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An Intervention Program to Raise Nutritional Awareness of Reproductive-Age Females in a Rural District of Alexandria, Egypt

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ABSTRACT

The nutritional status of both males and females significantly affects their offspring's growth, development, and long-term health. The study aimed to assess the nutritional awareness of rural women in reproductive age and improve their nutrition status through a tailored educational intervention. It included 229 females in reproductive age were selected from Houd 10 by El-Nofoos Al-Raheema association. We collected information using a pre-designed questionnaire that included sociodemographic data, maternal health state, information, and nutritional habits during pregnancy and lactation. Blood samples for CBC, TSH, Lipid profile, stool analysis, and urine analysis were tested. Anthropometric and blood pressure measurements were done for all subjects. The educational sessions were given weekly for three months. To complete our intervention, a follow-up interview was done to evaluate the nutritional and health knowledge improvement. There was statistically significant difference in the women's pre- and post-intervention program information. The awareness of the targeted group has increased from 19.45% before the education program to almost 24% after the education program. Most of the targeted group had a low educational level, a high TG level, and normal cholesterol levels. All the participants in the study had anemia, and most were prediabetic. The targeted group's nutritional knowledge was low. The nutrition education intervention program raised the nutritional awareness of the target group. In conclusion; the nutrition education program's beneficial effects infer that focused interventions may raise maternal knowledge and, consequently, health outcomes. The results also emphasize the serious problems conveyed by low educational attainment, early marriage, unhealthy eating patterns, and high rate of chronic diseases.

Keywords: Reproductive age, Women's Health, Nutrition awareness, Nutrition education program.

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INTRODUCTION

Malnutrition and poor health outcomes remain significant public health challenges in many developing countries, including Egypt. **(UNICEF Egypt 2013)** Reproductive-age females (RAFs), 18-45 years old, represent a particularly vulnerable population group, as their nutritional status directly impacts their health and the health of their children. In rural Egypt, there are often discrepancies in the access to healthcare services, education, and healthy food, all of which put them at higher risk. **(American University in Cairo (2020)**

Despite the availability of wide-ranging health information, many RAFs in rural areas of Egypt still lack adequate nutritional knowledge. This deficit can lead to poor dietary practices, increased risk of malnutrition, and adverse health impacts that can directly affect their fertility, pregnancy outcomes, and long-term health. **(Salem M et al., 2019)**

The health and nutrition of RAFs play an extremely critical role in improving the well-being of both mothers and their children. Access to healthcare services and nutritional education is often limited in rural areas. Thus, targeted interventions are highly demanded to improve these women's overall health. **(Maugeri, A et al., 2024)**

In Egyptian rural, the socioeconomic background, lack of awareness, and cultural factors contribute significantly to poor nutritional practices and health outcomes among RAFs. **(Herbst CH et al., 2020)** Poor nutritional habits and inadequate knowledge of healthy dietary practices are often prevalent due to inadequate nutrition education, poor infrastructure, and limited healthcare services. **(Abd El-Fatah NK et al., 2022)**

Interventions to address nutritional awareness

Despite the global health recommendations and nutrition programs, there is still a significant gap in implementing effective interventions in rural communities in Egypt. Empowering women with the knowledge and tools they need is highly needed to make informed decisions about their nutrition, eventually leading to improved health outcomes and their families. **(Santoso MV et al., 2019)** Interventions should be context-specific, culturally appropriate, and community-driven to improve nutritional awareness among reproductive-age females. Such programs should integrate various educational tools and materials, including interactive workshops, play roles, posters with infographics and flyers, mobile health initiatives, and peer-led groups that engage local women in a way that resonates with their experiences. **(Soleman L et al. 2017)**

One study found that health education programs tailored to the local context, incorporating traditional knowledge and cultural sensitivities, were more successful in changing health behaviors. **(El-Sayed AR et al., 2016)**

Houd 10 is a residential area in Alexandria Governorate, specifically in the Montazah Second district. The area is characterized by a mix of residential and agricultural areas, and it is considered part of the rural surroundings of Alexandria. **(Alexandrian Governorate. Official website, 2024.)** Nutritional awareness in rural areas of Egypt can be considered relatively low. However, there have been gradual improvements in recent years due to increased efforts from health organizations, government programs, and non-governmental organizations (NGOs). **(Abd El-Fatah NK et al., 2022)**

The challenges faced in rural Egypt regarding nutrition are multifaceted and influenced by factors such as:

(1) limited access to education and health information and lack of formal education, which directly affects their ability to understand modern nutritional concepts. Also, there is a health literacy gap as there is often limited exposure to health and nutrition campaigns, especially in isolated areas, meaning many rural dwellers rely on traditional diets and local beliefs about food.

(2) Economic Constraints: The low-income levels make rural families rely on inexpensive, calorie-dense foods that are low in nutrients but high in fats and sugars and also lead to limited food variety, making their diets more monotonous, consisting mainly of starchy foods like bread, rice, and potatoes, with limited access to a diverse range of healthy foods.

(3) Traditional Dietary Habits are due to cultural influence and limited awareness of balanced diets.

(4) The i**mpact of Rural-Urban Migration:** As some rural residents migrate to urban areas for better opportunities, they may gain exposure to more diverse diets and nutrition programs, which could improve awareness. However, those who stay behind may continue to have limited access to new information and resources.

(5) Gender Disparities: Women, especially in rural areas, are often the primary caregivers and food preparers, yet they may have less access to information and resources about nutrition that

impact the nutritional choices they make for themselves and their offspring. **(Egypt Strategy Support Program 2024, Black RE et al., 2013)**

Despite all these factors, targeted interventions from the government, NGOs, and local health systems are beginning to make a difference, slowly increasing awareness about the importance of nutrition in rural areas. Continuing these efforts and addressing underlying socioeconomic and educational barriers will be essential for improving nutritional outcomes in these communities. **(El-Sayed AR et al., 2016)**

There is an urgent need for a detailed examination of local nutritional practices, health issues, and cultural background to bridge the gap in nutrition education and contribute to developing sustainable, community-based interventions. **(Soleman L et al., 2017)**

Therefore, this study aimed to raise the nutritional and health awareness of rural RAFs by assessing their nutritional status and degree of nutritional awareness, conducting a nutrition education program, and evaluating the awareness level of the intended population post-intervention. The findings from this study can be a model that may assist other rural areas in Egypt, contributing to more tremendous efforts to reduce health disparities and improve the quality of life for RAFs.

MATERIALS AND METHODS

Study design: A Quasi Experiment

Study setting: Houd 10, a rural area in the Al-Montazah district of Alexandria, Egypt. Two partners collaborated in the study: Al-Nofoos Al-Raheema Association. The Central Agency for Public Mobilization and Statistics

Sample type: purposive sample

Sample size: To determine the minimum sample size, a priori power analysis using (G*Power 3.1.9.4) for a two-tailed paired t-test was performed, indicating that the minimum sample size to yield a statistical power of 0.95 with an alpha of 0.05 and a medium effect size (0.3) is 147.

The study included 229 of RAFs whom the Al-Nofoos Al-Raheema Association selected. The study was conducted over three Months (February -March-April) in 2024.

All participants in the study took informed consent.

Phases of the program:

I. **Data Collection phase:** The data was collected from the targeted group using different methods, including 1. **Interviewing:** We used a pre-designed questionnaire. Each interview lasted 20 minutes. The following data were collected: sociodemographic data (Age, family size, education level, occupation, and income) and medical history (Presence of any chronic diseases, use of drugs during pregnancy, age at the occurrence of pregnancy, and family history). 2. **Anthropometric assessment, including** weight, height, waist circumference, and body mass index (BMI), were measured. 3. **Dietary assessment**: The dietary intake was recorded using a structured 24-hours recall, including the six food groups (fruits, vegetables, grains, meat and meat products, milk and milk products, and fats) and a short-form food frequency questionnaire. 4. **Blood pressure. 5. Biochemical testing, including** glycated hemoglobin **(**HbA1c), lipid profile, complete blood count (CBC), TSH, stool analysis, and urine analysis. 6. **A pre-intervention knowledge questionnaire** was used to assess the nutritional knowledge of the targeted group.

II. **The intervention program:**

Twelve education sessions were conducted for all participants, one session every week over three months, using various tools: posters, PowerPoint presentations, and educational messages through face-to-face interviews.

The women were assigned to three groups, each receiving an education session from a skilled, trained nutrition educator.

The education sessions covered main topics such as My Plate, dietary sources of macronutrients, nutrients needed to boost their immune system, obesity (risk factors, causes, and management), healthful tips during pregnancy, breastfeeding and complementary feeding good practices, healthy feeding habits for school children, iron (dietary sources, enhancers, and inhibitors), and some important principles of food safety.

III. **A post-intervention questionnaire** was used to reassess the targeted group's nutritional and knowledge and evaluate the effectiveness of the education program.

The maternal nutrition awareness questionnaire:

The questionnaire assesses the participants' nutritional awareness before and after a nutrition education program. It highlights knowledge about protein, fats, anemia, calcium, vitamin sources, and iron absorption. It focuses on the importance of fiber, hydration, plant-based fats, and understanding the nutritional role of eggs, milk, vegetables, and whole grains.

Validation of the awareness questionnaire

Validity with factor analysis: Exploratory factor analysis and factor loadings (EFA) using Rotation Method: Promax with Kaiser Normalization to determine factor loading for each item. Internal consistency was assessed by Cronbach alpha coefficients (α), inter-item correlations, and corrected item-total correlations. A Cronbach's α of .70 or higher indicates acceptable reliability. The goodness of fit was assessed according to the following criteria: root mean square error of approximation (RMSEA ≤ 0.10), comparative fit index (CFI and IFI > 0.90 or more desirably ≥ 0.95). The Pearson coefficient was used for Divergent validity. $P \leq 0.05$ was considered statistically significant.

Statistical analysis of the data

Data were analyzed with SPSS version 26 and (AMOS 26.0). Qualitative variables were presented as number and percent, whereas quantitative variables were presented as mean (SD). Marginal Homogeneity Test: This test analyzes the significance of the different stages. Paired t-test: For normally distributed quantitative variables, to compare between two periods.

Ethical considerations

The ethical committee of Pharos University in Alexandria approved the research, which followed international guidelines for research ethics. All women included in the study were informed about the purpose of the study, and oral consent was taken after explanation. Confidentiality of the collected data was considered. Any participant was free to withdraw from completing the study.

RESULTS AND DISCUSSION

Results

The socioeconomic data was illustrated in Table (1). The majority of the women were illiterate (43.2%), followed by those who could read and write (27.9%) and those with intermediate education (27.5%). A tiny percentage had a high education level (1.3%). Concerning women's work, most women were housewives (94.3%), with only a small percentage engaged in various types of employment (collectively 5.7%). Almost all the women were married (93.9%), while only a few were widowed (3.5%) or divorced (2.6%). Most women married between 18 and 35 (62.4%), while 37.1% married under 18. Regarding the age of first pregnancy, most women had their first pregnancy between ages 18–35 (71.2%), with 27.9% experiencing it under 18. A significant portion had their last pregnancy between ages 18–35 (88.2%), with only 9.2% having

it after age 35. Concerning the number of children, most women had 1–3 children (62.4%), and 36.7% had more than three children.

Table (1): Distribution of the studied women according to their socio-economic demographic data

Women information	No.	%
Education level		
Illiterate	**99**	**43.2**
read and write	**64**	**27.9**
Intermediate	**63**	**27.5**
High	**3**	**1.3**
Work		
Housewife	**216**	**94.3**
Worker with fixed salary	**1**	**0.4**
Employee	**4**	**1.7**
Worker with unfixed salary	**6**	**2.6**
Business	**2**	**0.9**
Others	**0**	**0.0**
Marital status		
Married	**215**	**93.9**
Widow	**8**	**3.5**
Divorced	**6**	**2.6**
Age of marriage		
< 18	**85**	**37.1**
18–35	**143**	**62.4**
> 35	**1**	**0.4**
Age of first pregnancy (n=229)		
No pregnancy	**2**	**0.9**
< 18	**64**	**27.9**
18–35	**163**	**71.2**
> 35	**0**	**0.0**
Age of last pregnancy (n=227)		
Don't know	**1**	**0.4**
< 18	**5**	**2.2**
18–35	**202**	**88.2**
> 35	**21**	**9.2**
Number of children (n=227)		
None	**2**	**0.9**
1–3	**143**	**62.4**
> 3	**84**	**36.7**

The results from Table 2 highlight the distribution of the studied women according to their health status, focusing on chronic diseases. 41.9% of women reported having chronic diseases, while 55.9% did not have any known chronic conditions. A small portion (2.2%) were unaware of their health status. Among those with chronic conditions, 22.9% reported having diabetes, reflecting a moderate prevalence of this condition. Hypertension was the most common disease reported, affecting 57.3% of those with chronic illnesses. A small percentage (4.2%) reported suffering from cardiovascular diseases, highlighting a less common but still notable health concern. Chronic liver and kidney disease conditions were reported by 5.2% of women with chronic diseases, representing smaller segments of the population dealing with systemic health issues. Finally, 55.2% reported "other" conditions, which included anemia, allergies, colonic disturbances, and dyslipidemia.

Table (2):Distribution of the studied women according to health status

Chronic diseases	No.	%
Don't know	5	2.2
No	128	55.9
Yes	96	41.9
Diabetes Mellitus	22	22.9
Hypertension	55	57.3
Cardiovascular diseases	4	4.2
Chronic liver disease	5	5.2
Chronic kidney disease	5	5.2
others	53	55.2

DM: Diabetes mellitus, HTN: Hypertension, CVD: Cardiovascular disease. Other: anemia, allergy, colonic disturbance, and dyslipidemia.

Maternal health information is illustrated in Table (3) as it shows a very low percentage of women who had gestational diabetes (0.44%). In comparison, Anemia and pregnancy-induced hypertension during pregnancy were high, as 64.7% and 38.6% of the females in this study had anemia and hypertension, respectively. About a quarter of the women did not receive antenatal care (27.31%), while 73.56% received antenatal care. Regarding folic acid supplementation during pregnancy, 66.5% received folic supplements, while nearly one-third of the women did not. Almost two-thirds of the studied females (70.48%) had a specialist during childbirth. However, 29.51% had childbirth without a specialist. The distribution is nearly even between normal labor (50.67%) and Caesarean section (49.33%).

Table (3): Distribution of the studied cases according to maternal health information perinatally

Maternal health information (n=227)	No.	%
Diseases during pregnancy		
Gestational diabetes	1	0.44
Anemia	174	64.7
pregnancy induced hypertension	88	38.7
Follow up during pregnancy (antenatal care)		
No	62	27.31
Yes	167	73.56
Folic supplement during pregnancy	151	66.52
Childbirth with a specialist doctor		
No	67	29.51
Yes	160	70.48
Type of childbirth		
Normal labor	115	50.67
Caesarean delivery	112	49.33

Table (4) provides an overview of the studied cases' family food habits, highlighting meal patterns, dietary preferences, and the presence of special dietary accommodations. Most consume fewer than three meals daily (68.1%), while only 2.2% eat more than three. While a positive majority (65.5%) have breakfast daily, the remaining 34.5% who skip breakfast could experience reduced energy levels and metabolic issues. The studied cases' families show a low percentage of daily salad (46.3%) and fruit consumption (32.8%); almost half of the families (48.5%) do not include diverse food groups in their meals. About 21.0% of families reported having a special member requiring a tailored diet, with children being the most common (50.0%).

Table (4): Distribution of the studied cases according to the family food habits

Family food habits	No.	%
Number of meals		
<3	**156**	**68.1**
3	**68**	**29.7**
>3	**5**	**2.2**
Have breakfast daily		
No	**79**	**34.5**
Yes	**150**	**65.5**
Salad daily		
No	**123**	**53.7**
Yes	**106**	**46.3**
Fruits		
No	**154**	**67.2**
Yes	**75**	**32.8**
Variety of food groups in meals		
No	**111**	**48.5**
Yes	**118**	**51.5**
Special member in the family		
No	**181**	**79.0**
Yes	**48**	**21.0**
IF yes	**(n=48)**	
Father	**21**	**43.7**
Mother	**3**	**6.3**
Children	**24**	**50.0**
food items offered to the special member? (can be > 1 item)	**(n=48)**	
Protein	**26**	**54.2**
Starch	**9**	**18.8**
Fat	**2**	**4.2**
Other food items	**21**	**43.8**

Table (5) presents an overview of maternal nutritional habits during pregnancy and lactation among the studied cases. Most women (95.15%) did not consume exceptional food during pregnancy and lactation, while 4.85% consumed exceptional food, with most opting for protein-rich foods (72.7%), while others included vegetables and fruits (27.3%). Notably, no women reported additional fats or carbohydrates in their special diet. 42.29% of women consumed dairy products during pregnancy. However, the majority did not prioritize dairy. A significant proportion of women (80.17%) ate the same food as their families during pregnancy and lactation. Conversely, 20.71% tried to tailor their diet. Concerning iron-rich food, 64.3% reported consuming iron-rich foods. Maternal knowledge reported that Eggplants (41.4%) and spinach (31.27%) were the most consumed iron-rich foods, followed by Apples (15.42%), Liver and organ meat (7.05%), Bananas and meat (4.4% each), Chicken and fish (1.32%), and Molasses (6.17%), while 27.7% were unaware of whether their diets included iron-rich foods.

Table (5): Distribution of the studied cases according to maternal nutritional habits during pregnancy and lactation

Maternal nutritional habits during pregnancy and lactation (n=227)	No.	%
Special food during pregnancy and lactation		
No	**216**	**95.15**
Yes	**11**	**4.85**
IF yes (n=11)		
Protein	**8**	**72.7**
Carbohydrates	**0**	**0.0**
Fat	**0**	**0.0**
Other	**3**	**27.3**
Vegetables and fruits daily during pregnancy	**74**	**32.59**
Dairy product during pregnancy	**96**	**42.29**
Maternal nutritional habits during pregnancy and lactation	**No.**	**%**
Eat the same food of the family during pregnancy and lactation		
No	**47**	**20.71**
Yes	**182**	**80.17**
Iron Rich food		
No	**83**	**36.56**
Yes	**146**	**64.3**
IF yes		
Apple	**35**	**15.42**
Banana	**10**	**4.4**
Liver and organ food	**16**	**7.05**
Meat	**10**	**4.4**
Chicken and fish	**3**	**1.32**
Eggplants	**94**	**41.4**
Spanish	**71**	**31.27**
Molasses	**14**	**6.17**
don't know	**63**	**27.7**

Table (6) shows the laboratory investigation results. The hematological analysis showed that most cases (89.1%) had normal white blood cell counts. In comparison, a small percentage showed low (7.0%) or high (3.9%) counts (<4 × 10^9/L), over half of the cases (52.4%) had low red blood cell counts (<4.5 × 10^{12}/L) with Mean ± SD: 4.49 ± 0.39, and only 47.2% had normal RBC levels. Alarmingly, almost half of the participants (52.4%) presented with low hemoglobin (<11.5 g/L), the majority of cases (92.1%) were within the normal range of platelet levels, 6.6% presented low white blood cell counts (<165 × 10^9/L). Regarding hemoglobin A1C (HbA1c), 82.1% were in the prediabetic range (<6), while 17.9% were diabetic (>6). The lipid profile shows a majority with normal cholesterol, triglycerides, and HDL levels, while elevated LDL (66.4%) and hypercholesterolemia (22.3%) highlight notable cardiovascular risks. Most cases (93.9%) showed normal thyroid function, with only 6.1% exhibiting hyperthyroidism (>4 mIU/L), with mean ± SD as 2.72 ± 6.46. Concerning the urine analysis results, most participants had no albumin, glucose, or parasites, while 12.7% exhibited abnormal PUS cells, and 36.2% had abnormal RBC levels, indicating possible urinary or renal issues. The stool analysis indicates that while most cases were parasite-free and over half showed no fat content, 69.0% had muscle fibers and varying levels of fat presence, suggesting potential digestive inefficiencies and malabsorption issues.

Table (6):Distribution of the studied cases according to laboratory investigation

Laboratory investigation (n=229)	No.	%
WBCs		
Low (<4 x 10^9/L)	**16**	**7.0**
Normal (4–10 x 10^9/L)	**204**	**89.1**
High (>10 x 10^9/L)	**9**	**3.9**
Mean ± SD.	**6.58 ± 1.95**	
RBC		
Low (<4.5x 10^{12}/L)	**120**	**52.4**
Normal (4.5–5.7 x 10^{12}/L)	**108**	**47.2**
High (>5.7 x 10^{12}/L)	**1**	**0.4**
Mean ± SD.	**4.49 ± 0.39**	
HGB		
Low (<11.5 g/L)	**229**	**100.0**
Normal (11.5–16.7 g/L)	**0**	**0.0**
High (>16.7 g/L)	**0**	**0.0**
Mean ± SD.	**10.30 ± 2.72**	
PLT		
Low <165 x 10^9/L	**15**	**6.6**
Normal (165–415 x 10^9/L)	**211**	**92.1**
High (>415 x 10^9/L)	**3**	**1.3**
Mean ± SD.	**261.56 ± 64.97**	
HBA1C		
Pre diabetes < 6	**188**	**82.1**
Diabetes > 6	**41**	**17.9**
Mean ± SD.	**5.78 ± 1.15**	
Cholesterol		
Normal < 200 mg/dL	**178**	**77.7**
Hyper cholesterolemia > 200 mg/dL	**51**	**22.3**
Mean ± SD.	**177.22 ± 38.04**	
TG		
Normal < 150 mg/dL	**219**	**95.6**
Hyper triglyceridemia > 150	**10**	**4.4**
Mean ± SD.	**82.27 ± 35.33**	
HDL		
Normal < 50 mg/dL	**168**	**73.4**
High HDL > 50 mg/dL	**61**	**26.6**
Mean ± SD.	**47.39 ± 11.79**	
LDL		
Normal < 100 mg/dL	**77**	**33.6**
> 100 mg/dL	**152**	**66.4**
Mean ± SD.	**114.29 ± 32.01**	
TSH		
Normal 0.4 - 4 mIU/L.	**215**	**93.9**
Hyperthyroidism > 4 mIU/L.	**14**	**6.1**
Mean ± SD.	**2.72 ± 6.46**	

Urine analysis	No.	%
Albumin		
Absent	227	99.1
Present	2	0.9
Glucose		
Absent	221	96.5
Present	8	3.5
Acetone		
Absent	229	100.0
Present	0	0.0
PUS Cell		
<10 Normal	200	87.3
>10 Abnormal	29	12.7
RBCS		
<5 Normal	146	63.8
>5 Abnormal	83	36.2
Parasite (Ova)		
Nil	229	100.0
Stool analysis	**No.**	**%**
Fat		
Nil	122	53.3
Few	47	20.5
+	42	18.3
+ +	12	5.2
+ ++	6	2.6
Ova		
Nil	226	98.7
Few	3	1.3
Muscle		
Nil	11	4.8
few	44	19.2
+	158	69.0
+ +	15	6.6
+ ++	1	0.4
PUS		
Absent	229	100.0
Present	0	0.0
Nil	229	100.0

Figure (1): The distribution of the studied cases according to BMI

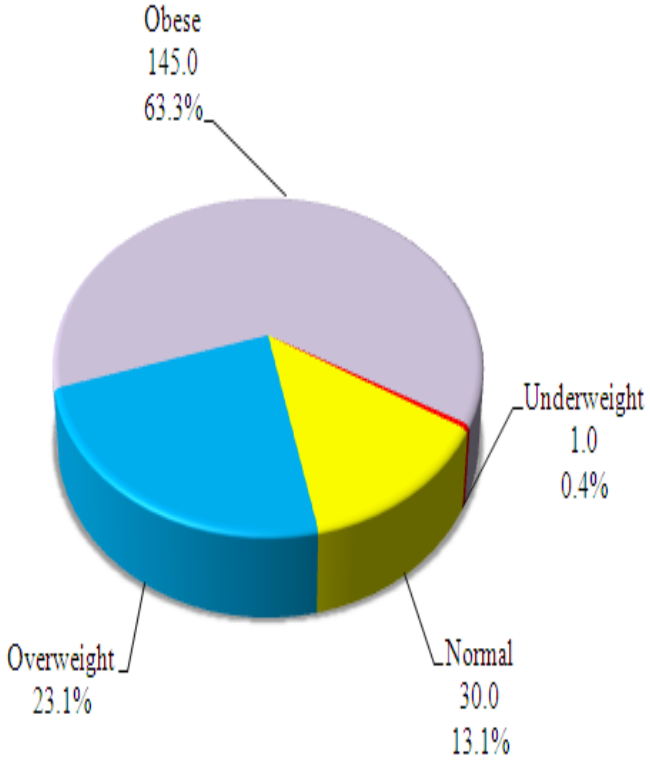

Figure (1) shows the distribution of the studied cases according to BMI. 63.3% were obese, 23.1% were overweight, 13.1% were normal, and 0.4% were underweight, with the mean ± SD at 33.34 ± 7.66

Figure (2): The distribution of the studied cases according to waist circumference

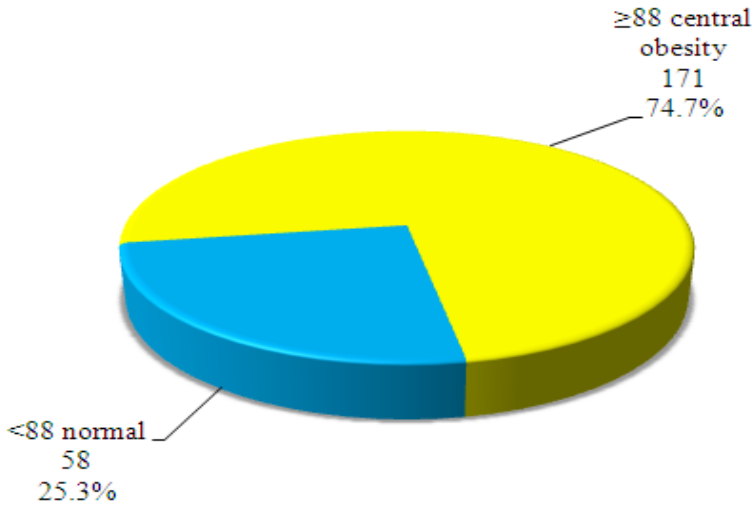

Figure (2) shows the distribution of the studied cases according to waist circumference. 25.3% had waist circumference <88 cm, while 74.6% were centrally obese with waist circumference ≥88 cm.

VIII. The nutritional awareness before and after the nutrition education program

The results from Table (7) and Figure (3) reveal the changes in maternal nutritional awareness before and after the nutrition education program. Significant ($p \leq 0.05$) improvements were observed in women's understanding of the key nutritional topics post-program. The awareness score increased from 19.14 ± 3.13 to 23.91 ± 3.75. Awareness of critical concepts such as iron absorption, the role of calcium in bone health, and the benefits of vitamins showed substantial gains. The program successfully addressed misconceptions; for example, the belief that anemia is caused by fat deficiency decreased from 11.8% pre-program to 4.8% post-program. Similarly, recognition of the importance of fiber in reducing cardiovascular disease risks increased from 42.4% to 80.8%.

Figure (3): the nutritional awareness before and after the nutrition education program

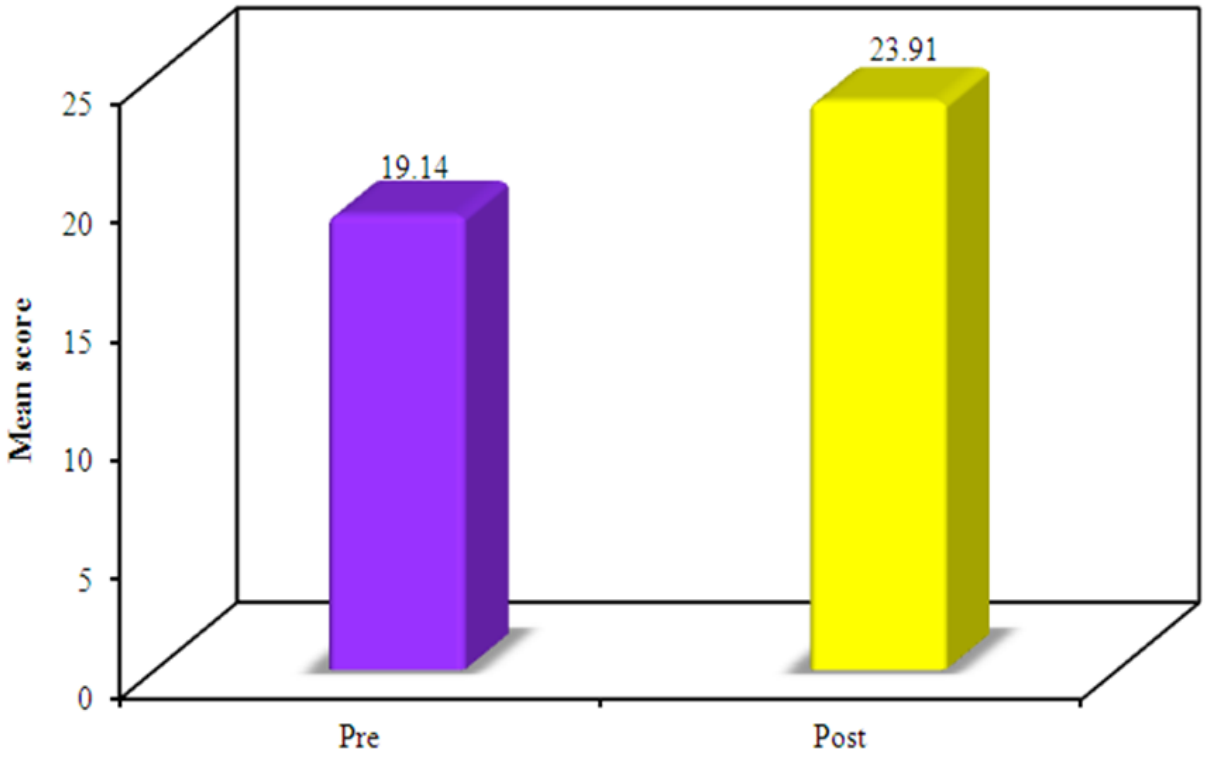

Table (7): The nutritional awareness of the participants before and after the nutrition education program.

The nutritional awareness	Pre						Post						p
	Yes		No		Don't know		Yes		No		Don't know		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Protein source of energy	170	74.2	24	10.5	35	15.3	209	91.3	15	6.6	5	2.2	<0.001*
Fats is necessary for building tissues	38	16.6	148	64.6	43	18.8	44	19.2	176	76.9	9	3.9	<0.001*
Anemia occurs due to a deficiency of fats in body	27	11.8	162	70.7	40	17.5	33	14.4	185	80.8	11	4.8	0.001*
Ca and PH need to build teeth and bones	188	82.1	7	3.1	34	14.8	221	96.5	6	2.6	2	0.9	<0.001*
Leafy veg, rich source of vit c	92	40.2	24	10.5	113	49.3	198	86.5	6	2.6	25	10.9	<0.001*
Breads and grains product good source of iron	60	26.2	101	44.1	68	29.7	80	34.9	138	60.3	11	4.8	<0.001*
Coffee drinks factors that prevent the absorption of iron	142	62.0	29	12.7	58	25.3	204	89.1	17	7.4	8	3.5	<0.001*
Egg is source of cholesterol	85	37.1	61	26.6	83	36.2	99	43.2	116	50.7	14	6.1	<0.001*
Vit D increase the absorption of Ca	67	29.3	16	7.0	146	63.8	173	75.5	18	7.9	38	16.6	<0.001*
No need for energy in the case of rest	100	43.7	92	40.2	37	16.2	150	65.5	73	31.9	6	2.6	<0.001*
The benefits of fiber decrease CVD	97	42.4	32	14.0	100	43.7	185	80.8	21	9.2	23	10.0	<0.001*
Tired -pallor -laziness is symptoms of anemia	197	86.0	12	5.2	20	8.7	226	98.7	1	0.4	2	0.9	<0.001*
Ca deficiency cause of OA	194	84.7	9	3.9	26	11.4	226	98.7	2	0.9	1	0.4	<0.001*
Meats rich source of Ca	81	35.4	90	39.3	58	25.3	69	30.1	152	66.4	8	3.5	0.008*
Vit needs for growth and reproductive	207	90.4	5	2.2	17	7.4	225	98.3	2	0.9	2	0.9	<0.001*
Main function of iron is RBCS synthesis and hemoglobin	103	45.0	5	2.2	121	52.8	192	83.8	7	3.1	30	13.1	<0.001*
Milk is low in iron	75	32.8	94	41.0	60	26.2	58	25.3	163	71.2	8	3.5	0.010*
2/3 needs of human should be from plant fats and the rest 1/3 from animals' sources	76	33.2	48	21.0	105	45.9	79	34.5	114	49.8	36	15.7	<0.001*
pickles lead to rise blood pressure	193	84.3	11	4.8	25	10.9	219	95.6	7	3.1	3	1.3	<0.001*
Not having breakfast may have bad consequences on the child	221	96.5	6	2.6	2	0.9	220	96.1	8	3.5	1	0.4	1.000
Should eat veg daily	208	90.8	19	8.3	2	0.9	225	98.3	4	1.7	0	0.0	<0.001*
Adults should drink 2-3 l per day	191	83.4	18	7.9	20	8.7	224	97.8	4	1.7	1	0.4	<0.001*
Egg is alternatives of meat	132	57.6	69	30.1	28	12.2	191	83.4	34	14.8	4	1.7	<0.001*
Folic acid is one type of vit B important during Pregnancy	127	55.5	11	4.8	91	39.7	204	89.1	4	1.7	21	9.2	<0.001*
Vit A improves vision	137	59.8	9	3.9	83	36.2	216	94.3	2	0.9	11	4.8	<0.001*
Milk is a good source of ca	209	91.3	5	2.2	15	6.6	226	98.7	3	1.3	0	0.0	<0.001*
Total score													
Min. – Max.	8.0 – 26.0						16.0 – 28.0						
Mean ± SD.	19.14 ± 3.13						23.91 ± 3.75						<0.001*
Median (IQR)	20.0 (17.0–21.0)						24.0 (21.0–28.0)						

OA: osteoarthritis, CVD: cardiovascular disease, Ca: calcium. MH: Marginal Homogeneity Test for comparing pre and postt: Paired t-test for comparing pre and post. *: Statistically significant at $p \leq 0.05$

DISCUSSION

The results of this study provided valuable insights into the socioeconomic, demographic, and health characteristics of women, the maternal nutritional habits during pregnancy and lactation, and the influence of nutrition education on the level of awareness. This study aimed to assess the nutritional awareness of rural women of reproductive age and improve their nutrition status through a tailored educational intervention. The population in this study predominantly consisted of women with low levels of education, as 43.2% of women were illiterate, and 27.9% had only basic literacy skills. This finding is consistent with a study by **Wagstaff et al., 2002** in low-resource settings, where lower educational attainment often correlates with limited access to healthcare and health-related information. Moreover, a recent study by **J Munir et al., 2023** showed a positive correlation between socioeconomic status and education level.

The predominance of housewives (94.3%) suggests that a significant proportion of women may not be engaged in the formal labor market, potentially influencing their economic status and access to healthcare services. A study by **Khan et al., 2013** also showed that the high percentage of married women (93.9%) aligns with traditional family structures in many developing regions where early marriage remains prevalent, especially in rural areas.

The age at marriage and first pregnancy observed in our study (62.4% married between 18-35 years, 71.2% had first pregnancy at this age) highlights the widespread early marriage and childbearing in rural areas, which has been associated with higher maternal and infant morbidity risks a result that coincides with a study by **Rahman et al., 2016.** Another study in Menofia, Egypt, concluded that early marriage has a wide prevalence in the selected areas. It was more prevalent among low-educated women, housewives, and married to low-educated husbands, leading to different social and health consequences for women and their children. **(Farahat TM et al., 2019)** Early marriage is a prevailing problem that needs an early and efficient plan of action to implement with the support of the stakeholders.

The high prevalence of chronic diseases, particularly hypertension (57.3%) and diabetes mellitus (22.9%), in this study, is alarming, as these conditions pose substantial risks during pregnancy and childbirth. However, according to a survey done by the Central Agency of Public Mobilization and Statistics in 2015 (**CAPMAS 2015**) regarding the economic cost of gender-based violence, 61.2% of women aged (18-64 years) reported having no health problems, while 24.1% had chronic diseases such as diabetes, hypertension, and heart disease.

The fact that the participants reported having diseases during pregnancy, including anemia (64.7%) and pregnancy induced hypertension (38.7%), further underscores the burden of non-communicable diseases on maternal health in our study. A finding consistent with a meta-analysis by **A Azzam et al., 2025** that found 49% anemia prevalence in pregnant Egyptian women, indicating severe health concern based on WHO criteria concluding the key determinants include maternal age over 30, rural residence, illiteracy, short birth spacing, insufficient iron supplementation, intestinal parasites, multiparity, low income, and limited antenatal care which are almost similar to the risk factors in our targeted group (21). An early study by **Kersten, I et al., 2014** found that every fifth pregnant woman suffers from at least one chronic disease.

This study showed that about 73.56% of the women attended prenatal care, and 70.48% had childbirth under a specialist doctor's supervision, reflecting positive trends in maternal healthcare utilization. However, there was nearly equal distribution between natural childbirth and cesarean section (50.67% vs. 49.33%). At the same time, the results, according to EDHS, showed that the

cesarean delivery rate increased from 28 % in 2008 to 52 % in 2014 and reached 72.2 %, according to the **Egypt Family Health Survey 2021 (EFHS 2021)**.

The limited consumption of special foods during pregnancy and lactation (95%) and the low intake of vegetables and fruits (32.3%) further emphasize the inadequate nutritional practices observed in this population. The study showed an evident deficiency in main micronutrients, as evidenced by the high rates of anemia during pregnancy. More than half the targeted group takes folate supplementation, a positive aspect (65.9%). However, despite being reported as part of the diet by 63.8% of mothers, iron-rich foods remain insufficient, further exacerbating the risk of iron deficiency anemia.

A critical point in this study was assessing maternal nutritional awareness before and after a nutrition educational program. The evident increase in maternal awareness, from 19.45% pre-intervention to 24% post-intervention, demonstrates the impact of nutrition education in improving maternal knowledge and potentially influencing dietary habits. This coincides with a study by **Talib Eidan, A. et al., 2020** which concluded that following the interventional program on nutrition-related health, the level of knowledge among the mothers in the study group was enhanced, and the study suggested that the nutrition education program should be offered to all moms in order to enhance their understanding and enthusiasm regarding the significance of child nutrition. Similar findings from a study by **Prasetyo, Y.B. et al. 2023,** which concluded that nutrition education programs for mothers are essential in improving children's nutritional status and nutrition education will increase mothers' awareness and knowledge in choosing adequate and safe food products and how to introduce good food to her children so that it can prevent nutritional problems among them.

The laboratory findings suggest a high prevalence of abnormal lipid profiles, with 66.4% of women having high levels of LDL cholesterol, which can increase the risk of cardiovascular diseases. The high BMI of 63.3% of the women, which falls into the obesity category, further adds to concerns about metabolic health. Similarly, 74.6% of the women had a waist circumference, which indicates central obesity, which is associated with insulin resistance and other metabolic disorders.

CONCLUSIONS

This study provides a comprehensive overview of the socioeconomic, demographic, health, and nutritional factors affecting maternal health. The findings highlight the significant challenges resulting from low educational levels, early marriage, poor dietary habits, and high prevalence of chronic diseases. The positive impact of the nutrition education program suggests that targeted interventions can improve maternal nutrition awareness and, by extension, health outcomes. Future research should focus on developing and implementing community-based nutrition education programs, focusing on increasing access to quality prenatal care, improving dietary diversity, and addressing the high burden of anemia and obesity among the participants.

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