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Reducing maternal morbidity from a nursing perspective: Effect of cardiovascular disease awareness during pregnancy

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ABSTRACT

Cardiovascular disease (CVD) is a leading cause of maternal morbidity and mortality worldwide, particularly in low-resource settings. This study evaluated the effect of a structured CVD awareness program on knowledge, attitudes, and practices (KAP) among pregnant women using a quasi-experimental pretest–posttest design. A purposive sample of 100 pregnant women attending the obstetrics and gynecology units at Benha University Hospital, Egypt, was divided into an intervention group (n = 50) and a comparison group (n = 50). The intervention group received a structured educational program on CVD prevention and management, while the comparison group received routine antenatal care. Data were collected using a modified KAP questionnaire before and after the intervention, and paired t-tests and chi-square tests were used for analysis. The intervention group showed significant improvements in knowledge, attitudes, and practices, with mean scores increasing from 69.1 to 83.9, 72.3 to 85.4, and 63.5 to 77.2, respectively ($p < 0.001$), while no significant changes were observed in the comparison group. These findings support integrating CVD education into antenatal care.

1. Introduction

Reducing maternal mortality is important for global development, and this goal has been hard to achieve in low-income countries. For 2023, the maternal mortality rate dropped to 197 maternal deaths per 100,000 live births, down from 328 a few years ago. Over the time span from 2000 to 2023, the maternal mortality rate (MMR) everywhere decreased every year by 2.2% (Kotit and Yacoub, 2021). The World Health Organization has split maternal deaths into two main categories: direct causes and indirect causes. Direct causes mean mothers die during or shortly after pregnancy, labor, or childbirth due to different complications. This group consists of hemorrhage, sepsis, and the hypertensive disorders of pregnancy. Indirect deaths are caused by a prior medical problem in the mother, which can worsen with the physical changes of pregnancy, and are not caused by pregnancy-specific problems such as cardiac and renal diseases. Maternal deaths were categorized according to World Health Organization guidelines into direct and indirect deaths (Kotit and Yacoub, 2021). Cardiac

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and hepatic diseases were the main causes of indirect maternal deaths (Kotit and Yacoub, 2021).

Cardiovascular disease (CVD) during pregnancy is a significant concern globally and contributes substantially to maternal morbidity and mortality. With cardiovascular complications accounting for up to one-third of all maternal deaths, this health issue poses a complex challenge, particularly in low- and middle-income countries where healthcare resources may be constrained (Kotit and Yacoub, 2021). In the Menoufia Governorate of Egypt, a retrospective study evaluates the risk factors and prevalence of maternal death. Bleeding was the first cause of maternal mortality with ratio (51.6%) then pregnancy-related hypertension diseases accounted for 24.1% of all maternal deaths, infections and sepsis were the third most common cause of death, accounting for 11.8% of all fatalities, and finally CVD ranks as the fourth most common cause of maternal mortality, accounting for 5.9% of all fatalities (Hettiarachchi et al., 2023). Also, in Sri Lankan Between 2006 and 2018, heart disease was responsible for 17.25% of the confirmed maternal deaths, with a rate of 7.24 per 100,000 live births; rheumatic heart disease led the way, followed by cardiomyopathies and congenital anomalies (Hettiarachchi et al., 2023). These statistics underscore the urgent need for targeted prevention and intervention strategies during pregnancy

Moreover, an underlying cause of death was found for 987 of the 1,018 pregnancy-related deaths, according to a study titled Pregnancy-Related Deaths: Data from Maternal Mortality Review Committees in 36 U.S. States, 2017–2019. More than 75% of pregnancy-related deaths were caused by the six most common underlying causes: mental health disorders, hemorrhage, heart and coronary diseases, infection, thrombotic embolism, and cardiomyopathy. Hemorrhage was the leading underlying cause of death among non-Hispanic Asian women, mental health disorders were the leading underlying cause of death among Hispanic and non-Hispanic White women, and cardiac and coronary conditions were the leading underlying cause of pregnancy-related deaths among non-Hispanic Black women (Hettiarachchi et al., 2023).

CVD encompasses a range of conditions, including hypertension, coronary artery disease, and congenital heart defects, each of which can affect maternal and fetal outcomes in unique ways (Hettiarachchi et al., 2023). Physiologically, pregnancy induces substantial cardiovascular changes, including increased blood volume, heart rate, and cardiac output, to meet the metabolic demands of both the mother and fetus (Soma-Pillay et al., 2016). While these adaptations are typically well-tolerated by healthy women, they can exacerbate existing heart conditions or reveal previously undiagnosed ones, leading to complications such as heart failure, arrhythmias, and thromboembolic events (Canobbio et al., 2017). These complications not only threaten maternal health but also increase the risk of adverse fetal outcomes, including preterm birth, intrauterine growth restriction, and stillbirth (Smith et al., 2023).

Several risk factors for CVD during pregnancy have been identified, including age, hypertension, obesity, and pre-existing diabetes. Studies have shown that pregnancy itself can act as a "stress test" for women, revealing cardiovascular vulnerabilities that may predispose them to future heart disease (Boyd, 2023). Women with conditions like preeclampsia and gestational hypertension, for instance, are at a significantly higher risk of developing CVD later in life (Oliver-Williams et al., 2023). Research has demonstrated that up to 68% of maternal morbidity associated with CVD could be mitigated with timely counseling, clinical evaluations, and close monitoring during pregnancy and labor, underscoring the importance of early intervention and preventative education (Howell, 2018)

Despite the known risks and the high prevalence of CVD during pregnancy, awareness levels among pregnant women remain low, particularly regarding risk factors, symptoms, and the importance of preventative care (O'Kelly et al., 2022). Studies conducted in similar settings have indicated that the general population, including women of reproductive age, may lack adequate knowledge about CVD and its implications during pregnancy (Alshakarah et al., 2023). This gap in awareness can delay diagnosis and treatment, increasing the likelihood of severe complications. In Egypt, cultural and educational factors may further influence the uptake of prenatal care and preventive health practices. Traditional beliefs and misconceptions about cardiovascular symptoms, combined with limited access to specialized care, can contribute to delayed or inadequate management of heart disease during pregnancy (Robson et al., 2012).

Increasing awareness of cardiovascular health among pregnant women can play a pivotal role in reducing maternal morbidity and improving outcomes for both mothers and their babies. Educational interventions, particularly those delivered in a culturally appropriate and accessible manner, have proven effective in raising awareness and changing health behaviors in other contexts (Marschner et al., 2023). The Knowledge, Attitudes, and Practices (KAP) framework is often used to design such interventions, as it provides a comprehensive view of the knowledge level, attitudes, and behaviors related to specific health issues within a target population (Zhao and Zhao, 2023). By assessing these three dimensions, the KAP model enables tailored education programs that address the unique needs of different groups, making it an ideal approach for cardiovascular awareness programs targeting pregnant women (Machaalani et al., 2022).

Several studies have highlighted the benefits of using KAP-based interventions to improve health outcomes among women at risk of CVD. For instance, in a study conducted among women in Iran, KAP-based educational interventions significantly

improved participants' knowledge and attitudes about CVD, though changes in behavior were less pronounced (Koohi and Khalili, 2020).

This study aims to assess the impact of a structured awareness program on CVD knowledge, attitudes, and practices among pregnant women in Egypt. By comparing outcomes between an intervention group receiving cardiovascular education and a control group receiving standard care, this study seeks to evaluate whether such interventions can enhance CVD awareness and promote healthier behaviors during pregnancy.

2. Methods

2.1. Study design

This study utilized a quasi-experimental pretest-posttest design to evaluate the effect of a CVD awareness intervention on KAP among pregnant women. The study design allowed for the comparison between an intervention group, which received a structured educational program, and a comparison group, which received standard prenatal care. This approach is appropriate for assessing the impact of health education interventions when random assignment is not feasible due to ethical or practical considerations.

2.2. Study setting

The research was conducted at Benha University Hospital, specifically within the obstetrics and gynecology inpatient units and outpatient clinics. Benha University Hospital belongs to the University and is the main teaching hospital linked with the Faculty of Medicine. It occupies a key position in Benha City and delivers healthcare to the people of Qalyubia Governorate and its surrounding areas. Medical and surgical services in many specialties are offered at the hospital, including internal medicine, internal surgery, pediatrics, cardiology, oncology, nephrology, and intensive care units. The obstetrics and gynecology department consists of eight inpatient rooms, and both inpatient and outpatient services are available here, offering patients diagnostic, treatment, and follow-up care through specialized clinics that work daily. The department is well known for offering antenatal advice, care for pregnancies that call for special attention, support for family planning, surgeries for women, and emergency treatment for childbirth complications. Surgical and non-surgical care is available to women through labor and delivery facilities, inpatient rooms, and an operating theatre.

2.3. Study population and sampling

A purposive sample of 100 pregnant women was selected for this study. Inclusion criteria required that participants be primiparous or multiparous, aged from 18 to 40 with various educational backgrounds, and diagnosed with CVD or pre-existing risk factors associated with cardiovascular complications, such as hypertension, hyperlipidemia, and high blood sugar levels. Exclusion criteria included women with high-risk conditions unrelated to cardiac disease (e.g., autoimmune diseases, active bleeding, or threatened abortion) and those who declined to consent.

2.4 Sample size

The sample size was calculated based on a hypothesized effect size of 0.560, using a standard normal deviate for α = 1.960 and β = 0.842. The study sample was divided into two distinct groups: the intervention group, which included mothers who participated in the educational session, and the control group, which included mothers who received standard hospital care. Participant Enrolments: Data collection was carried out alternately throughout the week to ensure consistency. For example, data from the intervention group was collected on alternating days (Sunday, Tuesday, and Thursday), while data from the comparison group was collected on the remaining days (Monday, Wednesday, and Friday). This alternating schedule ensured balanced and systematic data collection for both groups. yielding a total sample of 100 participants (50 in each group).

$$N_{total} = \frac{\left(Z_{1-\alpha/2}+Z_{1-\beta}\right)^2\left(\frac{1}{q_1}+\frac{1}{q_0}\right)}{\left(\frac{E}{S}\right)^2}$$

where, $q_0 = q_1 = 0.5$, $\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 = 7.849$, Standardized effect size $(E/S) = 0.560$, and N_{total} becomes 100.12.

2.5. Data collection tool KAP survey

The KAP survey was the primary tool for data collection, specifically adapted to assess knowledge, attitudes, and practices related to CVD awareness and prevention among pregnant women. This survey was based on Koohi and Khalili's (2020) validated instrument and culturally adapted to fit the context and needs of the Egyptian population. The survey was designed in Arabic, incorporating adjustments to ensure relevance and accuracy for the participants. The survey was divided into five sections: Section 1: Demographics (12 items) Section 2: Knowledge (18 items, scored 0–36) Section 3: Attitudes (10 items, scored 10–50) Section 4: Physical Activity (2 items) Section 5: Nutrition and Medication Practices (5 items) The knowledge section used a three-point rating scale (True = 2, False = 0, Don't Know = 1), while the attitude items were measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Practice items utilized a three-point scale (0 to 2), assessing adherence to specific behaviors.

Validity, reliability, and scoring system: All scores were proportionally transformed to 0-100.

Categorical variables are presented as frequencies and percentages, and KAP scores are presented as the median and interquartile range (IQR). Total knowledge, attitude, physical, nutritional, and smoking scores were classified into the following five categories based on the quintile scores: ≤20, "highly insufficient"; 21-40, "insufficient"; 41-60, "sufficient"; 61-80, "satisfactory"; > 80, "highly satisfactory. The KAP survey was validated through both a content validity ratio (CVR) and content validity index (CVI), with results of 0.80 and 0.91, respectively, indicating strong content validity. Cronbach's alpha for knowledge, attitude, physical activity, and nutrition subscales were 0.856, 0.915, 0.711, and 0.701, respectively, and for the total scale is .751, indicating good to acceptable internal consistency across domains.

Intervention: The intervention group received a comprehensive educational program designed to enhance CVD awareness and preventive practices during pregnancy. The program was developed based on the findings from the initial needs assessment and a thorough review of relevant literature on cardiovascular health in pregnancy. Study sessions were provided by qualified PhD researchers specialized in maternity health nursing. The educational intervention consisted of two sessions: Session 1: Overview of CVD, including definitions, risk factors, signs and symptoms, the impact of pregnancy on CVD, diagnostic procedures, and prevention. This introductory session lasted 30–45 minutes and used interactive methods and visual aids. Session 2: Focused on lifestyle modifications, such as dietary management, safe exercise practices, self-care, antenatal visits, delivery options, medication use, and postpartum care. This session also included a Q&A portion, and participants received an illustrated booklet summarizing key points. Each session was facilitated by a trained nurse educator in a private room to ensure comfort and confidentiality. Sessions were conducted in Arabic, ensuring all instructions and materials were culturally relevant and understandable.

Data collection procedure: Data were collected in two phases: A baseline assessment (pre-intervention) and a follow-up assessment (post-intervention). The pretest was administered to the intervention and comparison groups, covering demographics, knowledge, attitudes, and practices. Following the intervention, a posttest was conducted immediately to assess changes in KAP scores. Data collection alternated across days to balance participant recruitment between groups. Data for the intervention group were collected on Sundays, Tuesdays, and Thursdays, while data for the comparison group were collected on Saturdays, Mondays, and Wednesdays. This systematic approach ensured consistency across both groups.

Statistical analysis: Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize the data. Categorical variables were compared using Chi-square tests, and t-tests were used to compare mean scores between the intervention and control groups. Pearson correlation coefficients assessed relationships between quantitative variables, with a significance threshold set at $p < 0.05$ for all analyses. Results were analyzed to determine the impact of the awareness program on KAP scores, with particular attention to significant changes between pretest and post-test scores in the intervention group. The mean differences in KAP scores between the intervention and comparison groups were also examined, providing insights into the effectiveness of the educational intervention.

3. Results

3.1. Participant demographics

The demographic characteristics of the participants in both the intervention and comparison groups are presented in Table 1. The majority of participants were aged 20-30 years, with 60% in the intervention group and 78% in the comparison group. Most participants were married (96% in both groups), and educational levels were balanced, with 40% of the intervention and 18% of the comparison group having completed secondary education. Employment status showed that 78% in both groups were housewives, while body mass index (BMI) results indicated that over half of participants in both groups were either overweight or obese (46% overweight in the intervention group and 50% in the comparison group). No statistically significant differences were observed between the intervention and comparison groups regarding these baseline demographic variables, indicating comparable groups for further analysis.

Table 1: Demographic characteristics of study and control groups

Variable	Intervention group (n = 50)	Comparison group (n = 50)	χ^2	p-value
Age < 20 years	22%	12%	1.47	0.225
Age 20-30 years	60%	78%	1.34	0.321
> 30 years	18%	10%	1.69	0.451
Marital status	Married 96%	Married 96%	0.0	1.0
Education level	Secondary 40%	Secondary 18%	1.33	0.248
Employment status	Housewife 78%	Housewife 78%	0.0	1.0
Residence	Urban 76%	Urban 82%	0.11	0.736
BMI	Overweight/obese	Overweight/obese	0.50	0.480

χ^2: Chi-square

3.2. Stratification of the cardiovascular participants according to their associated risk factors

All participants in the study had a history of cardiovascular diseases; 24% of the intervention group had heart valve disease, compared to 18% of the comparison group. Moreover, 44% of the intervention group and 48% of the comparison group did not have hypertension. Regarding high blood sugar, 22% of the intervention group were affected, in contrast to 32% of the comparison group. Furthermore, 34% of the intervention group had a history of hyperlipidemia, compared to 36% of the comparison group. Overall, no significant differences were found between the intervention group and the comparison group concerning these medical conditions, as shown in Table 2.

3.3. KAP scores before and after intervention

The analysis of KAP scores before and after the intervention is shown in Table 3. Pre-intervention scores were nearly identical across the intervention and Comparison groups. For instance, the knowledge score in the intervention group pre-intervention was 69.1 (SD = 5.1), while it was 68.8 (SD = 4.5) in the Comparison group. Post-intervention, however, the intervention group showed a significant increase across all domains, with knowledge scores rising to 83.9 (SD = 4.9), attitudes to 85.4 (SD = 5.2), and practices to 77.2 (SD = 5.5).

In contrast, the Comparison group exhibited negligible changes, with a slight increase in knowledge to 70.1 (SD = 5.1) and minimal differences in attitude and practice scores. These improvements in the intervention group, with p-values < 0.001 across all KAP domains, indicate the intervention's effectiveness in enhancing participants' awareness and behaviors toward CVD management during pregnancy.

3.4. Distribution of knowledge items related to cardiovascular disease

Table 4 highlights key knowledge items related to cardiovascular disease, revealing a substantial increase in awareness in the intervention group following the intervention. For example, knowledge about CVD as a leading cause of maternal death rose from 88% to 98% in the intervention group, with no similar improvement in the comparison group. Understanding of CVD's impact on fetal outcomes, such as preterm birth, increased from 72% to 88% in the intervention group, whereas the comparison group saw only a minor change from 74% to 76%. Awareness of the importance of regular prenatal visits for women with CVD increased significantly from 56% to 84% in the intervention group post-intervention, while the comparison group remained largely unchanged.

These findings underscore the program's effectiveness in enhancing knowledge on critical CVD-related topics.

Table 2: Distribution of the studied samples according to their medical data

Variable	Category	Intervention n (%)	Comparison n (%)	χ^2	p
History of cardiovascular disease				0.09	0.763
	Cardiomyopathy	6 (12.0)	5 (10.0)		
	Heart valve disease	12 (24.0)	9 (18.0)		
	Valve replacement	11 (22.0)	10 (20.0)		
	Congenital heart disease	5 (10.0)	8 (16.0)		
	Arrhythmia	5 (10.0)	4 (8.0)		
	Rheumatic fever	11 (22.0)	14 (28.0)		
Hypertension				0.09	0.768
	No	22 (44.0)	24 (48.0)		
	Yes	14 (28.0)	16 (32.0)		
	I don't know	14 (28.0)	10 (20.0)		
High blood sugar				0.16	0.686
	No	29 (58.0)	26 (52.0)		
	Yes	11 (22.0)	16 (32.0)		
	I don't know	10 (20.0)	8 (16.0)		
Hyperlipidemia				0.02	0.879
	No	22 (44.0)	21 (42.0)		
	Yes	17 (34.0)	18 (36.0)		
	I don't know	11 (22.0)	11 (22.0)		

Table 3: Knowledge, attitude, and practice scores of pregnant women pre- and post-intervention

KAP domain	Intervention group pre-intervention	Intervention group post-intervention	Comparison group pre-intervention	Comparison group post-intervention	t-value	p-value
Knowledge	69.1 ± 5.1	83.9 ± 4.9	68.8 ± 4.5	70.1 ± 5.1	10.69	< 0.001*
Attitudes	72.3 ± 6.8	85.4 ± 5.2	71.9 ± 6.5	73.2 ± 6.4	9.87	< 0.001*
Practices	63.5 ± 6.0	77.2 ± 5.5	64.1 ± 6.1	65.3 ± 5.9	9.23	< 0.001*

*: Significant at p < 0.05

3.5. Attitudes toward cardiovascular health

Attitudes regarding cardiovascular health management saw a notable improvement in the intervention group after the intervention, as shown in Table 5. Attitudes about the importance of physical activity in maintaining health improved from 66% to 80% in the intervention group post-

intervention, compared to a small increase from 64% to 66% in the comparison group (p = 0.008). Beliefs about the importance of adhering to prenatal check-ups also increased significantly in the intervention group, from 84% to 92%, whereas the comparison group showed no change. Similarly, the importance of medication adherence rose from 82% to 90% in the intervention group, highlighting the intervention's positive influence on attitudes toward CVD management during pregnancy.

Table 4: Knowledge scores on cardiovascular disease awareness items

Knowledge item	Intervention group Pre (%)	Intervention group Post (%)	Comparison group Pre (%)	Comparison group Post (%)	p-value
CVD as leading cause of maternal death	88%	98%	86%	92%	0.746
CVD can lead to fetal complications (e.g., preterm birth)	72%	88%	74%	76%	0.027*
Regular prenatal visits for women with CVD	56%	84%	56%	60%	0.017*
Physical activity benefits	62%	82%	66%	70%	0.004*
Importance of a balanced diet for cardiovascular health	88%	88%	84%	86%	1.000

*: Significant at p < 0.05

3.6. Practices related to cardiovascular health

Table 6 details improvements in self-reported cardiovascular health practices among participants. Daily physical activity, such as walking for 15-30 minutes, increased in the intervention group from 52% to 74% post-intervention, while the comparison group declined from 58% to 50% (p < 0.001).

Dietary practices also improved, with 86% of the intervention group reporting daily fruit and vegetable intake post-intervention, up from 72%, while the comparison group saw a minor increase from 70% to 72% (p = 0.029). Additionally, those in the Intervention group who reported avoiding added salt in meals rose from 64% to 82%, while the comparison group remained largely unchanged, further highlighting the intervention's impact.

Table 5: Attitude scores on cardiovascular health management

Attitude item	Intervention group Pre (%)	Intervention group Post (%)	Comparison group Pre (%)	Comparison group Post (%)	p-value
Physical activity is essential for health	66%	80%	64%	66%	0.008*
Importance of regular prenatal check-ups	84%	92%	80%	80%	0.045*
Medication adherence prevents complications	82%	90%	80%	80%	0.026*

*: Significant at p < 0.05

3.7. Overall KAP levels

Table 7 summarizes overall KAP levels before and after the intervention. Initially, 94% of the intervention group and 96% of the comparison group were at a satisfactory KAP level. After the intervention, however, 80% of the intervention group reached a highly satisfactory level, while no participants in the comparison group achieved this level. This result reflects a highly significant improvement in the intervention group's overall KAP, driven by the intervention, with a chi-square of 66.8 and p < 0.001.

Table 6: Practice scores on cardiovascular health behaviors

Practice item	Intervention group Pre (%)	Intervention group Post (%)	Comparison group Pre (%)	Comparison group Post (%)	p-value
Engages in daily walking (15–30 minutes)	52%	74%	58%	50%	<0.001*
Includes fruits and vegetables daily	72%	86%	70%	72%	0.029*
Avoids adding extra salt to meals	64%	82%	58%	60%	0.001*

*: Significant at p < 0.05

4. Discussion

This study demonstrates the effectiveness of a structured awareness program in enhancing KAP related to CVD among pregnant women. Given the high maternal morbidity and mortality rates associated with CVD, this intervention addresses an urgent need in maternal healthcare, particularly in lower-resource settings such as Egypt. These findings add to a growing body of literature that underscores the importance of educational interventions in mitigating health risks associated with pregnancy-related cardiovascular conditions.

The significant improvement in knowledge scores among the intervention group highlights the impact of targeted educational programs on CVD awareness. Pre-intervention knowledge levels in both the intervention and comparison groups were modest,

indicating limited awareness of CVD's implications for both maternal and fetal health. This aligns with previous research suggesting that, globally, knowledge about CVD risks during pregnancy is insufficient among women of reproductive age, particularly in developing regions where access to comprehensive prenatal education is limited (Beussink-Nelson et al., 2022; Karim et al., 2024).

Table 7: Levels of KAP before and after intervention

KAP Level	Intervention group pre (%)	Intervention group post (%)	Comparison group pre (%)	Comparison group post (%)
Highly insufficient	0%	0%	0%	0%
Insufficient	6%	0%	4%	4%
Satisfactory	94%	20%	96%	96%
Highly Satisfactory	0%	80%	0%	0%

The intervention led to a notable increase in knowledge regarding the risks of CVD on fetal outcomes, such as preterm birth, low birth weight, and fetal mortality. Studies show that knowledge about these risks is crucial, as it motivates preventive behaviors and encourages timely prenatal care (Palinski, 2014). Participants in this study also demonstrated enhanced awareness of key CVD risk factors, such as obesity, hypertension, and sedentary lifestyle, which are often underrecognized by pregnant women (Azhari et al., 2022; Mujamammi et al., 2020). By improving knowledge in these areas, the intervention provides a foundation for women to better understand their health and make informed decisions regarding lifestyle modifications and healthcare engagement (Al-Makhamreh et al., 2024).

Attitude changes toward cardiovascular health: A positive shift in attitudes toward cardiovascular health was observed among participants following the intervention. The improvement in attitudes, particularly regarding the importance of regular prenatal check-ups, physical activity, and adherence to prescribed medications, mirrors findings in other studies that have explored the role of health education on maternal attitudes (Okafor and Goon, 2021). These attitude shifts are significant because they often precede and predict behavior changes, which are essential for sustained health improvements (Araújo-Soares et al., 2019). For instance, women who developed a positive attitude toward physical activity during pregnancy were more likely to engage in moderate exercise, which has been linked to improved cardiovascular health outcomes (Cannon et al., 2023). Additionally, the shift in attitudes toward prenatal check-ups emphasizes a growing awareness of the importance of continuous monitoring and early detection of potential complications, particularly in high-risk pregnancies (Cannon et al., 2023). This change in perspective is critical in settings like Egypt, where limited health infrastructure and misconceptions about prenatal care can delay women from seeking timely and appropriate medical advice. Also, Physical activity during pregnancy was the most impactful intervention element in the study as women in Egypt already adhere to work and perform household affairs.

Enhanced practices following intervention: The improvement in reported practices, such as daily physical activity, dietary adjustments, and reduced salt intake, suggests that the intervention had a tangible impact on participants' behaviors. Physical activity, for example, increased among participants from 52% to 74% following the intervention, a substantial shift that aligns with findings in similar studies (Cheikh Ismail et al., 2022). Physical activity during pregnancy has been shown to enhance maternal cardiovascular health, reduce the risk of gestational hypertension, and support fetal development (Taliento et al., 2024). Dietary modifications were also a significant finding, with a large proportion of participants reporting increased fruit and vegetable consumption and reduced salt intake post-intervention. These changes are consistent with recommendations from the World Health Organization (WHO) and the American Heart Association (AHA) for CVD prevention. A nutrient-rich diet, including fruits and vegetables, has protective effects against CVD due to its role in managing blood pressure, cholesterol levels, and body weight (Richardson et al., 2022). Salt reduction, as observed in this study, is particularly impactful given the prevalence of high sodium intake in many Middle Eastern diets, which is a known contributor to hypertension (Al-Jawaldeh et al., 2021). Complications, many remained unaware of their heightened risk, suggesting a lack of structured education during prenatal and postnatal care.

Comparison with similar KAP intervention studies: Several knowledge and education-based interventions targeting pregnant women have demonstrated improvements in awareness and maternal outcomes, supporting the rationale for this study. A systematic review of six randomized controlled trials evaluating educational interventions for hypertensive disorders of pregnancy (HDP) found that all included studies reported a significant increase in participants' knowledge post-intervention, with some also showing improvements in clinical outcomes such as blood pressure control and Apgar scores (Böhm et al., 2025). These interventions utilized various delivery methods, including pamphlets, mobile applications, and visual aids, highlighting the importance of multimodal strategies. A cross-sectional study in a high-income setting revealed that although over half of postpartum women had moderate knowledge of long-term cardiovascular risks following pregnancy In the Egyptian context, a

descriptive study among preeclamptic women found that 84% had unsatisfactory knowledge levels regarding CVD, and a significant portion held negative health beliefs, which correlated strongly with low awareness levels (Gouda et al., 2023). This further underscores the urgent need for targeted educational interventions in Egypt. Moreover, general population studies in the Middle East also show moderate CVD knowledge, with gaps in translating knowledge into practice (AlShehri et al., 2023). In comparison to these studies, the proposed quasi-experimental study in Egypt will uniquely focus on both low- and high-risk pregnant women, apply a structured CVD awareness intervention, and measure not only knowledge and attitudes but also behavioral and selected health outcomes. This integrated approach will allow for a more comprehensive understanding of the impact of maternal cardiovascular education in a low-resource setting. Implications for Maternal and Public Health The findings of this study hold significant implications for maternal and public health, particularly in regions with high maternal mortality and morbidity rates. By demonstrating that educational interventions can improve KAP among pregnant women, this study supports the argument for integrating cardiovascular health education into routine antenatal care programs. Health systems, especially those in low- and middle-income countries, could benefit from implementing similar programs to reduce maternal morbidity associated with CVD. Previous studies in countries such as South Africa and India have shown that integrating CVD education within antenatal services leads to better health outcomes for mothers and babies. This study also highlights the need for culturally tailored interventions. The educational materials and methods were adapted to the local cultural context, making them accessible and relevant to the participants. Cultural sensitivity is essential in health education, as it ensures that information resonates with the target audience and addresses specific beliefs and practices that may affect health behavior. Given that cultural and educational barriers are common in many regions, developing locally appropriate interventions could help increase program effectiveness and acceptability.

One of the strengths of this study is its use of the KAP model, which provides a holistic view of the intervention's impact on participants' knowledge, attitudes, and practices. The KAP framework is well-suited for assessing health education interventions, as it captures the multifaceted nature of behavior change, from knowledge acquisition to attitudinal shifts and behavior adoption. The quasi-experimental design also allowed for a pretest-post-test comparison, enhancing the study's internal validity. However, the study has limitations that warrant consideration. First, the sample size of 100 participants limits the generalizability of the findings, particularly to diverse populations outside the study setting. Furthermore, the alternation of assessment days (Sun/Tue/Thu vs. Sat/Mon/Wed) is a limitation, as it is not true randomization. This increases the risk of selection bias from systematic day-of-week differences. Additionally, the quasi-experimental design, while practical for this type of intervention, does not control for all potential confounders as rigorously as a randomized controlled trial (RCT) would. Future studies might consider employing RCTs to more definitively establish causality. Another limitation is the reliance on self-reported data for practices, which may be subject to social desirability bias, where participants may overreport positive behaviors due to perceived expectations. Moreover, some variables, such as socioeconomic status, access to healthcare, and educational level, were not controlled in the analysis. So, future studies are needed with detailed data to control all these variables and ensure the validity and generalizability. Finally, the findings were limited to a single institution in Banha. So, a multicenter study comparing the urban and rural populations, which usually have great differences in different aspects, is recommended.

This study paves the way for future research on maternal CVD interventions. Longitudinal studies could explore the sustainability of KAP changes over time and assess whether improved knowledge and attitudes translate into long-term health outcomes. Additionally, examining the impact of CVD education on actual health markers, such as blood pressure and cholesterol levels, would provide more objective measures of the intervention's effectiveness. Studies involving larger, more diverse samples across various socio-economic backgrounds could offer a more comprehensive understanding of how such interventions might be scaled up for broader public health impact. Moreover, this study suggests the potential benefit of multidisciplinary approaches to maternal health education. Collaborative efforts involving obstetricians, cardiologists, and nurses could ensure that education programs cover the full spectrum of cardiovascular health, from prevention to management. This aligns with global trends advocating for multidisciplinary maternal health teams to address complex health challenges effectively. Integrating educational interventions within broader maternal health programs, such as those focusing on gestational diabetes and hypertension, may also be beneficial, creating a more holistic approach to maternal health.

5. Conclusion

In conclusion, this study underscores the value of CVD awareness programs for improving knowledge, attitudes, and practices among high-risk pregnant women of CVD pregnant women. These improvements are essential for reducing maternal morbidity and mortality associated with CVD, particularly in resource-limited settings where access to specialized care may be restricted. By equipping women with the knowledge and tools to make informed health decisions, such interventions have the potential to create lasting benefits for

maternal and fetal health. The findings advocate for the inclusion of tailored CVD education in routine antenatal care and emphasize the importance of further research to refine and expand these interventions for broader public health application.

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Compliance with ethical standards

Ethical considerations

The study was approved by the ethics committee at the Faculty of Nursing, Benha University (IRB number: REC-OBSN-P24). Participants received a thorough explanation of the study's purpose, and informed written consent was obtained before enrolment. The study was conducted in accordance with the Declaration of Helsinki. The Participants were informed of their right to withdraw at any time without affecting the care they received. Confidentiality was maintained by anonymizing responses and securely storing all collected data.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Al-Jawaldeh A, Taktouk M, Chatila A et al. (2021). Salt reduction initiatives in the Eastern Mediterranean region and evaluation of progress towards the 2025 global target: A systematic review. Nutrients, 13(8): 2676. https://doi.org/10.3390/nu13082676 **PMid:34444836 PMCid:PMC8399509**

Al-Makhamreh H, Alkhatib A, Attarri A, Toubasi AA, Dabbas A, Al-Bkoor B, Sarhan Z, and Alghafri O (2024). Knowledge of cardiovascular disease risk factors among caregivers of cardiology patients attending Jordan University Hospital. PeerJ, 12: e16830. https://doi.org/10.7717/peerj.16830 **PMid:38313004 PMCid:PMC10838082**

Alshakarah A, Muriyah D, Alsaghir F et al. (2023). Awareness and knowledge of cardiovascular diseases and its risk factors among women of reproductive age: A scoping review. Cureus, 15(12): e49839. https://doi.org/10.7759/cureus.49839 **PMid:38164316 PMCid:PMC10758256**

AlShehri H, Alqahtani A, Al Mansour A et al. (2023). Knowledge and attitudes toward cardiovascular diseases and their risk factors among the Najran Population in Saudi Arabia. Cureus, 15(10): e46839. https://doi.org/10.7759/cureus.46839

Araújo-Soares V, Hankonen N, Presseau J, Rodrigues A, and Sniehotta FF (2019). Developing behavior change interventions for self-management in chronic illness. European Psychologist, 24(1): 7-25. https://doi.org/10.1027/1016-9040/a000330 **PMid:31496632 PMCid:PMC6727632**

Azhari HEE, Elderdery AY, Mohammed RR, Omer HE, Iman AM, Tabein EM, Ramadan O, and Shaban M (2022). Pregnancy and commonly usage hematological medications in Sudan. International Journal of Health Sciences, 6(S1): 9044-9055. https://doi.org/10.53730/ijhs.v6nS1.7126

Beussink-Nelson L, Baldridge AS, Hibler E et al. (2022). Knowledge and perception of cardiovascular disease risk in women of reproductive age. American Journal of Preventive Cardiology, 11: 100364. https://doi.org/10.1016/j.ajpc.2022.100364 **PMid:35866048 PMCid:PMC9294042**

Böhm M, von Kaisenberg C, Schippert C, and von Versen-Höynck F (2025). Maternal knowledge about long-term consequences of pregnancy complications: A cross-sectional study. BMC Pregnancy and Childbirth, 25: 935. https://doi.org/10.1186/s12884-025-08156-0 **PMid:40968389 PMCid:PMC12447609**

Boyd HA (2023). Pregnancy complications as indicators of cardiovascular disease risk in women: How do we tackle cardiovascular disease prevention in women who have failed the cardiac stress test of pregnancy? Journal of the American Heart Association, 12(11): e030452. https://doi.org/10.1161/JAHA.123.030452 **PMid:37260025 PMCid:PMC10382001**

Cannon S, Hayman M, and Lastella M (2023). Pregnant women's attitudes and beliefs towards sleep and exercise: A cross-sectional survey. Clocks and Sleep, 5(1): 34-44. https://doi.org/10.3390/clockssleep5010004 **PMid:36810841 PMCid:PMC9944079**

Canobbio MM, Warnes CA, Aboulhosn J, Connolly HM, Khanna A, Koos BJ, Mital S, Rose C, Silversides C, and Stout K (2017). Management of pregnancy in patients with complex congenital heart disease: A scientific statement for healthcare professionals from the American Heart Association. Circulation, 135(8): e50-e87. https://doi.org/10.1161/CIR.0000000000000458 **PMid:28082385**

Cheikh Ismail L, Hashim M, Jarrar AH et al. (2022). Impact of a nutrition education intervention on salt/sodium related knowledge, attitude, and practice of university students. Frontiers in Nutrition, 9: 830262. https://doi.org/10.3389/fnut.2022.830262 **PMid:35284451 PMCid:PMC8914224**

Gouda ADK, M Abdel-Rahman W, and M Nabil Aboushady R (2023). Knowledge and beliefs toward risk of cardiovascular disease among pre-eclamptic women. Egyptian Journal of Health Care, 14(3): 241-253. https://doi.org/10.21608/ejhc.2023.314951

Hettiarachchi A, Jayaratne K, De Silva C, Senanayake H, Lokunarangoda N, and Agampodi S (2023). Heart disease complicating pregnancy as a leading cause of maternal deaths in LMIC settings: The Sri Lankan experience. The Lancet Regional Health-Southeast Asia, 15: 100223. https://doi.org/10.1016/j.lansea.2023.100223 **PMid:37614353 PMCid:PMC10442957**

Howell EA (2018). Reducing disparities in severe maternal morbidity and mortality. Clinical Obstetrics and Gynecology, 61(2): 387-399. https://doi.org/10.1097/GRF.0000000000000349 **PMid:29346121 PMCid:PMC5915910**

Karim B, Jergel A, Bai S et al. (2024). Incorporating cardiovascular risk assessment into adolescent reproductive health and primary care visits. Journal of Pediatric and Adolescent Gynecology, 37(4): 426-432. https://doi.org/10.1016/j.jpag.2024.03.006 **PMid:38599564 PMCid:PMC11260258**

Koohi F and Khalili D (2020). Knowledge, attitude, and practice regarding cardiovascular diseases in adults attending health care centers in Tehran, Iran. International Journal of

Endocrinology and Metabolism, 18(3): e101612.
https://doi.org/10.5812/ijem.101612
PMid:33257905 PMCid:PMC7695352

Kotit S and Yacoub M (2021). Cardiovascular adverse events in pregnancy: A global perspective. Global Cardiology Science and Practice, 2021(1): e202105.
https://doi.org/10.21542/gcsp.2021.5
PMid:34036091 PMCid:PMC8133785

Machaalani M, Fakhry B, Zwaideh M, Mendelek K, Mahmoud N, Hammoud T, and Chahine PMN (2022). Knowledge, attitude, and practice toward cardiovascular diseases in the Lebanese population. Global Heart, 17(1): 47.
https://doi.org/10.5334/gh.1138
PMid:36051313 PMCid:PMC9336688

Marschner S, Mukherjee S, Watts M, Min H, Beale AL, O'Brien J, Juneja A, Tremmel JA, and Zaman S (2023). Prevention of cardiovascular disease in women with pregnancy-related risk factors: A prospective women's heart clinic study. Journal of the American Heart Association, 12(17): e030015.
https://doi.org/10.1161/JAHA.123.030015
PMid:37642017 PMCid:PMC10547318

Mujamammi AH, Alluhaymid YM, Alshibani MG, Alotaibi FY, Alzahrani KM, Alotaibi AB, Almasabi AA, and Sabi EM (2020). Awareness of cardiovascular disease associated risk factors among Saudis in Riyadh City. Journal of Family Medicine and Primary Care, 9(6): 3100-3105.
https://doi.org/10.4103/jfmpc.jfmpc_458_20
PMid:32984180 PMCid:PMC7491763

O'Kelly AC, Michos ED, Shufelt CL, Vermunt JV, Minissian MB, Quesada O, Smith GN, Rich-Edwards JW, Garovic VD, El Khoudary SR, and Honigberg MC (2022). Pregnancy and reproductive risk factors for cardiovascular disease in women. Circulation Research, 130(4): 652-672.
https://doi.org/10.1161/CIRCRESAHA.121.319895
PMid:35175837 PMCid:PMC8870397

Okafor UB and Goon DT (2021). Physical activity advice and counselling by healthcare providers: A scoping review. Healthcare, 9(5): 609.
https://doi.org/10.3390/healthcare9050609
PMid:34069474 PMCid:PMC8159082

Oliver-Williams C, Johnson JD, and Vladutiu CJ (2023). Maternal cardiovascular disease after pre-eclampsia and gestational hypertension: A narrative review. American Journal of Lifestyle Medicine, 17(1): 8-17.
https://doi.org/10.1177/15598276211037964
PMid:36636385 PMCid:PMC9830232

Palinski W (2014). Effect of maternal cardiovascular conditions and risk factors on offspring cardiovascular disease. Circulation, 129(20): 2066-2077.
https://doi.org/10.1161/CIRCULATIONAHA.113.001805
PMid:24842934 PMCid:PMC4053195

Richardson LA, Izuora K, and Basu A (2022). Mediterranean diet and its association with cardiovascular disease risk factors: A scoping review. International Journal of Environmental Research and Public Health, 19(19): 12762.
https://doi.org/10.3390/ijerph191912762
PMid:36232062 PMCid:PMC9566634

Robson MG, Stephenson R, and Elfstrom KM (2012). Community influences on antenatal and delivery care in Bangladesh, Egypt, and Rwanda. Public Health Reports, 127(1): 96-106.
https://doi.org/10.1177/003335491212700111
PMid:22298927 PMCid:PMC3234402

Smith ER, Oakley E, Grandner GW et al. (2023). Adverse maternal, fetal, and newborn outcomes among pregnant women with SARS-CoV-2 infection: An individual participant data meta-analysis. BMJ Global Health, 8: e009495.
https://doi.org/10.1136/bmjgh-2022-009495

Soma-Pillay P, Nelson-Piercy C, Tolppanen H, and Mebazaa A (2016). Physiological changes in pregnancy: Review articles. Cardiovascular Journal of Africa, 27(2): 89-94.
https://doi.org/10.5830/CVJA-2016-021
PMid:27213856 PMCid:PMC4928162

Taliento C, Piccolotti I, Sabattini A, Tormen M, Cappadona R, Greco P, and Scutiero G (2024). Effect of physical activity during pregnancy on the risk of hypertension disorders and gestational diabetes: Evidence generated by new RCTs and systematic reviews. Journal of Clinical Medicine, 13(8): 2198.
https://doi.org/10.3390/jcm13082198
PMid:38673471 PMCid:PMC11050519

Zhao L and Zhao Q (2023). Knowledge, attitude, and practice toward disease prevention among a high-risk population for chronic obstructive pulmonary disease: A cross-sectional study. International Journal of Nursing Sciences, 10(2): 238-244.
https://doi.org/10.1016/j.ijnss.2023.03.012
PMid:37128490 PMCid:PMC10148251