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MATERNAL NUTRITION KNOWLEDGE AND MOTHERS' ABILITY TO UTILIZE MOBILE PHONE APPLICATION FOR HEALTH INFORMATION SHARING AT KENYATTA NATIONAL HOSPITAL, NAIROBI CITY, KENYA

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ABSTRACT

The prevalence of maternal undernutrition has been reduced via numerous interventions, but it remains a global public health concern in underdeveloped countries. Pregnant women are increasingly using mobile phone applications to obtain, save, and share health information. This study evaluated maternal nutrition knowledge for the purposes of developing a mobile phone application-based health information sharing platform for pregnant women attending ante-natal care at Kenyatta National Hospital in Nairobi, Kenya. The study adopted cross-sectional descriptive and analytical study design. A food frequency and individual dietary diversity questionnaires were used to gather data on dietary consumption and diversity, while a semi-structured questionnaire was used to gather sociodemographic information from respondents who attended the antenatal clinic. Approximately 31.2% of respondents exhibited a high level of knowledge regarding mobile phone applications. Half of the participants (50.1%) demonstrated a moderate level of understanding, whereas 18.7% showed a low level of familiarity with mobile phone applications. About 19.9% met the minimum dietary diversity score, while 12.2% met the minimum meal frequency, and 26.7% met the minimum acceptable diet. Based on Mid-Upper Arm Circumference, 60% of the pregnant women had normal nutritional status, 36.9% moderate acute malnutrition while 3.1% had severe acute malnutrition. Significant association was observed between dietary diversity score and mobile phone application knowledge $p < 0.001$. Additionally, nutritional status $p < 0.05$ and level of education $p < 0.05$, and mobile phone application knowledge of pregnant women showed significant associations. Despite the growing number of mHealth apps, the level of knowledge and usability of such apps by patients still remains relatively low. Nevertheless, the majority who used health apps found them to be beneficial, and agreed that it helped them to live a healthier lifestyle. Health apps have great potential in health promotion and therefore, to increase the use of these apps, it is necessary to first increase awareness and knowledge of these apps, both to the public and to healthcare professionals.

Key words: Mobile phone application knowledge, Maternal nutrition status, Maternal Diet

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INTRODUCTION

Globally, maternal malnutrition remains a significant public health concern in developing countries, prompting the implementation of various interventions that aim at reducing its prevalence [1]. Evidence suggests that effective utilization of mobile phone applications may contribute to alleviating maternal malnutrition [2]. Maternal malnutrition is widespread in low-income and middle-income nations, leading to a significant rise in mortality rates and an increased overall burden of disease [3].

An expectant woman who consumes inadequate amounts of low-quality foods, despite having heightened nutrient requirements, increases poor health risk of herself and the developing baby not receiving sufficient calories and essential micronutrients [4]. Excessive nutrition in women leads to risks of non-communicable diseases like: diabetes, hypertension, elevated lipid levels, and abdominal obesity. Overweight or obese, during pregnancy, has been demonstrated to correlate with numerous adverse maternal and fetal outcomes throughout pregnancy, delivery, and the postpartum period [5].

Previous research laid the groundwork for understanding the efficacy and feasibility of mobile phone applications for antenatal nutrition services [4]. These studies demonstrate promising results, indicating improvements in dietary intake, maternal nutrition knowledge, and pregnancy outcomes among women who use mobile applications as part of their antenatal care regimen. Despite advances in antenatal care, a notable gap persists in the delivery of comprehensive and personalized nutrition services to pregnant women during their clinic visits, highlighting the need for further research and innovation to optimize the implementation and impact of mobile technology in antenatal nutrition services [6].

In Kenya, mobile phone coverage, cost, and capabilities have all increased within the last 20 years. A number of mobile health initiatives aim to enhance interpersonal interactions, facilitate access to healthcare services, offer a clinical diagnosis, promote treatment compliance, and assist in the management of chronic illnesses [7]. Antenatal nutrition counseling typically lacks systematic mechanisms for follow-up and monitoring of dietary behaviours and outcomes over time. Without ongoing assessment and feedback, pregnant women may struggle to implement dietary recommendations effectively, leading to suboptimal nutritional outcomes for both mother and baby [8]. Factors such as long waiting hours, language barriers, and competing priorities may hinder their ability to receive and retain essential dietary guidance. Only a small fraction of the many health apps that are available to the public have undergone randomized controlled trials evaluation [9].

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The objective of the study was to evaluate and contribute to the existing body of knowledge by providing insights into maternal nutrition knowledge shared via mobile phone application at Kenyatta National Hospital (KNH) thereby improving dietary behaviours and nutritional outcomes among pregnant women. This will inform the development of mobile-phone application interventions for sharing health information that optimize maternal nutrition and improve pregnancy outcomes in diverse healthcare settings [10]. To improve mother and child health outcomes, this study is intended to provide the groundwork for future research, policy recommendations, and focused interventions [11].

MATERIALS AND METHODS

Study Setting

This study was conducted at KNH in Nairobi County. The KNH stands as Nairobi, the Kenya's largest health facility under the Ministry of Health. It also serves as the largest teaching and referral public hospital in East and Central Africa. With an impressive inpatient capacity of 2,000 beds, it plays a pivotal role in healthcare provision and medical research environment.

Study Design, Population and Sampling

The study used a cross-sectional descriptive and analytical design with structured questions that assessed maternal nutrition knowledge. Data analysis involved establishing descriptive statistics (frequencies, percentages) to explore distribution and prevalence of mobile phone application knowledge, nutrition status, and dietary diversity among participants. Analytically, the study investigated associations, such as between mobile app use frequency and nutrition status and dietary diversity among pregnant women attending the ante-natal care at the KNH, aged 15-45 years. The sample size was calculated using Fischer *et al.* [12] formula. It included additional 10% to account for attrition hence resulting in a total of 423 study participants. A systematic random sampling procedure was used to select the study participants. The attendance list of the women who sought antenatal care (ANC) services sufficed as the sampling frame.

All the expectant women attending antenatal clinics and lived for at least six months in the study area (Nairobi County) before the data collection period who gave voluntary consent were included in the study sample. Pregnant women who could not respond because of health problems were excluded. Fifteen individuals attending the antenatal clinic at KNH participated voluntarily in the pretest of the study. Adjustments were implemented to enhance question clarity and eliminate redundancies observed during the process. The participants involved in the pretest were not eligible thus were not included in the study sample.

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Data Collection

Data collection included both qualitative and quantitative methods using a developed mobile phone application questionnaire. The quantitative approach was used to provide actual statistics on mobile phone application knowledge score and their current nutritional status. The qualitative research methodologies offered explanations of dietary practices of pregnant women attending antenatal care services. The socio-demographic included gender, age, and level of education and occupation among others. This information was obtained by inquiring from the respondents.

Mobile Phone Application Development

i. ***App development;*** a mobile application survey was created, taking into account maternal nutrition information knowledge. This made the software visually appealing, easy to use, and operating system and mobile device compatible.
ii. ***Data collection features;*** this included data collection tools in the app to help in the collection of pertinent information from expectant women. For example, expectant women had unique user profiles to collect basic demographic data about the users, including age, location, marital status, and educational attainment among others.
iii. ***Health information;*** pregnant women keyed in information about their health, including their MUAC measurements and any current medical issues.
iv. ***Dietary Habits*** allowed users to record all of the food including meals, snacks, and supplements that they ate throughout the day, which represented 24 hour re-call.
v. ***Activity tracking;*** this featured tools for monitoring exercise schedules and physical activity levels during the pregnancy.

Strong privacy and security measures were put in place to secure the private information of expectant women by making sure that the mobile phone application complied with all applicable data protection laws.

Mobile Phone Application Knowledge Score

To determine the mobile phone application knowledge score, assessment and scores was based on real questions about maternal and nutritional practices. Expectant women were introduced to nutritional mobile phone applications comprising of ante-natal questions that they downloaded from play store. The mobile phone application knowledge tool questionnaire that focused on the patients' knowledge on maternal nutrition knowledge was implemented during antenatal care visits. The questions were designed in such a way that the patient, according to her knowledge, chooses the best option and not according to her likes or dislikes. Later, the responses were graded; for every correct response one mark

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was given, for every wrong response no mark was given. The computed score gave a total mobile phone application knowledge score. The mobile phone application knowledge was rated as percentages. Respondents' scores were graded using three cut-off points based on a normal distribution curve scale that was adapted according to the recommendations of Parmenter and Wardle **[**13**]**. The cut-off points were chosen based on the typical distribution of scores observed in the study population, aiming to categorize the extent of knowledge levels objectively thereby understanding the proficiency levels of respondents in using mobile phone applications. Low Mobile phone application – less than 40%; Adequate mobile phone application Knowledge – between 41% - 69%; High Mobile Phone Application Knowledge - above 70%.

Dietary Diversity of Pregnant Women

This mobile application dietary section enabled pregnant women to log in their daily dietary intake, including meals, snacks and supplements. The dietary variety of each patient was determined by summing up the 18 types of food consumed during the 24-hour recall period. To establish the Individual Dietary Diversity Score (IDDS), new variables were created representing specific food groups that needed consolidation, resulting in a total of nine distinct food groups. The Food Agriculture Organization (FAO) cut-off criteria [14] categorized Dietary Diversity Scores (DDS) into nine food groups. A DDS score ranging from 1 to 3 was considered low, while scores from 4 to 7 were deemed moderate and a score of 8 or higher was classified as high. The summed-up scores created the overall dietary variable scores. The analysis facilitated the highlighting of the most frequently and least frequently consumed food groups.

Data Analysis

Data entry templates were developed using SPSS v.20 software. The data underwent scrutiny for missing values, followed by exploration of the quantitative data to identify outliers, defined as values significantly deviating from the mean by being either too high or too low. Detected outliers were omitted. Categorical variables were analyzed using frequency and proportion calculations, while measures of central tendency and dispersion were applied on continuous variables. Using the recommended cut-off points [15], outcome variables for MUAC were dichotomized into three zones: Green Zone (MUAC > 23 cm) indicating Adequate Nutrition Status (Normal), Yellow Zone (MUAC 19 cm to 23 cm) signifying Moderate Acute Malnutrition, and Red Zone (MUAC < 19 cm) representing Severe Acute Malnutrition. The study used chi-square and correlation analyses to explore the relationship between knowledge scores of mobile phone applications, dietary practices, and nutritional status. Statistical significance was determined using a significance level (alpha) of p <0.05.

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Ethical Approval

The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by KNH/UON Ethics Research Committee. All the study participants gave informed voluntary written consent. Information provided by the participants was held confidential.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics

The study, through interviews, obtained socio-demographic characteristics from a total of 423 expectant women. The majority of the participants (over 80%, *n* = 339) had received formal education and more than (90.8%, *n* = 384) were aged above 20 years. The majority (59.8%, *n* = 253) resided in non-slum areas, and over (98.6%, *n* = 417) were Kenyan citizens. Over half (59.6%, *n* = 252) were married, and approximately (48.7%, *n* = 206) were self-employed. About (38.1%, *n* = 161) had no other children while 60.3% (*n* = 255) had previous pregnancies. Over a third (40.9%, *n* = 173) of the women were in their second trimester (week 15-28) of pregnancy. The majority (55.6%, *n* = 235) identified as Protestant religion. At the time of the study, Safaricom was the preferred service provider for most (96.2%, *n* = 407) of participants as illustrated in Table 1.

A significant difference was observed between the expectant women with and without formal education (p=0.013). No significant associations were found in the following variables; age-based differences (p=0.447), area of residence (p=0.979), nationality (p=0.053), marital status (p=0.582), occupational status (p=0.738), number of children (p=0.440), religion status (p=0.560), pregnancy by age (year) category (p=0.894), previous pregnancy (p=0.855), gestational week (p=0.442) and telephone service provider during the study period (p=0.150) as shown in Table 1.

As observed in others studies, the higher the education level, the more a patient is able to manage their personal healthcare and well-being. Educated patients have financial muscles to seek medical care from the private sector [16]. The association aligns with Hsieh *et al*. [17], who reported the extension of the technology acceptance and health behavior theoretical perspectives in health literacy. According to Birati *et al*. [18] who consistently demonstrated that individuals with higher levels of education tend to have better health literacy skills, including the ability to access, understand, and utilize health-related information effectively.

Explanation for this association is that higher levels of education are often associated with greater access to resources and opportunities for learning, agreeing with the works of Kohl and Martin [19], who reported about the significant

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association between education and health literacy. Pregnant women with higher education levels may be more likely to seek out information on maternal health and actively engage with mobile phone applications as a supplemental resource for pregnancy-related guidance and support [20].

Furthermore, the significance of this association underscores the importance of considering educational disparities in the design and implementation of mobile phone application interventions for maternal health as reported by Choudhury *et al.* [21]. According to them [21] health literacy significantly reduces malnutrition among pregnant women in a mobile phone application intervention. While mobile phone applications have the potential to empower pregnant women with valuable information and tools for managing their health during pregnancy, disparities in access and usage may exacerbate existing health inequalities [22].

Mobile Phone Application Knowledge

Slightly less than a third (31.2%) of respondents exhibited a high level of knowledge regarding mobile phone applications. Nearly half of the participants (50.1%) demonstrated a moderate level of understanding, whereas 18.7% showed a low level of familiarity with mobile phone applications, as illustrated in Table 2.

Dietary Diversity

The highest proportion consumed starchy staples at (20.3%, *n* = 86) followed by (12.8%, *n* = 54) who consumed vitamin A rich fruits. About (10.3%, *n* = 44) of pregnant women consumed vegetables or greens, organ meat (11.3%, *n* = 48) and other fruits (11.3%, *n* = 48). About (10.9%, *n* = 46) consumed legumes, nuts or seeds. The proportion of women who consumed protein containing foods, such as poultry or eggs, meat or fish and milk products were all less than 10% per food group as shown in Figure 1.

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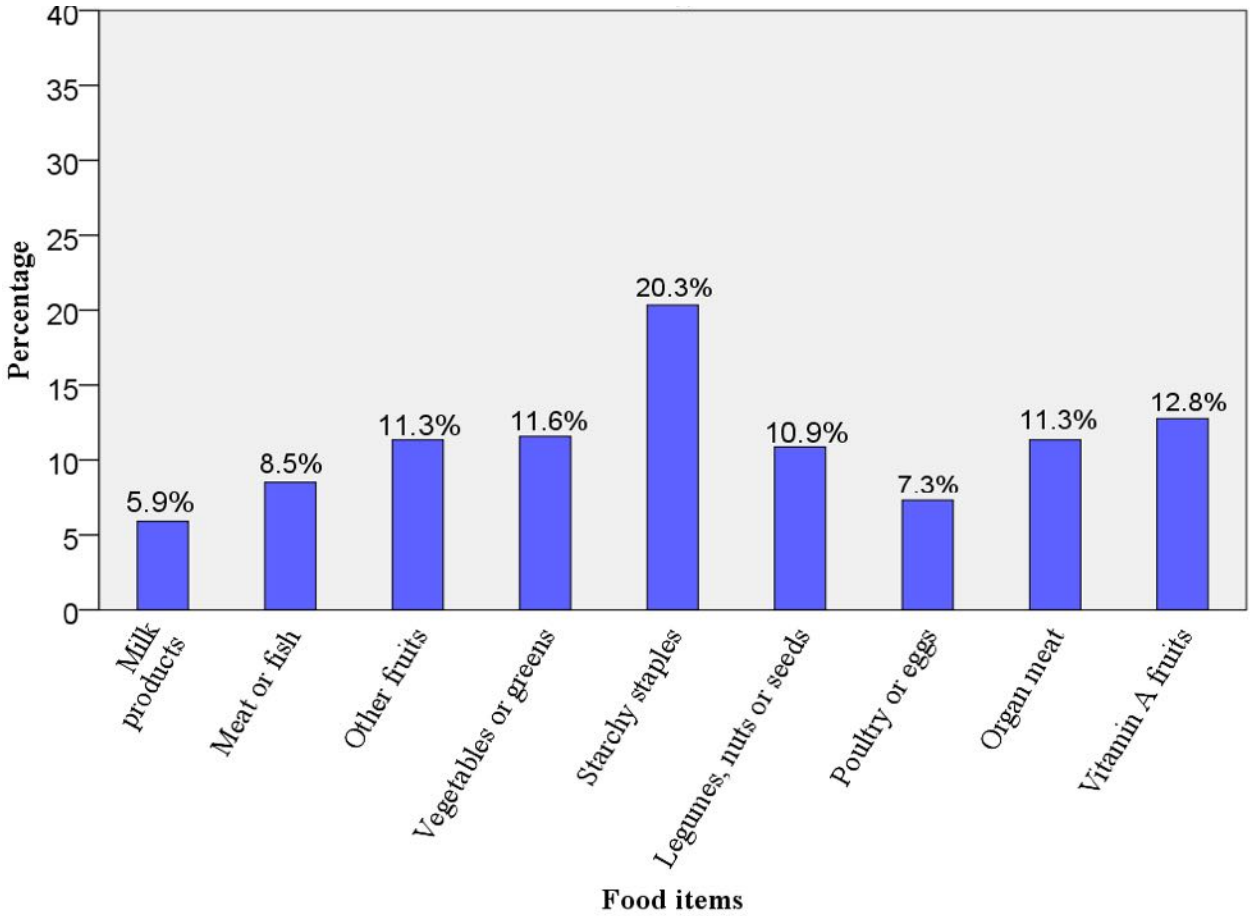

Figure 1: Distribution of pregnant women by food items consumed

Slightly less than a fifth (19.9%, *n* = 84) of expectant women met the ideal minimum dietary diversity score, while (12.2%, *n* = 52) met minimum meal frequency. About (26·7%, *n* = 113) met the minimum acceptable diet in a 24 hour re-call. There was a significant association between dietary indicators and mobile phone application knowledge score ($\chi^2 = 35.503$, df = 10, $p < 0.001$) as shown in Table 3. The association is consistent with the broader literature on maternal health and nutrition that was reported by Billah *et al*. [23]. They investigated the effect of nutrition counselling with a digital job aid on child dietary diversity from a cluster randomised controlled trial. Research has consistently shown that dietary diversity during pregnancy is associated with better maternal and fetal outcomes, including reduced risk of maternal complications and improved birth outcomes [21]. Pregnant women who consume a diverse range of nutritious foods are more likely to meet their nutritional needs, which is essential for supporting maternal health and fetal development [24].

Pregnant women who prioritize dietary diversity are more likely to also demonstrate proactive health-seeking behaviors, including seeking out information and resources to support their dietary choices [25]. Mobile phone applications offer a

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convenient and accessible platform for accessing evidence-based information on prenatal nutrition, meal planning, and healthy eating habits, aligning with the dietary preferences and goals of pregnant women with diverse diets [26]. Moreover, mobile phone applications designed for maternal health often feature interactive features, such as recipe suggestions, nutritional tips, and tracking tools, which can enhance users' knowledge and awareness of dietary recommendations during pregnancy [27]. Pregnant women who regularly engage with these applications are likely to acquire and retain a higher level of knowledge regarding optimal dietary practices for maternal and fetal health. The significance of this association underscores the potential of mobile phone application interventions that complement traditional prenatal care and in supporting pregnant women in making informed dietary choices as reported by Haddad *et al*. [28].

Nutritional Status of Pregnant Women

The prevalence of normal nutrition, moderate nutrition and acute malnutrition were (60%, *n* = 254), (36.9%, *n* = 156) and (3.1%, *n* = 13) respectively. There was a significant association between nutrition status and mobile phone application score of pregnant women (χ^2 = 10.423, df = 4, p <0.05) signifying that pregnant women who have higher knowledge scores regarding pregnancy-related information obtained through mobile phone applications are likely to have better nutrition status (Table 4). The findings are consistent with those of a study that was done by Zhang and Huo [29] on the intervention strategy of continuous nutrition management based on mobile medical APP for premature infants. They reported that mother's nutrition knowledge can significantly strengthen their nutritional status after discharge, promote their growth and development, improve nutritional status, reduce the incidence of diseases in premature infants, and hence enhance their quality of life. Adequate nutrition during pregnancy is crucial for maternal health and fetal development, with micro-nutrient deficiencies and poor dietary habits being associated with adverse pregnancy outcomes [27].

Several factors may explain the significant association observed in the study. For example, pregnant women who prioritize their nutrition status are likely to engage in proactive health-seeking behaviors, including seeking out information and resources to support their dietary choices as reported by Hojati *et al.* [30]. The significance of this association underscores the potential of mobile phone application interventions by leveraging mobile technology to deliver personalized nutrition education and support, healthcare providers can empower expectant women to optimize their nutrition status and improve maternal and fetal outcomes [28].

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CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The study provides compelling evidence that expectant women have awareness on use of mobile phone applications and this represents a transformative opportunity to promote positive behavior change and enhance access to antenatal care services. Hospital-based nutritionists who counsel expectant women on diet should contemplate utilizing mobile phone applications to monitor patients, to ensure adherence to recommended nutrition guidelines during pregnancy. Concurrently, policymakers should formulate policies to support the integration of mobile phone applications into the existing ante-natal services as a lasting enhancement to current healthcare provisions.

Future research should prioritize longitudinal studies to gauge the app's lasting impact on maternal nutrition outcomes, providing insights into knowledge retention and behavioral changes among pregnant women. Additionally, integrating the app into routine antenatal care services and aligning it with healthcare protocols could optimize its sustainability and effectiveness.

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Competing interest

The authors declared no competing interest regarding the publication of this manuscript.

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Table 1: An association between socio-demographic characteristics and mobile phone application knowledge score of pregnant women

Variables	Mobile phone application knowledge awareness score			Total N = 423	χ^2 value to Mobile app knowledge score
	Low % (n)	Moderate % (n)	High % (n)		
Age					
<20 years	0.7 (3)	3.5 (15)	1.4 (6)	24.0 (39)	**χ^2 = 1.612, df= 2,**
>20 years	18.0 (76)	46.6 (197)	29.8 (126)	94.3 (384)	**p-value=0.447**
Total	18.7 (79)	50.1 (212)	31.2 (132)	100 (423)	
Area of Residence					
Non-slum areas	11.3 (48)	29.8 (126)	18.7 (79)	59.8 (253)	**χ^2 = 1.612, df= 2,**
Slum areas	7.3 (31)	20.3 (86)	12.5 (53)	40.2 (170)	**p-value=0.979**
Nationality					
Kenyan	16.8 (71)	48.7 (206)	29.8 (126)	98.6 (417)	**χ^2 = 6.816, df= 2,**
Non-Kenyan	1.9 (8)	1.4 (6)	1.4 (6)	1.4 (6)	**p-value=0.053**
Marital status					
Married	9.9 (42)	31.2 (132)	18.4 (78)	59.6 (252)	**χ^2 = 4.691, df= 6,**
Single	6.1 (26)	12.3 (52)	9.7 (41)	28.1 (119)	**p-value=0.582**
Divorced	1.9 (8)	3.8 (16)	1.9 (8)	7.6 (32)	
Widowed	0.7 (3)	2.8 (12)	1.2 (5)	4.7 (20)	
Level of Education					
Non-Formal education	2.4 (10)	4.0 (217)	0.7 (3)	7.1 (30)	**χ^2 = 8.644, df= 2,**
Formal education	16.3 (69)	46.1 (195)	30.5 (129)	92.9 (393)	**p-value=0.013***
Occupation					
Salaried employee	3.1 (13)	7.1 (30)	5.4 (23)	15.6 (66)	
Self-employed	9.9 (42)	24.6 (104)	14.2 (60)	48.7 (206)	**χ^2 = 1.990, df= 4,**
Unemployed	5.7 (24)	18.4 (78)	11.6 (49)	35.7 (151)	**p-value=0.738**
Religion					
Catholic	4.7 (20)	10.9 (46)	10.2 (63)	25.8(109)	
Protestant	10.2 (43)	29.1 (123)	16.3 (69)	55.6 (235)	**χ^2 = 6.784, df= 8,**
Muslim	0.7 (3)	1.4 (6)	0.9 (4)	3.1 (13)	**p-value=0.560**
SDA	2.8 (12)	7.8 (33)	3.1 (13)	13.7 (58)	
ATR	0.2 (1)	0.9 (4)	0.7 (3)	1.8 (8)	
Number of children					
One	4.5 (19)	15.1 (64)	6.6 (28)	26.2 (111)	
More than one	6.6 (28)	17.3 (73)	11.8 (50)	35.7 (151)	**χ 2 = 3.754, df= 4,**
None	7.6 (32)	17.7 (75)	12.8 (54)	38.1 (161)	**p-value=0.440**

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Gestational week					
1st Trimester (week 1-14)	5.2 (21)	13.9 (59)	10.9 (46)	32.6 (138)	
2nd Trimester (week 15-28)	11.3 (48)	27.4 (116)	15.4 (68)	40.9 (173)	**χ 2 =13.213, df= 8,**
3rd Trimester (week 29-40)	2.4 (10)	8.7 (37)	5.0 (21)	26.5 (112)	**p-value=0.442**
Pregnancy by Age (year) category					
15-19	1.2 (5)	4.5 (19)	2.4 (10)	8 (34)	
20-24	1.4 (6)	4.5 (19)	2.1 (9)	8 (34)	**χ 2 = 6.410, df= 12,**
25-29	5.4 (23)	15.4 (65)	9.5 (40)	30.3 (128)	**p-value=0.894**
30-34	5.0 (29)	11.6 (49)	9.7 (41)	26.2 (111)	
35-39	3.5 (15)	10.4 (44)	5.0 (21)	18.9 (80)	
40-44	1.7 (7)	2.4 (10)	2.1 (9)	6.1 (26)	
45-49	0.5 (2)	1.4 (6)	0.5 (2)	2.4 (10)	
Previous pregnancy					
Yes	11.3 (48)	30.7 (130)	18.2 (77)	60.3 (255)	
No	7.3 (31)	19.4 (82)	13.0 (55)	39.7 (168)	**χ 2 = 0.312, df= 2, p-value=0.855**
Telephone service provider					
Safaricom	17.7 (75)	48.5 (205)	30.0 (127)	96.2 (407)	
Airtel	0.2 (1)	1.4 (6)	0.2 (1)	1.9 (8)	**χ 2 =6.749, df= 4,**
Telkom	0.7 (3)	0.2 (1)	0.9 (4)	1.9 (8)	**p-value=0.150**

Socio-Demographic Characteristics and Association to mobile phone application knowledge score
*= Statistically significant (level of education)
χ^2 - test value; the numbers in parenthesis are frequencies

Table 2: Mobile phone application knowledge score N=423

	%	*(n)*
High	*31.2*	*(132)*
Moderate	*50.1*	*(212)*
Low	*18.7*	*(79)*

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Table 3: Distribution between dietary indicator and mobile phone application knowledge score

Diet Variables	Mobile phone application knowledge score awareness % (n)			χ^2 value to Mobile app knowledge score
	Low % (n)	Moderate % (n)	High % (n)	
Minimum Meal Frequency				
Met	2.1 (9)	4.7 (20)	5.4 (23)	χ^2 = 35.503, df = 10, p-value = 0.000*
Not Met	1.7 (7)	8.7 (37)	3.1 (13)	
Minimum Acceptable Diet				
Met	5.7 (24)	14.4 (61)	6.6 (28)	
Not Met	4.3 (18)	9.5 (40)	4.0 (17)	
Minimum Dietary Diversity				
Met	1.4 (6)	10.2 (43)	8.3 (35)	
Not Met	3.5 (15)	2.6 (11)	3.8 (16)	

*significant relationship between mobile app knowledge score and dietary variable score of pregnant women
χ^2 - test value; the numbers in parenthesis are frequencies

Table 4: Prevalence of malnutrition and association to mobile phone application knowledge score of pregnant women

Nutritional status of pregnant women	Mobile phone application knowledge score			N=423	χ2 value to Mobile app knowledge score
	Low % (n)	Moderate % (n)	High % (n)		
Adequate nutrition Status	10.6 (45)	28.4 (120)	21.0 (89)	60 (254)	
Moderate acute malnutrition	8.0 (34)	19.1 (81)	9.7 (41)	36.9 (156)	χ^2=10.423, df=4, p-value=0.034*
Severe acute malnutrition	0 (0)	2.6 (11)	0.5 (2)	3.1 (13)	

*significant relationship between mobile app knowledge score and nutritional status
χ^2 - test value; the numbers in parenthesis are frequencies

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