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**Article** *in* Indian Journal of Agricultural Sciences · June 2018

DOI: 10.56093/ijas.v88i6.80657



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# Health and nutrition status of farm women in rural India: Case of Indo-Gangetic plains

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Received: 18 January 2017; Accepted: 15 May 2018

ABSTRACT

Women in India are facing several health-related issues, which ultimately affect the economic output of the nation. The health of Indian women is intrinsically linked to their status in society. Haryana and Uttar Pradesh are some of the few states in India which belong to Indo-Gangetic Plains where an overwhelming number of rural women have always been a part of the active work force in agriculture, forest protection, cattle care, and dairying. Present study is an attempt to know the food consumption and dietary intakes of farm women in rural sector of the UP and Haryana. Collected data were analyzed with the help of suitable statistical techniques. Education, energy consumption and protein consumption have significantly positive relationship with nutritional status of respondents, whereas family size has significantly negative relationship with nutritional status. It was found that the diets were inadequate in energy, protein, iron, β-carotene and ascorbic acid contents to the tune of 16.71 and 15.91; 7 and 10.58; 14.33 and 21.63; 25.66 and 34.33; 16.71 and 18.05 percent, respectively in selected villages of Haryana and Uttar Pradesh. These comparisons were made with recommended dietary allowances (ICMR 2010). Iron intake in the daily diet of women in both villages was found to be 19.7 mg and 20.54 mg, which is 34.33 and 31.53 per cent less than recommended level (30 mg). Prevalence of Chronic Energy Deficiency (CED) was found to be higher among the farm women of both the states.

**Key words:** Chronic Energy Deficiency, Dietary Pattern, Nutrition, RDA, RDI

Agriculture and rural economic activities are essential for growth, poverty reduction and food security especially for the poorer farm families of the nation. Women play multiple roles in a family, primarily as mothers and housekeepers and also equally important roles as wage earners, agricultural producers and nutrition providers. They are instrumental in the acquisition of food, its preparation, storage and distribution. While malnutrition is prevalent among all segments of the population, poor nutrition among women begins at infancy and continues throughout their life time (Chatterjee 1990). Experiences of food insecurity and hunger among slum households have been reported in other studies also (Aggrawal *et al.* 2009). Government of India has been making several efforts in developing health and population policies. However, there are several problems in the implementation of appropriate interventions due to poverty, gender discrimination, and illiteracy. Despite efforts to achieve the millennium development goals of achieving gender equality and women empowerment, there are adverse disparities amongst the entire population especially between men and women, which seems convincing enough to evolve strategies to counter these disparities spread across economic and social domains (Anand and Kumar 2015)

The major cause seems to be under-nutrition; the condition refers to inadequate intake of protein and calories for a long time that also leads to the deficiency of micronutrients such as minerals and vitamins. The malnutrition is directly associated with lack of health awareness amongst women, illiteracy, low socio-economic status, poor housing conditions, early marriage, low income, poor sanitation, and stressful environment, use of narcotics, child bearing, overwork and to some extent lethargy. Body becomes more prone to diseases when adequate amount of nutrient is not provided through diet. The negative effects of malnutrition among women are compounded by many factors like heavy work demands, poverty, child bearing and rearing and special nutritional needs of women, resulting in increased susceptibility to illness and consequently higher morbidity. India's maternal mortality rates in rural areas are one among the world's highest. From a global perspective, India accounts for 19% of all

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live births and 27% of all maternal deaths (NFHS-3 data, 2006). The health of Indian women is intrinsically linked to their status in society, especially for those living in a rural area. Because of wide variation in culture, religion and levels of development among different Indian States, it is not surprising that women's health also varies greatly from state to state. Research on women's status in society has revealed that the contributions Indian women make to families are often overlooked. Instead they are often regarded as economic burdens and this view is common in rural areas of the northern belt. The nutrition transition in low income countries is being recognized as an emerging crisis due to changing health profiles (Popkin 2008).

A classical example of changing health profile is evident from the nationwide surveys mapping the nutritional profile of women (NFHS 2007). According to NFHS-3 data, more than a third (36%) of women has a Body Mass Index (BMI) below 18.5, indicating a high prevalence of nutritional deficiency. The health status of women, is still a cause for grave concern, especially that of the rural women. This is reflected in the life expectancy (62.5 years), infant mortality rate (57/1000 live births), maternal mortality rate (230/100 000 live births) (NFHS-3data). Women require high-quality nutrients as their work load and energy expenditure is more; however in some areas of India, women typically take meal last and least. More than half of all Indian women develop anemia due to lack of essential nutrients (TOI 2011). In fact, nearly 22 000 people, mainly pregnant women, die every year from severe anemia. It has been estimated that prevalence of clinical and sub clinical vitamin A deficiency in India is among the highest in the world.

The dietary and nutrition transition, characterized by improved agricultural practices, food supplies and advances in food processing techniques, while making more food available to people, has also resulted in imbalanced nutrient intakes changing health profiles (Dharmalingam *et al.* 2009). Information at the household level is important to understand the dietary patterns of women and to assess whether their nutritional requirements are met.

## MATERIALS AND METHODS

An attempt was made to assess the diet and nutrition profile of women in Haryana and Uttar Pradesh States of India. The study was undertaken to assess the nutritional status, dietary intake and deficiency patterns among 100 non-pregnant non-lactating rural women of reproductive age group (18-45 years) in the village Rajpur (Aligarh), U P and Khajurka (Palwal), Haryana. A cross-sectional survey was conducted using both qualitative and quantitative data collection methods. The study involved interviews using a questionnaire, measurement of food/nutrient intake, anthropometry, and observations of clinical signs of deficiencies. Food intake during three non-consecutive days was investigated with a 24-hour recall. The women were asked about the kind of meals, foods and beverages they had had in the previous 24 hr, expressed in cooking units, which were then converted to grams (g). The nutrient composition was estimated with the software NutWin® 1.5, version 2002. Assessment of the adequacy of individual intake was done by subtracting the median requirement from the intake, as follows:

$D = Mi - EAR$

where: D = difference, Mi = mean intake, EAR = median requirement

$$Z = D/Dpo = Mi - EAR / \sqrt{V_{req} + (V_{int}/n)}$$

where: Mi = mean intake of the nutrient in "n" days by the individual , EAR = the best estimate of the individual's requirement for the nutrient , $V_{req}$ = requirement variance, $V_{int}$ = intrapersonal variance

The requirement variation coefficient assumed for all nutrients was 10%. Frequency of consumption of raw foods per month was collected with the help of a questionnaire and computed as daily intake of foods by average number of respondents.

The quantity of raw food consumed by an individual was calculated using the following formula:

$$RFI = \frac{TRQ \times II}{TCQ}$$

where, RFI= Raw amount of a food stuff consumed by the individual, TRQ= Total raw quantity of food stuff used in that preparation, II= Individual intake of the cooked amount of preparation, TCQ= Total cooked quantity of food prepared.

Weighment survey (Thimmayamma *et al.* 2009) was also conducted for a sub-sample of 10% of sample with the purpose of validation of data. Dietary intake data for all subjects was collected twice for every subject on a week day to avoid bias and average food and nutrient intake was computed using food composition tables for Indian foods (Gopalan *et al*. 1996). The percent adequacy of nutrient intake was determined using the latest recommended dietary allowance as per Indian Council of Medical Research (ICMR 2010).

Prevalence of chronic energy deficiency (CED) among farm women was assessed using the Body Mass Index. Body Mass Index was derived by measuring weight and height of the respondents using the following formula;

Body Mass Index (BMI) ($kg/m^2$) = Weight (kg)/Height$^2$ (m)

Classification of Body Mass Index as per the physiological characteristics

| BMI grades | BMI range |
|---|---|
| CED III | Less than 16 |
| CED II | 16-17 |
| CED I | 17.18.5 |
| Low-Normal | 18.5-20 |
| Normal | 20.25 |
| Overweight and obesity | ≥ 25 |

Collected data was analyzed with the help of suitable statistical techniques, viz, percentage, arithmetic mean,

standard deviation and two samples't' test. Coefficient of correlation was computed by Karl Pearson's formula to determine the nature of relationship between independent variables and nutritional status of farm women.

## RESULTS AND DISCUSSION

*Physiological characteristics*

Physiological characteristics of subject were analyzed by using different parameters. In the Haryana region (Khajurka) the subjects were with mean age of 35.42 ± 12.3 years, having mean height of 156.32 ± 9.12 centimeters, mean weight 43.02± 6.12 Kg, mean blood pressure 80.07 ± 1.53 and mean BMI, kg/m$^2$ of 17.68± 5.87. As per NHFS-4 (2016) survey of Haryana also revealed that in rural Haryana 18.2 per cent of women having Body Mass Index (BMI) which is below normal (BMI < 18.5 kg/m$^2$). In Rajpura (Uttar Pradesh) also women were found with less BMI 17.52 ± 7.59 which is in line with NHFS-4 2016 data (Table 1).

*Dietary diversity*

Data on Dietary diversity among subjects was computed as intake of different food stuffs per day by number of respondents and summarized in Table 2. Dietary data was taken twice in a month to reduce errors. Food frequency revealed that the major cereal consumed was wheat followed by pearl millet in both the villages. Rice was consumed to a lesser extent and other cereals were rarely used. Among legumes, use of greengram and cowpea was very common in both the areas; other pulses were used only once or twice a week indicating a low level of dietary diversity. Among vegetables only few seasonal vegetables were consumed, the use of green leafy vegetables was only once or twice a week. Fruits were rarely eaten except in Rajpur because of availability of guava orchards in the region. Mallikharjuna *et al.* (2010) also stated that low intake of all food groups except other vegetables, roots and tubers; micronutrient deficiency prevalent were Fe, Vitamin A and free folate in their subjects.

Milk, curd and butter milk were common commodities in all households. Overall food dietary diversity indicates that the varieties of foods used were very limited and subjects depended mostly on locally grown produce. The food frequency of both the region was found quiet similar in case of cereals, legumes, and animal products but it differed in case of fruits and vegetables because of availability of food.

Table 1 Physiological Characteristics of the Subject ($N_1$=50, $N_2$=50)

| Physiological characteristics | Khajurka Mean± SD | Rajpura Mean± SD |
|---|---|---|
| Age, Years | 35.42 ± 12.3 | 37.25 ± 7.89 |
| Weight, Kg | 43.02± 6.12 | 41.39± 1.23 |
| Height, cm | 156.32 ± 9.12 | 153.41± 5.65 |
| Blood pressure (Sys/Dia) | 117.31/65.24 | 119.35/68.23 |
| Mean blood pressure | 80.07 ± 1.53 | 81.5± 3.89 |
| Pulse rate (per min) | 67.04 ± 1.79 | 68.23± 2.36 |
| BMI, kg/m$^2$ | 17.68± 5.87 | 17.52 ± 7.59 |

*Food and nutrient intake*

The consumption of a wide variety of nutritious foods is important for women's health. Adequate amounts of protein, fat, carbohydrates, vitamins, and minerals are required for a well-balanced diet. Meat, fish, eggs, and milk, as well as pulses and nuts, are rich in protein (Sharma *et al.* 2016). Green, leafy vegetables are a rich source of iron, folic acid, vitamin C, carotene, riboflavin, and calcium. Many fruits are also good sources of vitamin C. Bananas are rich in carbohydrates. Papayas, and other yellow fruits contain carotene, which is converted to vitamin A. Vitamin A is also present in milk and milk products, as well as egg yolks.

The Dietary Reference Intakes (DRI) are defined as the set of reference values that correspond to quantitative estimates of nutrient intake, established to be used in the dietary planning and assessment of healthy individuals and groups, according to their life stage and gender. The DRI cover and differentiate the concepts of nutritional requirements and recommendations, the reduction of risks for non-communicable chronic diseases, the bioavailability of the nutrients and the errors associated with the assessment methods. The information pertaining to the food consumption pattern of the farm women has been given in Table 3. Food consumption by the women farmers, in both villages, was quite low. Intake of cereals and pulses were less than Recommended Dietary Intake (RDI) in both the villages. Milk consumption was more than RDI in both study locations. Consumption of green leafy vegetables and other vegetables was significantly lower than RDI in both the villages.

Table 4 presents the mean nutrient intake and average percent adequacy of nutrient intake by all subjects. Both in Khajurka and Rajpur area, the diets were found inadequate in comparison to RDA recommended by ICMR (2010) in terms of energy, protein, iron, β-carotene and ascorbic acid.

Daily per capita average energy consumption in villages were 1853 kcal and 1870 kcal respectively in Khajurka and Rajpur which is 16.71 and 15.91 per cent less than recommended level (2225 kcal). Pant (2002) also reported that the average energy intake by the rural women of the Central Himalaya was below the standard requirement. Restriction in energy intake affects adversely the utilization of dietary protein. According to NNMB (2002) intake of protein, energy, vitamin A and riboflavin was less than the Recommended Dietary Allowances (RDA) in almost all states. Protein plays an important role in many bio-chemical, biophysical and physiological processes in the body.

Several studies have also reported deficient intake of calories and protein among populations relative to the Indian RDA (Agte *et al.* 2005, Mittal and Srivastava 2006). Iron deficiency is recognized as the major cause of anemia in communities and reported that deficiencies of micronutrients such as iron and zinc often occur together.

Table 2 Dietary diversity among rural women (number of subjects) ($N_1$=50, $N_2$=50)

| Food stuffs | Frequency of daily use | | Food stuffs | Frequency of daily use | |
|---|---|---|---|---|---|
| | Khajurka | Rajpur | | Khajurka | Rajpur |
| *Cereals* | | | *Animal foods* | | |
| Wheat | 50 | 50 | Egg | 2.3 | 6 |
| Pearl Millet | 36 | 29 | Mutton/ Chicken | 1.3 | 2.7 |
| Rice | 17 | 19 | Milk and milk products | | |
| Legumes | | | Milk | 50 | 50 |
| Green gram dhal | 18 | 27 | Curd | 38 | 42 |
| Red gram dhal | 13 | 15 | Butter Milk | 36 | 50 |
| Cowpea | 18 | 12.5 | Ghee | 28 | 27 |
| Field bean | 9 | 7 | *Green leafy vegetables* | | |
| Fruits | | | Spinach | 7 | 10 |
| Banana | 12 | 5 | Amaranths | 12 | |
| Tomato | 29.5 | 23.5 | Fenugreek | 18 | 15 |
| Guava | 6.8 | 23 | Coriander | 17 | 19 |
| Grapes | 3.2 | 7 | Roots and tubers | | |
| Ber | 7.8 | 8 | Onion | 12 | 20 |
| Miscellaneous | | | Potato | 50 | 50 |
| Tea | 50 | 50 | Other vegetables | | |
| Coffee | 4.5 | | Ladies finger | 7 | |
| | | | Brinjal | 22 | 28 |
| Sugar | 50 | 50 | Bottle gourd | 12.7 | 10 |
| | | | Bitter gourd | 13 | 15 |
| Jaggery | 28 | 36 | Cauliflower | 27.5 | 21 |

Intake of calcium was found to be higher than Recommended Dietary Allowance (RDA) among the women of both villages. Absorption of calcium is dependent on level and bioavailability of vitamin D. Dobhal *et al.* (2003) also reported higher percentage of women consuming adequate calcium in their diet but the bio availability and calcium absorption pattern is inadequate because of nicotine and caffeine present in tea.

Table 3 Average consumption of various food items (g/day) in comparison to RDI

| Food items | Average consumption Mean± SD (Khajurka) | Average consumption Mean± SD (Rajpur) | RDI |
|---|---|---|---|
| Cereals and millets (g) | 389 ±2.54* | 367 ±7.12* | 350 |
| Pulses (g) | 37.5 ± 3.24** | 30.8 ± 2.45** | 60 |
| Green leafy vegetables (g) | 38.5 ± 3.96** | 36 ± 5.23** | 125 |
| Other vegetables (g) | 53.5 ± 4.12* | 47.8 ± 8.56** | 75 |
| Roots and tubers (g) | 92 ± 0.12 $^{NS}$ | 95.5 ± 5.26$^{NS}$ | 75 |
| Milk (g) | 250 ± 9.21* | 224 ± 6.25$^{NS}$ | 200 |
| Friuts (g) | 15.5 ± 3.24** | 18 ± 5.98* | 30 |
| Fats and oils (g) | 25 ± 0.21$^{NS}$ | 27 ± 1.03$^{NS}$ | 35 |
| Sugar and jaggery (g) | 28.5 ± 3.12$^{NS}$ | 32 ± 0.98$^{NS}$ | 30 |

* Significant at P=0.05 level, ** Significant at P=0.01 level, NS-Non significant

Iron intake was found 31-34% less than RDA in both the villages. In India nearly 70 per cent of women are estimated to be iron deficient (Rammohan *et al.* 2012) Iron deficiency can exist without anemia also. Anemia has been the most common parameter employed to determine iron deficiency. Personal experiences of several pediatricians and obstetricians all over the country indicate a dramatic decline of severe anemia with oedema in children and women (pregnant and non-pregnant). A limited comparison of studies conducted in similar areas on comparable age and physiological groups at different time periods yielded two such series. Iron Deficiency Anemia (IDA) is very late manifestation of iron deficiency because iron deficiency can be very well tolerated. Maternal anemia during pregnancy increases the risk of prenatal and maternal mortality and contributes to low birth weight. Iodine deficiency during pregnancy can impair motor, physical and mental development of the fetus and increase the risk of miscarriage (Zimmermann 2009). Anemia does not develop till storage iron is exhausted (Shah 2004). The NNMB (2006) survey revealed that the intake of dietary iron is grossly inadequate in most of the states, meeting less than 50 per cent of RDA

Table 4 Nutrient intake and average percent adequacy

| Nutrients | Nutrient Intake Mean± SD (Khajurka) | Nutrient Intake Mean± SD (Rajpur) | % Change then RDA (Khajurka) (t-test calculated) | % Change then RDA (Rajpur) (t-test calculated) | RDA |
|---|---|---|---|---|---|
| Energy (kcal) | 1853 ± 3.12 | 1871 ± 7.21 | -16.7191** | - 15.91** | 2225 |
| Protein (g) | 46.5 ± 1.75 | 44.71± 3.17 | -7** | -10.58* | 50 |
| Calcium (g) | 823 ±4.98 | 689 ± 7.29 | 37.1667* | 12.91** | 600 |
| Iron (mg) | 19.7 ± 2.25 | 20.54± .17 | -34.33333** | -31.53** | 30 |
| β-carotene (µg) | 3568 ± 3.47 | 3152 ± 7.52 | -25.6667* | -34.33** | 4800 |
| Thiamin (mg) | 2.1 ± 4.25 | 1.9 ± 3.47 | 61.5385** | 46.15** | 1.3 |
| Riboflavin (mg) | 2.3 ± 6.51 | 2.0 ± 7.24 | 76.9231* | 53.84* | 1.3 |
| Nicotinic acid (mg) | 24.3 ± 3.10 | 23.52 ± 4.29 | 62* | 56.8* | 15 |
| Ascorbic acid (mg) | 35.7 ± 1.79 | 32.78 ± 1.79 | -16.7191* | -18.05** | 40 |

* Significant at (P = 0.05), ** Significant at P = 0.01.

of males (28 mg) or females (30 mg).

The diets of respondents were found to be adequate in riboflavin consumption. Riboflavin deficiency leads to diseases like angular stomatitis, glossitis, skin lesions and chilosis in humans.

The calculation of β -carotene in diets of respondents revealed the sufficiency to the extent of 25-34 %. Over 80 per cent of the dietary supply of vitamin A in the Indian diets is derived from its precursors, β -carotene, a-carotene, g-carotene and b-cryptoxanthin which are present in many plant foods. Among these carotenoids, β -carotene has the highest vitamin A activity. The important deficiency states due to vitamin A intake in diet are night blindness, xerosis conjunctiva, xerosis cornea, bitot's spots, keratomalacia and follicular hyperkeratosis.

The consumption was compared with RDAs (Table 5) at less than 75%, 75-100% and more and equal to 100% with intake of protein, energy, calcium, iron, β-carotene and ascorbic acid. It was found that majority of the women in both the locations were consuming less than RDAs (Table 5) except in case of protein (72 %), energy (65 %), and ascorbic acid (60 %). Data in Table 5 presents further reveals that farm women of both the villages were consuming iron less than RDA with 30 and 20% respondents not even meeting the 75% of requirement of iron. Diet containing foods of plant origin particularly cereals and pulses and lower consumption of green leafy vegetables could be the possible reasons of low consumption of iron.

*Anthropometric measurements*

Height and weight were determined according to standard anthropometric methods (Marfell Jones *et al*. 2006, Rao *et al.* 2009). Height was measured to the nearest 0.1 cm in bare feet with participants standing upright against a mounted stadiometer. Weight was measured to the nearest 0.1 kg with participants lightly dressed using a portable Seca digital platform scale (model 770). Body Mass Index (BMI) of the respondents was computed using height and weight values and subjects were classified into various categories of Chronic Energy Deficiency (James *et al.* 1988). The findings in Fig 1 suggest that the prevalence of Chronic Energy Deficiency was high among farm women. However, no woman was found overweight. In Khajurka location approximately 60% of women found to be in different grades of CED and only 22% women were found to be normal (Fig 1). The same trend was also seen in Rajpur village of Uttar Pradesh where only 26 per cent women were found to be normal as per BMI status.

Further relationship between Body Mass Index (BMI) and other independent variables as nutrient consumption,

Table 5 Percent distribution of farm women according to intake of Nutrients

| | | ≥ 100% of RDA | 100-75 % of RDA | ≤ 75 % of RDA |
|---|---|---|---|---|
| Protein | Khajurka | 14.0 | 76.0 | 10.0 |
| | Rajpur | 24.0 | 68.0 | 8.0 |
| | Average | 19.0 | 72.0 | 9.0 |
| Energy | Khajurka | 22.0 | 66.0 | 12.0 |
| | Rajpur | 18.0 | 64.0 | 18.0 |
| | Average | 20.0 | 65.0 | 15.0 |
| Calcium | Khajurka | 84.0 | 14.0 | 2.0 |
| | Rajpur | 80.0 | 18.0 | 2.0 |
| | Average | 82.0 | 16.0 | 2.0 |
| Iron | Khajurka | 16.0 | 54.0 | 30.0 |
| | Rajpur | 20.0 | 60.0 | 20.0 |
| | Average | 18.0 | 57.0 | 25.0 |
| β-carotene | Khajurka | 42.0 | 10.0 | 48.0 |
| | Rajpur | 34.0 | 4.0 | 62.0 |
| | Average | 38.0 | 7.0 | 55.0 |
| ascorbic acid | Khajurka | 18.0 | 58.0 | 24.0 |
| | Rajpur | 12.0 | 62.0 | 26.0 |
| | Average | 15.0 | w60.0 | 25.0 |

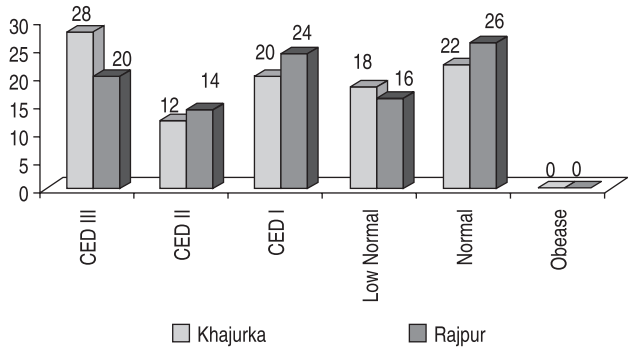


Fig 1 Prevalence (%) of chronic Energy Deficiency (CED) among farm women

age, education, land holding, size of family were also analyzed (Table 6) and it was found that BMI is positively correlated with nutrient uptake, educational status.

In the present study, Carbohydrate and Protein were positively correlated which is significant at 5% level.

The results of the present study revealed the facts that inadequate dietary intake, especially hidden hunger and Chronic Energy Deficiency was prevalent among rural women. Rural women were particularly vulnerable to under nutrition. The study highlights the need for necessary steps for awareness generation among farm women about health, nutrition and nutritious diets. Health and Nutrition Education may be strengthened through department of health and ICDS, to bring awareness and behavioral change for better health and nutrition practices to improve the nutritional status of rural women. The mindset of looking at food security only in terms of energy security has now changed. It is important to ensure balanced diet which is adequate in micro and macro nutrients.

Table 6 Relationship between nutritional status (using BMI) and different independent variables.

| Variables | Correlation Co-efficient |
|---|---|
| Age | -0.0025$^{NS}$ |
| Education | 0.544** |
| Family Size | -0.114 |
| Land holding | 0.131 $^{NS}$ |
| No of children | -0.314* |
| Year of marriage | 0.147$^{NS}$ |
| Protein Consumption | 0.518* |
| Carbohydrate Consumption | 0.578* |
| Fat Consumption | 0.315* |
| Blood Pressure | 0.524** |

* 5 % level of significance, ** 1% level of significance, NS = Non Significant, df-98.

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