

Dietary Adequacy among Reproductive Aged Women Attending Urban and Rural Health Care Facilities Gharbia Governorate, Egypt

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ABSTRACT

Background: Women of reproductive age are central to the health of future generations, yet their diets are often inadequate. With excess energy intake alongside key micronutrients deficiencies.

Aim: This study assessed nutrient adequacy among reproductive aged women.

Subjects and methods: A cross-sectional study was conducted from January 2024 to June 2025 in urban and rural healthcare facilities, recruited 400 women aged 15–49 years selected by systematic random sampling. Data were collected through interviews, including sociodemographic information and 24-hour dietary recall. Nutrient adequacy was assessed against Dietary Reference Intakes (DRIs) using computer software SPSS and statistical analysis was performed with Chi-square, t-test, Monte Carlo, and Mann-Whitney U test ($p < 0.05$).

Results: Urban women represented (53.25%) had greater education (71.8%) and employment, whereas rural women represented (46.75%) were mostly housewives (58.8%), with lower income (40.1% vs. 21.1%) and limited food access (54.5% vs. 31.9%, $p < 0.001$). Overconsumption of energy, carbohydrates, and fat exceeds 50% in all reproductive stages, whereas urban pregnant women had significantly higher protein adequacy (70.8% vs. 57.9%, $p = 0.01$). Women had higher rates of micronutrient deficiencies (>50%) in most of micronutrients. Overweight and obesity were more common among non-pregnant women.

Conclusion: This study highlighted a double burden of malnutrition among women in all reproductive stages, with excessive intake of energy, fat, and carbohydrates which may contribute to overweight, alongside micronutrient deficiencies exceeding 50%. Targeted nutrition education, food fortification, and better access to affordable diverse foods are recommended to reduce these deficiencies.

Keywords: Nutritional Adequacy, Reproductive-Aged Women, Micronutrient Deficiency.

INTRODUCTION

Nutrient adequacy is the level of intake of an essential nutrient in relation to the nutrient requirement for adequate health, which is expressed as the percentage of recommended dietary allowance. It directly impacting overall health, particularly for women of reproductive age. Each nutrient serves a specific function, and requirements vary based on age, sex, physical activity level, and health status. Furthermore, individual differences in nutrient absorption and metabolism can lead to higher nutritional demands in certain people ⁽¹⁾.

A review of studies conducted from 2011 to 2021 in low- and middle-income countries found that Women of reproductive age (WRA) did not consume adequate amounts of essential micronutrients, particularly calcium, iron, zinc, vitamin A, thiamine, riboflavin, folate, and vitamin B₁₂. However, the intake of vitamin C, niacin, and vitamin B₆ was above the required levels ⁽²⁾.

In Egypt, data from the National Nutrition Institute (NNI) between 2015 and 2020 showed that most adult females consumed insufficient amounts of key nutrients such as potassium, calcium, magnesium, and

vitamin A. While vitamin C intake was generally adequate, the consumption of sodium, copper, and vitamin B₁ exceeded recommended levels. Alarming, intake of potassium, calcium, and magnesium fell below 50% of the recommended daily allowances ⁽³⁾.

Nutrients are divided into macronutrients and micronutrients, with each playing an important part in supporting human health. Macronutrients are huge amounts of carbs, proteins, and lipids that the body consumes and uses as its principal source of energy. They also serve as structural components for numerous tissues, directly adding to the body's caloric intake. A well-balanced intake of these macronutrients is required for good health and body function ⁽⁴⁾.

Micronutrients, on the other hand, are significantly lower in quantity but extremely important. These include vitamins (both fat-soluble and water-soluble) and minerals, which contribute little to calorie intake but are essential for maintaining important physiological functions. Micronutrients play a crucial role in supporting immunity, bone strength, metabolism, and

countless other functions necessary for survival and well-being ⁽⁵⁾.

The double burden of malnutrition refers to the coexistence of undernutrition (such as stunting, wasting, and micronutrient deficiencies) along with overweight, obesity, or diet-related non communicable diseases within the same population, household, or individual. It reflects a major global health challenge, particularly in low- and middle-income countries undergoing rapid nutrition and lifestyle transitions ⁽⁶⁾.

Women of reproductive age have critical nutritional needs that influence maternal and child health. Globally, they face the double burden of malnutrition, yet in Egypt few studies have assessed nutrient adequacy, particularly comparing urban and rural women across reproductive stages. This gap highlights the importance of investigating nutritional disparities to guide context-specific interventions.

Objectives:

- 1- To assess dietary adequacy among women at reproductive age attending urban and rural health care facilities at the different reproductive stages.
- 2- To identify the double burden of malnutrition among reproductive-aged women.

SUJECTS AND METHODS

The current investigation was conducted using a cross-sectional design. It followed the Strengthening Reporting of Observational Studies in Epidemiology (STROBE) recommendations. This ensures transparency and reproducibility in observational studies ⁽⁷⁾.

The Supplementary File) provides details on how these rules were applied. Adherence to STROBE helps ensure a methodical approach to study design, participant selection, data collection procedures, and statistical analysis, resulting in clarity and replicability.

STROBE Checklist (The Supplementary File)

Section	Item No.	Recommendation	Addressed in the Manuscript
Title and Abstract	1	Indicate the study's design with a commonly used term in the title or abstract and provide an informative and balanced summary of what was done and found.	Title and abstract clearly describe a cross-sectional study assessing dietary adequacy among reproductive-aged women in urban and rural Egypt.
Introduction	2	Explain the scientific background and rationale for the investigation being reported.	The introduction describes the importance of nutrient adequacy among women of reproductive age, the prevalence of deficiencies in Egypt, and the concept of the double burden of malnutrition.
	3	State specific objectives, including any prespecified hypotheses.	Clearly stated in "Objectives" section: to assess dietary adequacy and identify the double burden of malnutrition among reproductive-aged women.
Methods	4	Present key elements of study design early in the paper.	The study design (cross-sectional) is stated in the Methods section and referenced as adhering to STROBE guidelines.
	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	Conducted from January 2024 to June 2025 in two primary healthcare facilities (urban and rural) in El Mahalla El-Kubra, Gharbia Governorate.
	6	Give the eligibility criteria and the sources and methods of participant selection.	Inclusion and exclusion criteria are described under "Target population." Systematic random sampling was used.
	7	Clearly define all variables, including outcomes, exposures, predictors, potential confounders, and effect modifiers.	Nutrient adequacy (based on DRI), BMI, sociodemographic, and dietary intake variables are clearly defined.
	8	For each variable, provide data sources and details of measurement methods.	24-hour dietary recall and anthropometric measurements explained under "Tool of the study."
	9	Describe any efforts to address potential sources of bias.	Selection bias minimized by systematic random sampling; pilot study conducted to ensure clarity and feasibility.
	10	Explain how the study size was arrived at.	Sample size calculated using ($n = Z^2P(1-P)/d^2$) with 400 women included to account for missing data.
	11	Explain how quantitative variables were handled in analyses.	Nutrient adequacy categorized as insufficient (<75%), adequate (75–100%), or over (>100%) based on DRI.
	12	Describe all statistical methods, including those used to control for confounding.	Chi-square, Monte Carlo tests were used ($p < 0.05$).
Results	13	Report numbers of individuals at each stage of study.	400 women included (Urban = 213, Rural = 187); exclusions described in Methods (pilot participants excluded).
	14	Give characteristics of study participants (demographic, clinical, and social) and information exposures and potential confounders.	Table 1 provides detailed sociodemographic characteristics.
	15	Report numbers of outcome events or summary measures.	Tables 2–5 summarize nutrient adequacy and BMI distribution.
Discussion	17	Summarize key results with reference to study objectives.	The discussion restates key findings excess macronutrient intake and micronutrient deficiencies.
	18	Discuss limitations of the study, taking into account sources of potential bias or imprecision.	Addressed under "Strengths and Limitations," including recall bias and cross-sectional design limitations.
	19	Give a cautious overall interpretation of results considering objectives, limitations, and other relevant studies.	Comprehensive discussion comparing results with international studies
	20	Discuss the generalizability (external validity) of the study results.	Findings discussed in the context of Egypt and similar low- and middle-income countries.
Other Information	21	Give the source of funding and the role of the funders.	Funding: "None." Stated under "Declaration."
	22	Ethical approval and consent.	Ethical approval obtained from Tanta University (Code: 36264MS558/4/24); informed consent documented.

Study settings and duration:

The study ran from January 2024 to June 2025 and was conducted at two primary health care facilities: an urban comprehensive health center in El Mahalla El-Kubra City and a rural primary health care unit in Kafer Higazy village. Both facilities are located in El Mahalla El-Kubra district, the largest and most famous district in Gharbia Governorate in Egypt's Middle Delta region. According to the Central Agency for Public Mobilization and Statistics (CAPMAS) data from 2024, the population of El Mahalla El Kubra district was 826,692, including 407,004 females.

Target population

The study's target demographic consisted of reproductive age women attending primary health care facilities including non-pregnant, pregnant, and lactating.

Inclusion criteria:

The study included women of reproductive age (15-49 years old) who visited healthcare facilities in both urban and rural locations during data collection. The study comprised participants of all marital statuses, socioeconomic backgrounds, and educational levels.

Exclusion criteria:

The study excluded women with mental illnesses, major physical conditions (such as cancer, renal or hepatic failure), with chronic diseases, or dietary limitations (such as food allergies or intolerances). Additionally, women who reported fasting the day before the interview were eliminated.

Sample Size:

The minimal sample size for this investigation was derived using the following equation: $N = (1.96)^2 pq / d^2$. Whereas 1.96 is the critical value of z at the 95% confidence level. The population percentage (P) is equal to the prevalence of dietary diversity among women of reproductive age in both urban and rural areas, which is predicted to be 50% based on prior studies ⁽³⁾. q equals $1-p$, and d is the confidence range around the estimate of 0.05. The confidence interval (d) should not be more than 20% of the proportion (P). $n = Z^2 P(1-P) / d^2$. The sample size in both sections was 384, which was expanded to 400 to account for any missing data and improve the study's validity.

A systematic random sampling technique was employed to obtain the requisite random sample.

The number of monthly attendants at both facilities was around 1600 women and every 4th woman was selected after a random start.

Tool of the study:

Data were collected using a pre-designed interviewer questionnaire, the questionnaire included:

- a- Sociodemographic data: it includes participant age, residence, marital status, occupation, education level achieved and family income, reproductive status.

- b- Dietary history was used to assess dietary adequacy, which was determined based on 24-hour dietary recall data.

- a) Anthropometric measurements: Height was measured by a stadiometer a height measurement chart (0-200 cm) from the bottom of the feet to the highest point of the head back the wall, steady steady, look ahead, compressing hair to determine exact height.
- b) Weight was measured in kg using a digital weighing scale in kg get rid of heavy cloths, bare foot, steady on the scale and looking forward.
- c) BMI was computed by dividing weight by square height (Weight (kg) / Height (m²))

procedure:

By using the 24-hour recall method, participants were asked to describe the foods (meals and snacks) they ate the previous day and night whether at home or outside the home with their quantities and preparation method, starting with the first food eaten in the morning. All mentioned foods and drinks were recorded.

These data were analysed by the National Nutrition Institute in Cairo using specialized software and Egyptian food composition tables . Nutrient levels were then compared to Dietary Reference Intakes (DRIs) ⁽⁸⁾. Adequacy was classified based on intake:

From 75–100% of DRI as adequate, above 100% as excessive, and below 75% as insufficient. This method helps evaluate whether women's diets meet essential nutritional standards ⁽⁹⁾.

Validity assessment of the study tools:

Face and Content Validity:

The questionnaire underwent a rigorous validation process to ensure accuracy and usefulness. Face validity, assessed by three public health and nutrition experts, was 85%, leading to revisions for improved clarity and relevance. Cronbach's alpha for reliability was 0.870. A pilot study with 30 women (excluded from the main analysis) tested feasibility, completion time, and potential barriers. The average completion time ranged from 10 to 15 minutes.

Ethical consideration:

The current study adhered to the research ethical rules applied in Faculty of Medicine, Tanta University, throughout the whole period of implementation. Approval of the research protocol was obtained from the Ethical Committee of Tanta Faculty of Medicine before starting the study (Approval Code: 36264MS558/4/24). The purpose of the study was explained to participants before data collection, formal consent was obtained before conducting the study. Also, Confidentiality and privacy were guaranteed during the whole period of the study.

Statistical Analysis

- Sorting and analysis of data were performed by using Statistical Package for Social Sciences (SPSS) version 21. For quantitative data mean (M) $\pm$ standard deviation (SD) were calculated, and significance was tested whenever needed.
- For qualitative data, Chi-square test (χ^2) was used for comparison between two independent groups (diverse versus non-diverse diet). Monte Carlo test was applied when the assumptions of the Chi-square test were not met.

RESULTS

Among 400 women (Urban = 213, Rural = 187), urban women had higher education (71.8% university graduates) and more employment, while rural women were mostly housewives (58.8%). Insufficient income was more common among rural women (40.1% vs. 21.1%), and food access was easier in urban areas (68.1%), while rural women faced more price-related difficulties (54.5%). Significant urban–rural differences were observed in age ($p = 0.011$), education, occupation, income, and food availability (all $p < 0.001$) (table 1).

Table (1): Sociodemographic characteristics of reproductive aged women attending urban and rural health care facilities

Sociodemographic data	Urban N=213		Rural N=187		Total N=400		x^2	<i>p</i> value
	n	%	n	%	n	%		
Age (Years)								
< 20	6	2.8	14	7.6	20	5.0	11.15	0.011*
20 -	97	45.5	67	35.8	164	41.0		
30 -	94	44.1	79	42.2	173	43.2		
40 -	16	7.5	27	14.4	43	10.8		
Mean ± SD	29.8 ± 6.6		30.7± 7.38		30.26 ± 7.01		t = 1.4	0.162
Range	17-45		17-45		17-45			
Marital status								
Single	34	16.0	18	9.6	52	13.0	1.85	0.34
Married	173	81.2	163	87.2	336	84.0		
Ex -married	6	2.8	6	3.2	12	3.0		
Educational level								
Illiterate, read and write, primary	6	2.8	24	12.8	30	7.5	78.05	<0.001*
Secondary/ technical	54	25.4	95	50.8	149	37.3		
University	153	71.8	68	36.4	221	55.2		
Occupation								
Housewife	81	38.0	110	58.8	191	47.8	37.46	<0.001*
Manual worker	5	2.3	16	8.6	21	5.3		
Governmental employee	54	25.4	30	16.0	84	21.0		
Private employee	45	21.2	11	5.9	56	14.0		
Student	28	13.1	20	10.7	48	12.0		
Family income								
Not enough	45	21.1	75	40.1	120	30.0	27.6	<0.001*
just enough	135	63.4	95	50.8	230	57.5		
Enough and saving	33	15.5	17	9.1	50	12.5		
Reproductive state								
Non pregnant non lactating	127	59.6	121	64.7	248	62.0	1.30	0.52
Pregnant	45	21.2	32	17.1	77	19.3		
Lactating	41	19.2	34	18.2	75	18.7		
Availability of food staffs								
Available and easy to get it	145	68.1	85	45.5	230	57.5	19.34	<0.001*
Difficult to get it due to high prices	68	31.9	102	54.5	170	42.5		

χ^2 : chi square test, * p :<0.05(statistically significant), MCET: Monte Carlo exact test

Figure (1) shows a clear trend of excessive macronutrient consumption, particularly in fat and carbohydrates. Over-intake of fat reaches a striking 78.5%, while carbohydrates follow at 57.25%, indicating a dietary pattern heavily skewed toward energy-dense foods. In contrast, protein over-intake is minimal at just 2.75%, suggesting that while energy sources are consumed in excess, protein remains more balanced.

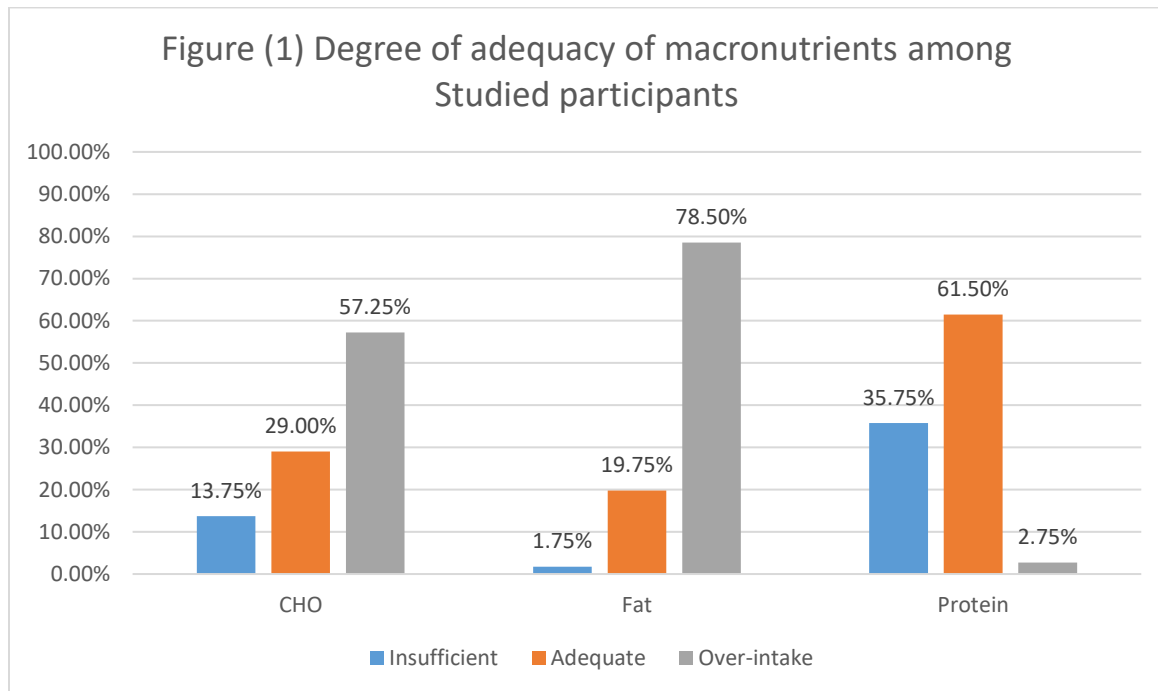


Figure (1): Degree of adequacy of micronutrients among the studied participants

Figure (2) reveals a significant public health concern for reproductive-aged women, with extremely high rates of insufficient intake for key nutrients: calcium (82.5%), magnesium (81.5%), iron (79.25%), vitamin A (74.5%), and potassium (67.5%). Adequate intake remains low across all nutrients.

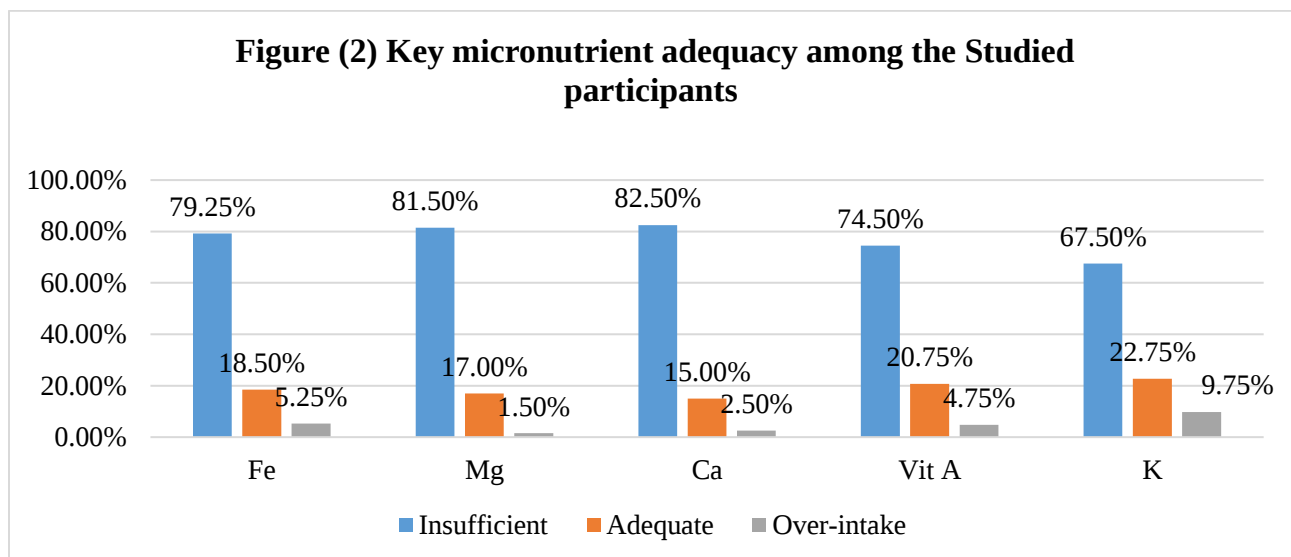


Figure (2): Key micronutrient adequacy among the studied participants.

Table (2) highlights nutrient adequacy among non-pregnant, non-lactating women attending urban and rural healthcare facilities. Overconsumption of energy was prevalent in both groups (53.5% urban, 52.1% rural). Excessive carbohydrate intake tended to be more common among rural women (63.6%) than urban (51.2%). Fat intake was similarly high in both groups. Sodium intake was significantly higher in rural women (78.5%) compared to urban (63.0%, $p = 0.02$). Insufficient intake of potassium, magnesium, calcium and iron across both groups more than 70 %.

Table (2): Nutrient adequacy among non-pregnant non lactating women attending urban and rural health care facilities (N= 248)

	Urban N= 127						Rural N=121						χ^2	p value
	Insufficient Intake		adequate intake		over intake		Insufficient intake		adequate intake		over intake			
	n	%	n	%	n	%	n	%	n	%	n	%		
Energy	18	14.2	41	32.3	68	53.5	13	10.7	45	37.2	63	52.1	1.06	0.59
Macro nutrient														
CHO	24	18.9	38	29.9	65	51.2	21	17.4	23	19.0	77	63.6	5.79	0.055
Fat	1	0.8	19	15.0	107	84.3	2	1.7	16	13.2	103	85.1	0.52	0.77
protein	40	31.5	83	65.3	4	3.2	51	42.1	70	57.9	0	0.0	MC	0.99
Micronutrient														
Na	21	16.5	26	20.5	80	63.0	9	7.4	17	14.0	95	78.5	7.82	0.02*
K	93	73.2	22	17.3	12	9.4	85	70.2	29	24.0	7	5.8	2.49	0.28
P	48	37.8	29	22.8	50	39.4	51	42.1	29	24.0	41	33.9	0.83	0.65
Cu	79	62.2	25	19.7	23	18.1	85	70.2	21	17.4	15	12.4	2.10	0.34
Mg	104	81.8	20	15.7	3	2.4	100	82.6	20	16.5	1	0.8	MC	0.63
Ca	105	82.7	19	15.0	3	2.4	106	87.6	12	9.9	3	2.5	MC	0.45
Iron	100	78.7	19	15.0	8	6.3	104	86.0	12	9.9	5	4.1	2.20	0.33
Zinc	46	36.2	36	28.3	45	35.4	60	49.6	33	27.3	28	23.1	5.79	0.05*
Vit A	90	70.8	32	25.2	5	4.0	95	78.5	22	18.2	4	3.3	MC	0.26
Vit C	43	34.0	48	37.7	36	28.3	53	43.8	42	34.7	26	21.5	3.75	0.15
B1	52	40.9	49	38.6	26	20.5	60	49.6	49	40.4	12	9.9	2.21	0.33
B2	38	29.9	47	37.0	42	33.1	39	32.2	55	45.5	27	22.3	1.54	0.46

χ^2 : Chi square test, *p:<0.05 Statistically significant, Na: Sodium, K: Potassium, Ca: Calcium, Mg: Magnesium, Fe: Iron, Zn: Zinc, B1: Thiamine, TB2: Riboflavin, MC: Montecarlo test.

Table (3) highlights nutrient adequacy among pregnant women in urban and rural healthcare facilities, showing notable dietary imbalances. There was no statistically significant difference between pregnant women at both localities for all studied nutrients. However, it was observed that there was an overconsumption of energy affected 60.0% of urban and 53.1% of rural women, while excessive carbohydrate intake was higher in urban women (64.4%) compared to rural women (53.1%). Fat intake was high in both groups (64.4% urban, 62.5% rural). Insufficient intake of potassium, magnesium, calcium and iron across both groups.

Table (3): Nutrient adequacy among pregnant women attending urban and rural health care facilities (N= 77)

	Urban N=45						Rural N=32						χ^2	p value
	Insufficient Intake		adequate intake		over intake		Insufficient intake		adequate intake		over intake			
	n	%	n	%	n	%	n	%	n	%	n	%		
Energy	4	8.9	14	31.1	27	60.0	6	18.8	9	28.1	17	53.1	1.61	0.45
Macro nutrient														
CHO	3	6.6	13	28.9	29	64.4	5	15.6	10	31.3	17	53.1	1.73	0.42
Fat	1	2.2	15	33.3	29	64.4	2	6.3	10	31.2	20	62.5	MC	0.67
protein	14	31.2	28	62.2	3	6.7	14	43.6	18	56.4	0	0.0	MC	0.16
Micronutrient														
Na	4	8.8	14	31.1	27	60.0	2	6.9	14	37.9	16	50.0	MC	0.56
K	26	57.8	13	28.9	6	13.3	20	62.5	11	34.4	1	3.1	MC	0.36
P	9	20.0	22	48.9	14	31.1	11	34.4	14	43.8	7	21.9	2.17	0.33
Cu	20	44.4	16	35.6	9	20.0	17	53.1	13	40.0	2	6.3	2.89	0.23
Mg	36	80.0	9	20.0	0	0.0	24	75.0	7	21.9	1	3.1	MC	0.65
Ca	35	77.8	8	17.8	2	4.4	24	75.0	7	21.9	1	3.1	MC	0.90
Iron	31	68.9	11	24.4	3	6.7	25	78.1	6	18.8	1	3.1	MC	0.64
Zinc	10	22.2	17	37.8	18	40.0	12	37.5	11	34.4	9	28.1	3.47	0.17
Vit A	31	68.9	8	17.8	6	13.3	24	75.0	5	15.6	3	9.4	0.40	0.81
Vit C	15	33.3	21	46.7	9	20.0	11	34.4	15	46.9	6	18.8	0.06	0.96
B1	14	31.1	20	44.4	11	24.5	12	37.5	15	46.9	5	15.6	1.63	0.44
B2	10	22.2	20	44.4	15	33.3	9	28.1	16	50.0	7	21.9	1.22	0.54

χ^2 : Chi square test, *p:<0.05 Statistically significant, MC: Montecarlo test, Na: Sodium, K: Potassium, Ca: Calcium, Mg: Magnesium, Fe: Iron, Zn: Zinc, B1: Thiamine, TB2: Riboflavin.

Table (4) shows that nutrient adequacy among lactating women at urban and rural health care facilities varies across nutrients. Over-intake of energy was more common among rural women (55.9%) compared to urban (43.9%). Carbohydrate and fat overconsumption exceeded 50% in both groups. Sodium was also frequently overconsumed, while potassium intake showed a statistically significant difference, with 73.5% of rural women having insufficient intake compared to 51.2% in urban areas ($p = 0.01$). Magnesium and calcium deficiency exceeded 75% in both groups, and iron insufficiency was widespread, especially among rural participants (79.4%).

Table (4): Nutrient adequacy among lactating women attending urban and rural health care facilities (N= 75)

	Urban N =41						Rural N = 34						χ^2	p value
	Insufficient Intake		adequate intake		over intake		Insufficient intake		adequate intake		over intake			
	n	%	n	%	n	%	n	%	n	%	n	%		
Energy	6	14.6	17	41.5	18	43.9	2	5.9	13	38.2	19	55.9	MC	0.40
Macro nutrient														
CHO	2	4.8	17	41.5	22	53.7	0	0.0	15	44.1	19	55.9	MC	0.57
Fat	1	2.4	10	24.4	30	73.1	0	0.0	9	26.5	25	73.5	MC	0.08
protein	11	26.8	26	63.4	4	9.8	13	38.3	21	61.7	0	0.0	2.24	0.134
Micronutrient														
Na	2	4.9	5	12.2	34	82.9	1	2.9	7	20.6	26	76.5	MC	0.63
K	21	51.2	14	34.1	6	14.6	25	73.5	2	5.9	7	20.6	8.84	0.01*
P	12	29.3	10	24.4	19	46.3	13	38.2	11	32.4	10	29.4	2.24	0.32
Cu	24	58.5	10	24.4	7	17.1	26	76.5	3	8.8	5	14.7	3.56	0.169
Mg	32	78.0	9	22.0	0	0.0	30	88.2	3	8.8	1	2.9	MC	0.45
Ca	31	75.6	10	24.4	0	0.0	29	85.3	4	11.8	1	2.9	MC	0.18
Iron	30	73.2	9	22.0	2	4.9	27	79.4	5	14.7	2	5.9	MC	0.83
Zinc	14	43.1	11	26.8	16	39.0	17	50.0	9	26.5	8	23.5	2.52	0.28
Vit A	30	73.2	10	24.4	1	2.4	28	82.4	6	17.6	0	0.0	MC	0.99
Vit C	13	31.7	19	43.9	9	22.0	13	38.2	14	41.2	7	20.6	1.54	0.46
B1	13	31.7	17	41.5	11	26.8	14	41.1	16	47.1	4	11.8	3.55	0.16
B2	10	24.4	16	39.0	15	36.6	10	29.4	15	44.1	9	26.5	0.48	0.78

χ^2 : Chi square test, * $p < 0.05$ Statistically significant, MC: Montecarlo test, Na: Sodium, K: Potassium, Ca: Calcium, Mg: Magnesium, Fe: Iron, Zn: Zinc, B1: Thiamine, TB2: Riboflavin.

Table (5) highlights differences in BMI among reproductive-aged women attending urban and rural healthcare facilities. The prevalence of overweight and obesity is notably high among reproductive-aged women in both urban and rural settings. Normal weight was more common among urban women (23.8%) compared to rural women (17.4%), while overweight was similarly distributed between urban (39.9%) and rural (38.7%) women. Obesity was slightly higher among rural women (43.9%) than urban women (36.3%).

Table (5): Anthropometric measurements among reproductive aged women attending urban and rural health care facilities

BMI (kg/m ²)	Urban N=168		Rural N=155		Total N=323		χ^2	p value
	n	%	n	%	n	%		
Normal weight	40	23.8	27	17.4	67	20.7	2.77	0.25
Overweight	67	39.9	60	38.7	127	39.3		
Obesity	61	36.3	68	43.9	129	39.9		

χ^2 : Chi square test, * $p < 0.05$ (statistically significant), t: Independent sample t test, **Exclude pregnant women in BMI, BMI: Body mass index.

DISCUSSION

The current study focuses on key dietary problems for reproductive-aged women in both urban and rural settings. Despite the apparent availability of food in some locations, the data indicate a complicated interplay between over nutrition and micronutrient deficiencies, sometimes known as hidden hunger and the double burden of malnutrition. High rates of overweight and obesity are associated with widespread shortages in critical vitamins and minerals, indicating poor nutritional quality rather than food quantity.

This study was conducted among reproductive-aged women attending urban and rural healthcare facilities in El Mahalla El-Kubra district, Middle Delta, Egypt, with the goal of assessing dietary adequacy across reproductive stages (non-pregnant, pregnant, and lactating) while comparing urban and rural populations. It is among the few Egyptian studies that address nutritional adequacy by both reproductive status and locality.

Key finding showed that despite consuming an excessive number of calories, fat, and carbohydrates. While, many women lacked iron, calcium, magnesium, and vitamin A. This syndrome is referred to as hidden hunger, particularly in rural regions. Overweight and obesity were prominent in both urban and rural areas. The cohabitation of overnutrition and undernutrition, known as the double burden of malnutrition, was seen throughout all reproductive stages and regions, with rural women being disproportionately affected. These findings highlight the importance of tailored nutritional therapy. Notably, this is the first study to classify women based on both urban-rural residency and reproductive status, providing a more complete picture of nutritional differences.

Nutrient adequacy reflects the extent to which dietary intake meets the body's needs, and its imbalance can predispose women of reproductive age to both deficiencies and diet-related chronic conditions. The current study revealed a notable imbalance in macronutrient intake among reproductive-aged women in El Mahalla El-Kubra. A substantial proportion of participants exceeded recommended levels for fat > 75% and carbohydrates (>50%), indicating a dietary pattern dominated by energy-dense, nutrient-poor foods. This trend was particularly due to high reliance on starchy food using excess margarine in food preparation and fried foods. Comparing data from the United States align more closely with the findings of the present study. **Miketinias et al.** ⁽¹⁰⁾ analysed dietary intake among women aged 20–44 years using NHANES data and found elevated consumption of energy and fat, especially among non-pregnant individuals. Carbohydrate intake remained high across reproductive stages, mirroring the overconsumption patterns observed in the current study.

Micronutrient deficiencies were common among the participants, with more than three-quarters of women reporting inadequate intakes of iron, magnesium, calcium, and vitamin A, and potassium intake also frequently insufficient. These findings are consistent with data from Egypt's National Nutrition Institute (NNI) from 2015 to 2020, which also showed insufficient intake of key nutrients ⁽³⁾.

Both urban and rural women at the current study showed similarly high intake of fats and carbohydrates, with no major differences in overall diet quality. Protein intake was slightly greater among urban women due to better income and food accessibility, while micronutrient levels were generally low across both groups. Similarly, **Martin et al.** ⁽¹¹⁾, from Australia, found that total diet quality did not differ significantly between urban and rural women in Australia. However, rural women exhibited higher macronutrient intake, potentially linked to greater lean meat consumption.

Deficiency rates were notably high among non-pregnant, non-lactating women, especially in rural areas. This is consistent with findings from **Ngassa et al.** ⁽¹²⁾ in Tanzania, where women outside the maternal health spotlight had high rates of micronutrient inadequacy due to poor dietary habits, particularly among younger and unmarried women, and their exclusion from nutrition programs may explain their limited intake and lack of guidance.

Pregnant women in the current study had significant micronutrient deficits, with iron deficiency reaching 78.1% among rural participants and vitamin A deficiency surpassing 75%. This could be attributed to higher physiological demands during pregnancy, a lack of understanding of nutrient-dense food sources, and poor nutritional guidance during prenatal care.

Similar findings have been recorded globally, with research such as **Yeneabat et al.** ⁽¹³⁾ in Ethiopia and **Bailey et al.** ⁽¹⁴⁾ in the United States both demonstrated that pregnant women commonly have inadequate intakes of essential micronutrients.

Lactating women, who have higher nutritional demands, had the highest magnesium and calcium deficits, with more than three-quarters of individuals suffering from inadequacy in both rural and urban areas. These findings are consistent with global evidence, as studies such as **Kaliwile et al.** ⁽¹⁵⁾ in Zambia and **Wang** ⁽¹⁶⁾ in China have found widespread inadequacy of essential micronutrients among lactating women, which is frequently linked to monotonous diets and a prioritization of infant feeding over maternal nutrition.

The current study highlights the combined burden of malnutrition, with reproductive-aged women suffering from both overweight (39.3%) obesity (39.9%) and widespread micronutrient deficiencies, particularly in iron, calcium, magnesium, and vitamin A > 65 %. Similar

patterns have been described globally, as reported by **Prithishkumar *et al.*** ⁽¹⁷⁾ in Vietnam and **Williams *et al.*** ⁽¹⁸⁾ across 55 low- and middle-income countries, where rising rates of overweight and obesity coexist with persistent micronutrient deficiencies. This highlights the widespread and complex challenge of addressing the double burden of malnutrition among women of reproductive age.

Although macronutrient intake was adequate, micronutrient intake was low, owing to poor dietary diversity and a lack of consumption of vitamin and mineral-rich food groups, preventing women from achieving their daily micronutrient requirements.

CONCLUSION AND RECOMMENDATIONS

This study found a double burden of malnutrition in reproductive-aged women, with overweight and obesity coexisting with widespread micronutrient deficiencies, including iron, calcium, magnesium, and vitamin A. Despite excessive calorie, fat, and carbohydrate consumption, dietary quality remained low, highlighting the critical need for tailored interventions. To address these nutritional challenges, it is critical to strengthen nutrition education and counseling during reproductive health visits, improve access to diverse and affordable nutrient-rich foods, particularly in rural areas, as well as implement food fortification strategies, and integrate maternal nutrition programs across all reproductive stages, including non-pregnancies.

STRENGTHS AND LIMITATIONS

This study is among the first in Egypt to assess nutrient adequacy by both reproductive stage and residence, with a relatively large sample size of 400 women selected through systematic random sampling, which improved representativeness. The use of validated dietary assessment tools ensured data reliability, and adherence to STROBE guidelines enhanced transparency and quality. However, reliance on a single 24-hour recall may not fully capture habitual intake, introducing recall bias. The cross-sectional design limits the ability to establish causal relationships between variables,

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REFERENCES

- Bhattacharjee S, Datta S, Ray K, Mukhopadhyay D (2016):** Nutrient adequacy and its correlation in a sub-Himalayan region of West Bengal, India. *J Fam Med Prim Care*, 5(2):314-319.
- Islam M, Nayan M, Jubayer A, Amin M (2024):** A review of the dietary diversity and micronutrient adequacy among the women of reproductive age in low- and middle-income countries. *Food Sci Nutr.*, 12(3):1367-79.
- Saleh S, Elsayed H, El Gezery H, Mostafa A (2022):** Micronutrient Intake Profile of Egyptian Women in Reproductive Ages. *Bull Natl Nutr Inst Arab Repub Egypt*, 60(2):212-41
- Carreiro AL, Dhillon J, Gordon S *et al.* (2016):** The Macronutrients, Appetite, and Energy Intake. *Annu Rev Nutr.*, 36:73-103. doi: 10.1146/annurev-nutr-121415-112624.
- Savarino G, Corsello A, Corsello G (2021):** Macronutrient balance and micronutrient amounts through growth and development. *Ital J Pediatr.*, 47(1):1-14.
- World Health Organization (2020):** The double burden of malnutrition: policy brief [Internet]. Geneva: World Health Organization. Available from: <https://www.who.int/publications/i/item/WHO-NMH-NHD-17.3>
- Ghaferi A, Schwartz T, Pawlik T (2021):** STROBE Reporting Guidelines for Observational Studies. *JAMA Surg.*, 156(6):577-578.
- World Health Organization (2004):** Vitamin and mineral requirements in human nutrition. 2nd ed. Geneva: World Health Organization. Available from: <https://www.who.int/publications/i/item/9241546123>
- Elshenawy A, Ahwal L, Eldeeb A, Hassan N (2021):** Dietary Habits and Adherence to Dietary Approaches to Treat Hypertension in Adults with High Blood Pressure: CSS. *J Adv Med Med Res.*, 199-205. DOI: 10.9734/jammr/2021/v33i2431236.
- Miketinias D, Luo H, Firth J *et al.* (2024):** Macronutrient and Micronutrient Intake Among US Women Aged 20 to 44 Years. *JAMA Netw Open*, 7(10):e2438460. doi: 10.1001/jamanetworkopen.2024.38460.
- Martin J, Moran L, Teede H *et al.* (2017):** Exploring diet quality between urban and rural dwelling women of reproductive age. *Nutrients*, 9(6):586. doi: 10.3390/nu9060586.
- Ngassa N, Masumo R, Hancy A *et al.* (2024):** Food and nutrient intake among non-pregnant, non-lactating women of reproductive age of Mbeya in Tanzania: A repeated 24-hour dietary recall. *PLOS Glob Public Health*, 4(12):e0004010. doi: 10.1371/journal.pgph.0004010.
- Yeneabab T, Adugna H, Asmamaw T *et al.* (2016):** Maternal dietary diversity and micronutrient adequacy during pregnancy and related factors in East Gojjam Zone, Northwest Ethiopia, 2016. *BMC Pregnancy Childbirth*, 19(1):173. doi: 10.1186/s12884-019-2299-2.
- Bailey R, Pac S, Fulgoni V *et al.* (2019):** Estimation of Total Usual Dietary Intakes of Pregnant Women in the United States. *JAMA Netw Open*, 2(6):e195967. doi: 10.1001/jamanetworkopen.2019.5967.
- Kaliwile C, Michelo C, Titcomb T *et al.* (2019):** Dietary Intake Patterns among Lactating and Non-Lactating Women of Reproductive Age in Rural Zambia. *Nutrients*, 11(2):288. doi: 10.3390/nu11020288.
- Wang D, Thielecke F, Fleith M *et al.* (2021):** Analysis of dietary patterns and nutritional adequacy in lactating women: a multicentre European cohort (ATLAS study). *J Nutr Sci.*, 10:e17. doi: 10.1017/jns.2021.7.
- Prithishkumar I, Sappani M, Ranjan V *et al.* (2024):** Double burden of malnutrition among women of reproductive age: Trends and determinants over the last 15 years in India. *PLoS One*, 19(6):e0304776. doi: 10.1371/journal.pone.0304776.
- Williams A, Guo J, Addo O *et al.* (2019):** Intraindividual double burden of overweight or obesity and micronutrient deficiencies or anemia among women of reproductive age in 17 population-based surveys. *Am J Clin Nutr.*, 112(1):468S-477S.