, age, education level, employment status and wealth index.

The Women's Age

The average age of the women was 23.4 at the time of the study (Table 1). Majority (64%) of the women had their first pregnancy at below 19 years while 36% had their first pregnancies at over 19 years. The women's parity was averagely 2.7.

Women's and their Husbands' Educational Level.

Seven percent of the women had tertiary education, 9% had completed secondary school, 10% had attended but not completed secondary school, 2% had no education at all and 72% had attended primary school and either completed or dropped out before completion (Fig 1). If compared with the national standards, these figures would be considered low. For instance 29% of women in Kenya have some secondary education while 12% have completed secondary school [13] compared to only 10% and 9%, respectively, from this study. Education is a human right and one of the major factors that contribute to better living standards, its importance cannot be over emphasised. Education insufficient to achieve basic literacy is however unlikely to bring much benefit [14]. As seen in figure 2, more than half of the women only had a primary level of

education. This may imply that illiteracy levels are high among this study sample.

The husbands generally had higher levels of education than the women. Only 1% had no education at all, 10% had tertiary education, 16% had completed secondary education, 10% attended secondary but dropped before completion, and more 57.5% of the men had only full or incomplete primary education (figure 1). The figures obtained from this study correspond with the national figures (10% and 16%) [13] for complete tertiary and complete secondary education respectively and is a confirmation of the status of men's education in Kenya.

Women's and their Husbands' Employment Status

Most of the women (66%) were not employed while some were (23%) self-employed with most of them involved in small businesses like hawking and selling in the market. Small proportions (3%) were casual labourers. Only a small percentage (8%) had some employment (wage earner) where they obtained wages at the end of the month (figure 2). Employment status of members of a household is vital because it is an important indicator of the economic status of the household [14] and hence a key determinant of activity patterns of the women. Employment is a means by which money comes into the household which in turn is used to obtain food which may be adequate or not adequate depending on the type of employment.

More men than the women tended to be involved in some income generating activity. Fewer men (21.8%) than women (66%) were un-employed; some (23%) were casual labourers, and more of the men (26.4%) were employed (wage earner) while most (28.7%) were self-employed (Fig.2). Husbands who are employed have a means of providing for the requirements including food for their households. Households where husbands have some form of income may not lack food even if the wife is not employed. Traditionally men are supposed to be the household provider.

Wealth Index of the Women

The wealth index was a composite measure of the living standard of the pregnant women's household's ownership of selected assets, materials used for housing construction, and water and sanitation facilities. The wealth index placed the pregnant women's households on a continuous scale of relative wealth using principal components analysis. The pregnant women were ranked according to the score of the household in which they resided. The index categorised the women into four quintiles: Poorest, Second poorest, Middle and Slightly rich. Only 5% of the women fell within the slightly rich wealth index and 17% fell within the middle wealth index. Majority fell within either second poorest (36%) or poorest (42%) wealth indices (figure 3). This finding suggests that this study sample was made up mostly of women from poor households. This finding may be in agreement with a 2006 FAO report that found a proportion of Kenyans to be suffering from food poverty and further reported that Nyanza, Rift valley and Eastern provinces contributed 66% of the total rural food poverty. The report further states that there is an intricate relationship between food poverty and absolute.

Activity Patterns of the Women

The work schedule of the women investigated comprised averagely of 14 hours a day. Each activity was categorized as economic work, productive work, domestic work, personal care and leisure activities. Activity pattern of the pregnant women in the study based on the IPAQ show that 52.3% of women worked in the farm, and 22.8% tended animals. Majority of these women did cooking, washing clothes and utensils and cleaning. The women spent an average of 11% of their time on economic activities, 14 % of their time on productive activities, 37% of their time on domestic activities, 16% of their time on personal care and 22% of their time on leisure activities. The women dedicated 78% of their time on physical work and only 22 % of their time on leisure activities per day. Women allocated most of their time (37%) to domestic activities and least (11%) to economic work (figure 4). This is true because majority of the women were neither employed nor self employed. Women engaged in

productive and domestic activities spent less time resting. These activities and less resting is synonymous, as the study observed that most tasks performed by these women were deemed moderate to heavy activity.

In this study women were observed to dedicate 63 hours on unpaid work and only 11% given to income earning. This confirms UNICEF's [1] description that women have lesser opportunities than men to find paid employment or invest in business because they lack land, tools, and technical inputs and knowhow and opportunities, and other essentials reduce them to relative inactivity. Some factors may affect activity patterns of women. These include family size of the women studied. Family size may increase the domestic workload, but the possibility of finding helping hands to share work cannot be ruled out in this study. Approximately 47% made one or several trips to the river to fetch water, wash clothes, or take a bath while 17.6 % hauled water from nearby dug wells. About 20.3% had to collect firewood (table 2).

Modified IPAQ and direct observation records of the women were converted to energy expenditure and translated into values of 1780 Kcal/day for activity questionnaire and 1920.34 Kcal/day from direct observation (table 3). The women did not include trips within the home as a result of routine domestic chores in their activity reports; hence the actual figure may be higher than the one obtained in this study. There may have been greater underestimation of energy expenditure associated with higher physical activity from the activity questionnaires. However, the figure for energy expenditure obtained through observation is higher because of the inclusion of energy used in these trips. Mehretu & Mutambirwa's [15] study on Excessive Time and Energy Cost of Women found that time cost of distance accounted for about 49% of the total time cost of distance output with about 1/3 of this effort devoted to trips to fetch water, firewood and to do laundry, hence the big difference observed between Energy Expenditure (EE) from activity questionnaires and Energy Expenditure from observation.

The women in this study did not reduce their activity levels during the 3rd trimester but seemed to increase their expenditure from 1659.62 Kcal/day in the 2nd trimester to 1733.09 Kcal/day in the 3rd trimester. The results show that women on average were active in their 2nd trimester as well as their 3rd trimester of pregnancy. A similarity is observed between findings from this study and a study on Physical Activity and Mood during Pregnancy [16] which found an underestimation of energy expenditure with the activity diary compared with recall. The study found pregnant women to be active during the 2nd as well as the 3rd trimesters of their pregnancy as non-pregnant women who participated in a large community study. Findings

from this study as well as Poudevigne's [16] study confirm the observation that pregnant women in rural areas of developing countries do not reduce their activity levels during pregnancy but continue with the same tasks into late pregnancy [17]. Studies in Asian countries have found that large numbers of women work very hard during pregnancy and this makes their energy requirements harder to meet and increases their risk of energy deficit and Inter Uterine Growth Retardation (IUGR) [18]. Our study sample was also observed to work very hard and this may have made their energy requirements difficult to meet and may be at increased risk of negative pregnancy outcomes. Pike [19] in his study of Nomadic Turkana women found that a higher proportion of women who reduced their activity levels experienced positive pregnancy outcomes.

Central to our understanding of the role played by behavioural adjustments in the adaptive response to energy deficiency is the ability to discriminate between the physiologically driven, nutrition dependent modifications of physical activity and the changes of inactivity imposed by external, mainly economic constraints. Kanade *et al*, [17] state that in developing countries, the extra cost of pregnancy is imposed upon a limited supply of food and pregnant women may not have the possibility of increasing their energy intake very much. They continue to state that these observations lead to the alternative possibility of energy sparing mechanisms in pregnant women in developing countries resulting from either a decrease in BMR or an increase in work efficiency as they found total Energy Expenditure to be significantly correlated with body weight ($r = 0.50$, $p < 0.001$). Unravelling of these two processes poses enormous difficulties that this study was not designed to address. Ferro-Luzi [20], however, states that there is evidence to suggest that decreases in physical activity may play a lesser role than originally anticipated under the conditions prevailing in rural areas of developing countries. Although a study carried out in a developed country setting on Dutch women found that energy used for physical activity was reduced by an average of 70 Kcal/day during pregnancy and was considered modest although less than FAO/WHO/UNU'S estimate [21]. They suggested that amount of energy saved by reducing activity during pregnancy may be greater than previously thought.

Ferro-Luzi's [20] study found that energy expenditure remained unchanged throughout all seasons in Ethiopian, Biennese and Indian women whose energy deficit was most severe. Changes in their BMR and body weight appear to have been sufficient to meet the potential energy debt leaving little scope for further energy saving through curtailing physical activity. They concluded that physical activity and therefore energy expenditure may well prove to be strictly regulated by social obligations and environmental

constraints. Therefore lower seasonal energy expenditure may be explained by the practical difficulties faced by the rural poor as observed from our findings of daily energy expenditure that are lower than some from other regions. For example, a 1981 study in India obtained a daily kilocalorie expenditure of 2505Kcal/day for women [22](although a negative energy balance was obtained) while our finding is 1780 Kcal/day a figure that is much lower but similar to the Indian study in terms of negative energy balance.

Conclusion

Women remained active in their 2nd trimesters as well as their 3rd trimesters of pregnancy as is the pattern in rural areas of developing countries. The daily energy expenditure of the women was however lower than that of women from several other studies, a fact that may be attributed to lack of opportunities for rural women as shown by the least amount of time (11%) given to economic work per day and also supported by Batliwala [22] and UNICEF [1]. Findings from this study show that habitual physical activity of pregnant women at South Western Kenya encompassed three distinct dimensions, domestic, productive and leisure activities. Most of their time was given to domestic activities and least time was given to income earning activities. In conclusion, this study found the women to remain active in their 2nd trimesters as well as their 3rd trimesters of pregnancy. Their daily energy expenditure remained relatively high considering similar reports from several authors. The daily energy expenditure of the women was however lower than that of women from several other studies. The Government and Non-governmental organizations should protect pregnant women in this community from excessive energy expenditure on activity by promoting programmes that attempt to reduce energy expenditure on physical activity among the pregnant women.

REFERENCES

1. UNICEF; Children Growing into the 21st Century: Annual report. A regional profile: Eastern and Southern African Regional office, 1997.
2. Shaw GM; Nutrition as a Preventive Strategy against Pregnancy Outcomes, Strenuous Work: Nutrition and Adverse Pregnancy Outcomes. The American Society for Nutritional Sciences J N, 2003; 133 1718-1721.
3. WHO; Global Strategy on Diet, Physical Activity and Health. African Regional Cumulative Report, 2003.
4. Musoke RN; Women's Well-Being: A Nation's Wealth. A Paper Presented at the World Health Day. Daily Nation, 2005; 32.
5. FAO; Africa Report, 2004.
6. Brown J, Isaacs JS, Krinke BU, Murtaugh MA, Sharbaugh, Woolridge NH and Stang J;

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- Nutrition through the Life Cycle.. 2nd Ed. Thomson Wasworth, 2005, USA.
7. Leslie J; Nutrition: the key to improving family health in developing countries? *Health Policy and Planning*, 1991; 6 (1): 1-9.
 8. Graham JW, Murray MS; A Question of Survival: A Review of Safe Motherhood in Kenya. Institute of Child Health, 1997.
 9. Migori District Medical Records; MOH, 2004.
 10. Food and Nutrition Technical Assistance Project; Sampling Guide. Academy for Educational Development. Washington DC, 1997.
 11. Garza C, Motel KJ; Protein-Energy Relationships in Pregnancy and Lactation. Children's Nutrition Research Centre, Division of Nutritional Sciences, Cornell University, 2000.
 12. Ekellund U, Sepp H, Brage S, Becker W, Jakes R, Hennings M, Wareham NJ; Criterion-related Validity of the last 7-day short form of the IPAQ in Swedish Adults. *Public Health Nutrition*, 2005; 9 (2) 258-265.
 13. Central Bureau of Statistics (CBS) Kenya, Ministry of Health (MOH) Kenya and ORC Macro, 2004. Kenya Demographic Health Survey 2003: key findings. Caverton USA, MOH and MACRO.
 14. Ministry of Medical Services and Ministry of Public Health and Sanitation. (2009). Kenya Household Health Expenditure Utilisation Survey Report, 2007.
 15. Mehretu A, Mutambirwa C; Time and Energy costs of distance in rural life space of Zimbabwe: case study in the Chiduku communal area. *Social Science and Medicine*, 1992; 34 (1): 17-24.
 16. Poudevigne M; Physical Activity and Mood during Pregnancy. *Medicine in sports and Exercise*, 2005; 37(8): 1374-1380.
 17. Kanade AN, Rao S, Yajnik CS, Margetts BM, Fall CHD; Rapid Assessment of Maternal activity among rural Indian Mothers (Pune Maternal Nutrition Study). *Public Health Nutrition*, 2004; 8(6): 588- 595.
 18. Dyle W, Crawford MA, Srivastarat A, Costetoret KL; Interpregnancy Nutrition Intervention with Mothers of Low Birth Weight Babies living in an Inner City Area. *Journal of Human Nutrition and Dietetics.*, 1999; 12: 517-527.
 19. Pike II; Pregnancy outcome for Nomadic Turkana Pastoralists of Kenya. *American Journal of Physical Anthropology*, 2000; 11: 1331-45.
 20. Ferro-Luzi A; Seasonal Energy Stress in marginally nourished Rural Women: Interpretation and Intergrated conclusions of a Multicentre Study in three Developing Countries. *European Journal of Clinical Nutrition*, 1990; 44 (1): 41-46
 21. Joop MA, Joseph AJ, Susan H, Raaj V, Casja M, Veermat M; Energy cost of Physical Activity throughout pregnancy and the first year postpartum in Dutch women with sedentary lifestyles. *American Society for Clinical Nutrition*, 1990; 0002: 9165.
 22. Bafliwala S; Women's' Access to Food. *Indian Journal of Social Work*, 1987; 48, (3): 255-271.