Section: Community Medicine

Original Research Article

NUTRITIONAL ADEQUACY AMONG ANTENATAL FEMALES AND ITS ASSOCIATION WITH SOCIO-DEMOGRAPHIC VARIABLES

Hira Alam[1], M. Athar Ansari[2], Tabassum Nawab[2], Nasreen Noor[3]

[1]*Junior Resident, Department of Community Medicine, Jawaharlal Nehru Medical College and Hospital, Aligarh, Uttar Pradesh, India.*
[2]*Professor, Department of Community Medicine, Jawaharlal Nehru Medical College and Hospital, Aligarh, Uttar Pradesh, India.*
[2]*Assistant Professor, Department of Community Medicine, Jawaharlal Nehru Medical College and Hospital, Aligarh, Uttar Pradesh, India.*
[3]*Associate Professor, Department of Obstetrics and Gynecology, Jawaharlal Nehru Medical College and Hospital, Aligarh, Uttar Pradesh, India.*

Received *: 08/07/2024*
Received in revised form *: 28/08/2024*
Accepted *: 13/09/2024*

Corresponding Author:
Dr. Hira Alam,
Junior Resident, Department of Community Medicine, Jawaharlal Nehru Medical College and Hospital, Aligarh, Uttar Pradesh, India.
Email: hiraalam42@gmail.com.

DOI: 10.70034/ijmedph.2024.3.123

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (3); 686-691

ABSTRACT

Nutritional Adequacy is defined as a sufficient intake of essential nutrients needed to fulfil nutritional requirements for optimal health. Good maternal nutrition is important for the health and reproductive performance of women and the health, survival, and development of their children. The study was conducted to assess nutritional adequacy and its sociodemographic correlates among antenatal females attending the ANC clinic. A cross-sectional study was conducted among 400 antenatal females with a gestational age of 24 weeks and beyond attending the ANC clinic of a tertiary hospital in North India, selected by systematic random sampling. Those who gave consent, having a singleton pregnancy, and having no pre-existing illnesses were included. Nutritional Adequacy for energy, protein, calcium, iron, vitamin A, and vitamin D was assessed by Nutrient Adequacy Ratio (NAR) using the 24-hour dietary recall method and subsequently Mean Adequacy Ratio (MAR). The mean NARs of energy and protein were found to be 80.6% and 56%, respectively. The mean NARs of calcium, iron, and vitamin A were 58.2%, 45.1%, and 6.4%, respectively. Vitamin D had a dismally low NAR, i.e., 0.28%. The Mean Adequacy Ratio of all six nutrients was found to be 41.0 ± 11.1, which means requirements for all six nutrients were met in only 41% of females. Maternal age, education, area of residence, occupation, and social class were found to be significant determinants of Nutritional Adequacy. From the study, it was concluded that Nutritional adequacy was met in only 41% of pregnant females, and it was also influenced by socio-demographic factors.

Keywords: Nutritional Adequacy, Socio-demographic, Antenatal women,
Theme: Maternal Health.

INTRODUCTION

Pregnancy is a critical period where adequate nutrition is needed for the healthy development of the fetus and the well-being of the mother.[1] Malnutrition during pregnancy can be defined as a condition where a pregnant woman's diet is insufficient in vital elements such as calories, proteins, vitamins, and minerals to support the fetus's growth and development. A variety of negative effects, including low birth weight, stunted growth, cognitive impairment, and an elevated risk of infections, may occur for both the mother and the child.[2] Prenatal malnutrition, according to Bhutta et al,[3] is considered to be the root cause of 800,000 infant fatalities per year. In India, 20% of all maternal deaths are caused by maternal malnutrition.[4]

Nutritional Adequacy is defined as a sufficient intake of essential nutrients needed to fulfil nutritional requirements for optimal health. Good maternal nutrition is important for the health and reproductive performance of women and the health, survival, and development of their children.

According to studies, a varied and sufficient diet is linked to better mother and foetal outcomes during

pregnancy,[5] also pregnant women who consumed a diverse diet got more of the essential elements folate, iron, and calcium than those who ate a less varied diet.

The majority of women in India are malnourished and poor. When compared to other developing nations, India has higher maternal and infant mortality rates. In the light of this fact, we need to improve the health of antenatal mothers in improving the health status. Therefore, understanding the dietary habits and nutritional adequacies of pregnant women in different settings is crucial in developing targeted interventions to improve maternal and fetal health outcomes.

The study aimed to assess nutritional adequacy and its sociodemographic correlates among antenatal females attending the ANC clinic.

MATERIAL AND METHODS

Study setting, sample size and sampling

This study is part of a larger cross-sectional study conducted from August 2021 to July 2022 among antenatal women attending antenatal clinic at a tertiary medical facility at Aligarh, North India.

Sample size was calculated using the formula-

N = [(1.96)2*P(1-P)]/L

Where P= Expected prevalence of adequate dietary diversity =18[6], L (Allowable error) = 4% and adding 10% non-response rate, final sample size calculated was 389.81 and round off to 400.

All the antenatal females of 24 weeks gestational age and beyond attending the ANC clinic and giving consent were included in the study whereas females with the twin pregnancy, those who did not give consent and those having Gestational Diabetes and overt Diabetes were excluded from the study.

Considering an average attendance of Antenatal clinic (ANC) as 150 females per day and 10 females to be interviewed per day, n was calculated as 150/10= 15.

One female was chosen randomly from list of first 15 registrations and then every 15th female registered was approached for interview, if she did not satisfy inclusion criteria then next in line was approached.

Study tools and variables

Predesigned Performa was used for entering patient's sociodemographic details and dietary intake was assessed by using 24-hour dietary recall method.

The recommended dietary allowances (RDA) of each item was calculated, according to **ICMR, NIN**, as shown below.

Recommended Dietary Allowance for Indians (ICMR-NIN, 2020),[7]

Categories	M
Calorie	Sedentary worker – 1660+350 = 2010 kcal/day
Protein	2nd trimester -46 g/day+ 9.5 = 55.5g/day 3rd trimester – 46g/day+ 22= 68g/day
Iron	27mg/day
Calcium	1000mg/day
Vitamin A	900µg/day
Vitamin D	600 IU/day

Nutritional Adequacy for macronutrients (energy and protein) and four micronutrients (calcium, iron, vitamin A, and vitamin D) were assessed by Nutrient Adequacy Ratio (NAR) and subsequently Mean Adequacy Ratio (MAR) was calculated.

The NAR is equal to the ratio of an individual's nutrient intake to the current recommended allowance of the nutrient for his or her age and sex and can be represented as a ratio or as a percentage **(ICMR, 2012).**

NAR =Average current intake / RDA

If the intake of a nutrient exceeds the RDA, the NAR is capped at 100% or 1, depending on whether it is expressed as a percentage or ratio. This prevents nutrients with very high intake (NAR value > 1) from masking nutrients with a very low intake (low NAR value) when they are averaged to calculate the MAR.[10]

MAR is calculated by averaging all the NAR values together.[11]

$$MAR = Sum\ of\ NAR \div Number\ of\ nutrients \times 100$$

The MAR is reported on a scale from 0 to 100% (or 1), where 100% (or 1) indicates the requirements for all the nutrients were met.

For studying its socio-demographic determinants, we dichotomized MAR into two groups -MAR more than or equal to 50 % and MAR less than 50%, as no standard and meaningful cut-off value was found in review of literature among Indian females.

Statistical Analysis: Data was analyzed using IBM SPSS 26.0 package (Statistical Package of Social Science). Descriptive statistics was carried out for qualitative variables showing Percentages and proportions, and for quantitative variables showing mean ± S.D. Chi square test was used to study association between categorical data and $p<0.05$ was considered to be statistically significant.

Ethical considerations: Approval for the study was obtained from the Institutional Ethical Committee. The women were informed about the nature of the study and consent was taken. Confidentiality was maintained. Appropriate health education and counseling was provided to all women.

RESULTS

As shown in Table 1, The Mean age of respondents was 25.03 ± 3.7. More than half (54.7%) of the pregnant females belonged to the age category of 21- 25 years followed by the age group of 26-30 years (28.5 %). Majority (79.5 %) of the pregnant females belonged to urban area while only 20.5 % resided in rural area. 82.7% of the pregnant females were followers of Islam while 16% followed Hinduism. 58.5% of females were able to read and write followed by 29.7% of females were educated up to primary level and above. Maximum number of the pregnant females were homemaker (95.8 %) while 4.2 % were working females. The husband's of 4.7 % of pregnant females were illiterate and 23.3 % , 24 % and 19.2 % had completed primary schooling , high schooling and Intermediate schooling , respectively. A professional degree was only held by 10.5% of husbands. The majority of the husbands worked in skilled occupations (41.8%), followed by unskilled occupations (37%). According to modified BG Prasad ,2021, most of the pregnant females belonged to middle class (28 %) followed by Lower Middle class (27.3%).

NUTRIENT ADEQUACY RATIO

The NAR of energy, protein, iron, calcium, vitamin A and vitamin D was found 80.6%, 56%, 58.2%, 45.1%, 6.4% and 0.28% respectively.

MEAN ADEQUACY RATIO (MAR)

The MAR is the average of the NAR, computed by summing the NAR and dividing by the number of nutrients, expressed as percentage. The Mean Adequacy Ratio of all the NARs (energy, protein, calcium, iron, Vitamin A and Vitamin D) was found to be 41.0 ± 11.1 or **41%.**

The ideal value of MAR is 1, or 100%, which signifies that all nutrients were consumed at the recommended levels. But none of the pregnant women in the study sample were able to achieve that.

As shown in Table 2, maximum (36.5%) of the pregnant females were having a MAR between 30 – 39 % , followed by (24.5%) of the females between 40-49%. Only 5.3 % of the females were having MAR % value 60- 70 %.

We also categorized pregnant females according to achievement of half the ideal recommended value i.e less than or more than and equal to 50%.

Only 70 (17.5%) of the pregnant females achieved equal to or more than 50% Mean Adequacy Ratio, as illustrated in Figure 1.

MAR does not serve as an accurate predictor of nutrient adequacy since it represents the average ratio of a total that includes all nutrient deficiencies, surpluses, and even adequacies. Because each nutrient has a unique level of adequacy, the mean of the total of the NARs can, in practice, conceal the true status of a given nutrient. For instance, MAR will be 100% representing ideal adequacy if the nutritional adequacy for calcium is 60% and that for iron is 140%. Higher levels of iron consumption conceal the lack of calcium.[11]

DETERMINANTS OF NUTRITIONAL ADEQUACY IN ANTENATAL FEMALES

As shown in Table 3, most of the pregnant females who had a Mean Adequacy ratio (MAR) ≥50 % belonged to the age group of ≥ 30 years followed by 26-30 years. The association between maternal age and adequacy was found to be statistically significant.

Those females who were literate (19.5%) and residing in Urban areas (19.5%) achieved 50 % criteria of MAR, and the association was found to be significant.

Our study also found that 16.6 % Muslim pregnant females and 21.7% non – Muslim pregnant females had 50 % MAR and no significant association was found between religion and nutritional adequacy.

As given in Table 3, Maternal occupation has a significant association with the adequacy as working (47.1%) pregnant females were more likely to achieve adequacy as compared to the homemakers (16.2%).

Females whose husbands had a professional degree (78.6%) and occupied in professional occupation (78.6%) were significantly associated with nutrient adequacy (p=0.000).

Socioeconomic class and MAR were shown to be significantly associated, with MAR being highest in the upper class (67.3%), followed by upper middle class (21.3%), and lowest in the lower class (2.6%).

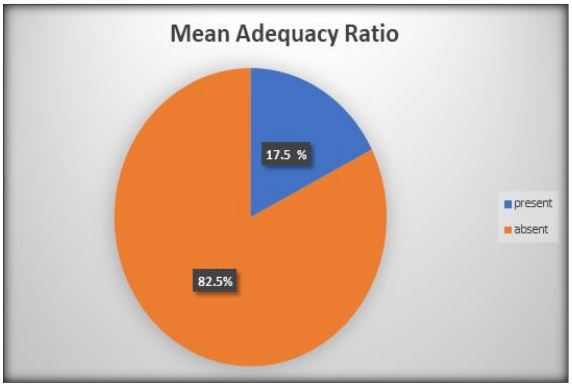

Figure 1: Proportion of pregnant females attending 50% Mean Adequacy Ratio (MAR)

Table 1: Distribution of Study Population According to Socio Demographic Profile (N=400)

	BACKGROUND CHARACTERSTICS	FREQUENCY (n)	PERCENTAGE (%)
MATERNAL AGE (IN YEARS)	≤ 20	33	8.3
	21- 25	219	54.7
	26-30	114	28.5
	>30	34	8.5

AREAOF RESIDENCE	**Rural**	82	20.5
	Urban	318	79.5
RELIGION	**Muslim**	331	82.7
	Hindu	64	16.0
	Others	05	1.3
MATERNAL EDUCATION	**Illiterate**	47	11.8
	Read and write only	234	58.5
	Primary school and above	119	29.7
MATERNAL OCCUPATION	**Homemaker**	383	95.8
	Working	17	4.2
HUSBAND'S EDUCATION	**Professional degree**	42	10.5
	Graduation	73	18.3
	Intermediate/ Diploma	77	19.2
	High school	96	24.0
	Primary school	93	23.3
	Illiterate	19	4.7
HUSBAND'S OCCUPATION	**Unemployed**	14	3.5
	Unskilled	148	37.0
	Skilled	167	41.8
	Semi-professional	29	7.2
	Professional	42	10.5
SOCIAL CLASS (MODIFIED BG PRASAD ,2021)	**Upper class**	52	13.0
	Upper Middle	89	22.2
	Middle class	112	28.0
	Lower Middle	109	27.3
	Lower class	38	9.5
TYPE OF FAMILY	**Nuclear**	118	29.5
	Joint	282	70.5

Table 2: Distribution of pregnant females according to MAR category (n= 400)

MAR (%)	N	(%)
<20	5	1.3
20.00 – 29.99	81	20.2
30.00-39.99	146	36.5
40.00-49.99	98	24.5
50.00-59.99	49	12.2
60.00-69.99	21	5.3
Total	**400**	**100**

Table 3: Nutritional Adequacy and its association with socio demographic variable

CHARACTERSTICS	MAR		TOTAL	
	Less than 50 % N (%)	**More than or equal to 50% N(%)**		
MATERNAL AGE (IN YEARS)				
≤ 20	29(87.9)	4(12.1)	33(100)	**χ^2=11.4, df=3, p=0.010**
21- 25	185(84.5)	34(15.5)	219(100)	
26-30	95(83.3)	19(16.7)	114(100)	
≥ 30	21(61.7)	13(38.3)	34(100)	
MATERNAL EDUCATION				
Literate	284(80.5)	69(19.5)	353(100%)	**χ^2=8.7, df=1, p=0.003**
Illiterate	46(97.9)	1(2.1)	47(100%)	
AREAOF RESIDENCE				
Rural	74(90.2)	8(9.8)	82(100)	**χ^2=4.28, df=1, p=0.038**
Urban	256(80.5)	62(19.5)	318(100)	
RELIGION				
Islam	276(83.4)	55(16.6)	331(100%)	χ^2=1.038, df=1, p=0.308
Hindu/ others	54(78.3)	15(21.7)	69(100%)	
MATERNAL OCCUPATION				
Homemaker	321(83.8)	62(16.2)	383(100%)	**χ^2=10.74, df=1, p=0.001**
Working	9(52.9)	8(47.1)	17(100)	
HUSBAND'S EDUCATION				
Professional degree	09(21.4)	33(78.6)	42(100%)	**χ^2=146.7, df=5, p=0.000**
Graduation	51(69.9)	22(20.1)	73(100%)	
Intermediate / Diploma	71(92.2)	06(7.8)	77(100%)	
High school	91(94.8)	05(5.2)	96(100%)	
Primary school	90(96.8)	03(3.2)	93(100%)	
Illiterate	18(94.7)	01(5.3)	19(100%)	
HUSBAND'S OCCUPATION				

Unemployed	14(100)	00(0.0)	14(100%)	**χ^2=138.6, df=4, p=0.000**
Unskilled	142(95.9)	6(4.1)	148(100%)	
Skilled	146(87.4)	21(12.6)	167(100%)	
Semi-professional	19(65.5)	10(34.5)	29(100%)	
Professional	09(21.4)	33(78.6)	42(100%)	
SOCIAL CLASS (MODIFIED BG PRASAD ,2021)				
Upper class	17(32.7)	35(67.3)	52(100%)	**χ^2=115.0, df=4, p=0.000**
Upper Middle	70(78.7)	19(21.3)	89(100%)	
Middle class	101(90.2)	11(9.8)	112(100%)	
Lower Middle	105(96.3)	04(3.7)	109(100%)	
Lower class	37(97.4)	01(2.6)	38(100%)	
TYPE OF FAMILY				
Nuclear	92(78.0)	26(22.0)	118(100%)	χ^2=2.38, df=1, p=0.123
Joint	238(84.4)	44(15.6)	282(100%)	

DISCUSSION

To the best of our knowledge, this study is one of the foremost studies to explore NAR and MAR among pregnant females of Uttar Pradesh, the most populous state of India. We found NAR and MAR to be very inadequate among the pregnant females thus priority towards need of urgent and continuous efforts to improve the same.

The mean NAR of energy was found to be 0.806 or 80.6% i.e the energy intake among study participants was 80 % of the RDA. Similar to our finding, Islam et al (2022) conducted a study among 972 lactating women in Bangladesh and found that the median NAR of energy was 0.85.[11]

Majili MZ et al (2017) conducted a cross sectional study in Tanzania among 270 adult population and found that the average intake of energy among participants was 2295.6 ± 264.6 Kcal with the mean NAR of 0.86.[12] Interestingly, Saaka et al (2020) in his study among 400 pregnant women in Ghana reported, the mean NAR of energy to be 100 %.[13]

The mean NAR of protein was found to be 0.56 or 56%. It means that the nutrient intake of protein among pregnant females is only 56% of the RDA.

Islam et al (2022) reported a median NAR of 2.47 which is very high as compared to our findings. Saaka et al (2020) in his study in Ghana reported that the average daily protein intake was 59.2±27.5g with the mean NAR of 80%. Majili MZ et al (2017) conducted a cross sectional study in Tanzania among 270 adult population and found that the average protein intake was 65.6 ± 11.5g with the mean NAR of 1.05 among the study participants.

The mean NAR of calcium was found to be 0.58 or 58.2%. Similar findings were found in a study carried out in Kenya by (Steyn et al, 2022). The average NAR for calcium was 56.7%.[14]

Likewise, Zhong et al (2022) conducted a cross-sectional study among (n= 775) pregnant women in urban China. Out of 15 nutrients assessed, the Mean Nutrient Adequacy Ratio of calcium was found to be 0.59 ± 0.29.[15] Also, in Southwest Ethiopia, 558 pregnant women participated in a community-based cross-sectional study by Forsido et al (2021), which reported that the calcium NAR was 0.50, or 50%.[16]

The mean Nutrient Adequacy Ratio of iron was found to be 0.45 or 45.1%. Similarly, Saaka et al (2020) in his study among 400 pregnant women in Ghana reported that the mean iron intake among study participants was 17.0 ± 8.6 and the mean NAR of iron was 56.7%. A higher result was found in a study conducted by Karimi et al (2022) among (n = 585) pregnant women. The mean intake of Iron (mg/d) was found to be 22.32 ± 15.64.[17]

Not similar to our finding, Zhong et al (2022) conducted a cross-sectional study among (n= 775) pregnant women in urban China and found that , the Mean Nutrient Adequacy Ratio of Iron was 0.76 ± 0.23. The NAR of iron was found to be 0.74 according to Forsido et al (2021) in a community-based cross-sectional survey of 558 pregnant women in Southwest Ethiopia.

The mean Nutrient Adequacy Ratio of Vitamin A was found to be 0.064 or 6.4% which is very low. Nguyen et al (2019) in his study calculated the nutritional intakes of 660 pregnant females in India found that the average of the probability of adequacy of vitamin A was less than 20%.

In three districts of Jimma Zone, Southwest Ethiopia, Forsido et al (2021) conducted a community-based cross-sectional survey and discovered that the NAR for vitamin A was 0.29, which is low.

The Mean Adequacy Ratio of all the six nutrients (energy, protein, calcium, iron, vitamin A and Vitamin D) was found to be 41.0 ± 11.1 or 41%. (Maximum- 68.7 and Minimum – 16.9).

The ideal value of MAR is 1, or 100%, which signifies that all nutrients were consumed at the recommended levels. But none of the pregnant women in the study sample were able to achieve that.

A study by Saaka et al (2020) involved 400 pregnant women in Ghana. Based on the 24-hour dietary recall, a nutrient adequacy ratio (NAR) of 14 nutrients and a mean adequacy ratio (MAR) were determined. As a general indicator of nutrient adequacy, the average MAR of 14 nutrients was calculated to be 68%. A higher value of MAR (0.72 or 72%) was found in a study conducted by Islam et al (2022) among 972 lactating women in Bangladesh. Only 70 (17.5%) of the pregnant

females had more than or equal to 50% Mean Adequacy Ratio, as illustrated in Fig 4, as compared to 330(82.5%), who had less than 50% MAR.

MAR does not serve as an accurate predictor of nutrient adequacy since it represents the average ratio of a total that includes all nutrient deficiencies, surpluses, and even adequacies. Because each nutrient has a unique level of adequacy, the mean of the total of the NARs can, in practice, conceal the true status of a given nutrient. For instance, MAR will be 100% representing ideal adequacy if the nutritional adequacy for calcium is 60% and that for iron is 140%. Higher levels of iron consumption conceal the lack of calcium. (Habte et al ,2016).[17]

CONCLUSION

This study demonstrates a positive relationship between nutritional adequacy and socio-demographic variables. Mean NARs for energy and nutrients such as protein, calcium, iron, vitamin A, and vitamin D were low. Fewer than 2 in 10 pregnant women had more than or equal to 50% Mean Adequacy Ratio.

Improving educational status of females and their spouses can improve nutritional adequacy.

Conflict of Interest: None

Funding: Nil.

REFERENCES

1. Ramakrishnan U, Lowe A, Vir S, Kumar S, Mohanraj R, Chaturvedi A, Noznesky EA, Martorell R, Mason JB. Public health interventions, barriers, and opportunities for improving maternal nutrition in India. Food and Nutrition Bulletin 2012 ;33(2_suppl1): S71-92.
2. World Health Organization. Malnutrition [Internet]. WHO; 2021 [cited 2023 Mar 13]. Available from: https://www.who.int/news-room/questions-and-answers/item/malnutrition
3. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Lancet [Internet] 2013;382(9890):452–77. Available from: http://dx.doi.org/10.1016/S0140-6736(13)60996-4 (Accessed on 11 March 23)
4. UNICEF. Maternal and Newborn Health Disparities in India [Internet]. UNICEF; 2018 [cited 2023 Mar 13]. Available from: https://www.unicef.org/india/media/1066/file/India%20Newborn%20and%20Maternal%20Health%20Disparities%20.pdf.
5. Darnton-Hill I, Mkparu UC. Micronutrients in pregnancy in low- and middle-income countries. Nutrients [Internet]. 2015;7(3):1744–68. Available from: http://dx.doi.org/10.3390/nu7031744 (Accessed on 13 Feb 23)
6. Nguyen PH, Kachwaha S, Avula R, Young M, Tran LM, Ghosh S, et al. Maternal nutrition practices in Uttar Pradesh, India: Role of key influential demand and supply factors. Matern Child Nutr [Internet]. 2019;15(4). Available from: http://dx.doi.org/10.1111/mcn.12839
7. ICMR-national institute of nutrition, India [Internet]. Res.in. [cited 2023 Mar 23]. Available from: https://www.nin.res.in/
8. Hatløy, A., Torheim, L. E. & Oshaug, A. (1998) Food variety—a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. Eur. J. Clin. Nutr 1998; 52:891–898
9. INDDEX Project (2018), Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA. https://inddex.nutrition.tufts.edu/data4diets (Accessed on 23 March 2023).
10. Islam S, Jubayer A, Nayan MM, Islam MH, Nowar A. Assessment of nutrient adequacy and associated factors among lactating women of rural Bangladesh using observed intake: Findings from Bangladesh Integrated Household Survey 2018-2019. Food Sci Nutr [Internet]. 2023;11(1):126–36. Available from: http://dx.doi.org/10.1002/fsn3.3044 (Accessed on 21 March 23)
11. S. MZ, R. P, N. B. Nutrient adequacy of foods consumed among adult population residing in urban parts of Dar-es-salaam, Tanzania. Int J Innov Res Dev [Internet]. 2017;6(12). Available from: http://dx.doi.org/10.24940/ijird/2017/v6/i12/dec17001
12. Saaka M. Dr. Adequacy of nutrient intakes among pregnant Women in Northern Ghana. World Nutr[Internet]. 2020;11(1):145–64. Available from: http://dx.doi.org/10.26596/wn.2020111145-164
13. Steyn N, Parker W, Nel JH, Rosemary A, Mbithe D. The nutrition transition and adequacy of the diet of pregnant women in Kenya. 2015 [cited 2023 Mar 21]; Available from: https://repository.hsrc.ac.za/handle/20.500.11910/3002
14. Zhong W, Zhao A, Lan H, Mao S, Li P, Jiang H, Wang P, Szeto IM, Zhang Y. Dietary Diversity, Micronutrient Adequacy and Bone Status during Pregnancy: A Study in Urban China from 2019 to 2020. Nutrients 2022 5;14(21):4690.
15. Forsido SF, Tadesse F, Belachew T, Hensel O. Maternal dietary practices, dietary diversity, and nutrient composition of diets of lactating mothers in Jimma Zone, Southwest Ethiopia. PLoS One [Internet]. 2021;16(7): e0254259. Available from: http://dx.doi.org/10.1371/journal.pone.0254259
16. Karimi T, Eini-Zinab H, Rezazadeh A, Moslemi Z. Maternal dietary diversity and nutritional adequacy in relation with anthropometric measurements of newborns at birth: a cohort study in Tehran city. BMC Pediatrics 2022;22(1):129.
17. Habte T, Krawinkel M. Dietary diversity score: A measure of nutritional adequacy or an indicator of healthy diet? Journal of Nutritional Health and Science 2016;3(3):303.