SCIENTIFIC CULTURE

www.sci-cult.com

*SCIENTIFIC CULTURE, Vol. 12, No. 5, (2026), pp. 2478-2495*
*Open Access. Online & Print*

**DOI: 10.5281/zenodo.21489435**

# EFFECTIVENESS OF AN E-MODULE ON HEALTH AWARENESS AMONG PREGNANT WOMEN AND ITS IMPACT ON ACCESSING PERINATAL MATERNITY CARE SERVICES AT UNDERSERVED COMMUNITIES IN SAUDI

**Nujud Atiyah K. Alharthi[1], Regidor III Dioso[2]**

*[1]Lincoln University College, Malaysia, nojooda@moh.gov.sa*
*[2]Assoc. Prof., Department of Post Graduate, Lincoln University College, Malaysia, duke@lincoln.edu.my*

*Received: 20/06/2026*
*Accepted: 09/07/2026*

*Corresponding Author: Nujud Atiyah K. Alharthi (nojooda@moh.gov.sa)*

## ABSTRACT

***This study examined the effectiveness of a structured electronic module (e-module) on health awareness among pregnant women and its impact on accessing perinatal maternity care services in underserved communities in Altaif City, Saudi Arabia. An explanatory sequential mixed-methods design was employed, with this paper reporting Phase 1 quantitative findings. The experimental group comprised 109 participants (54 before and 55 after e-module engagement), while the control group comprised 53 participants assessed at baseline and post-intervention. Five perinatal health awareness domains were evaluated: antenatal assessment, safe delivery practices, maternal mental health, breastfeeding support, and postpartum complications. Mann-Whitney U tests revealed statistically significant and large-effect improvements across all five domains in the experimental group following e-module engagement ($r = 0.529–0.665$, all $p < .001$), with post-intervention mean accessibility ratings converging near the scale maximum. Within the control group, paired samples analyses demonstrated significant within-period improvements across all domains (all $p < .001$), attributable to measurement reactivity, enumerator presence, and social network diffusion, though the magnitude remained substantially smaller than experimental group gains. Spearman correlation analysis identified a significant inverse relationship between postpartum complications awareness and perceived accessibility ($r_s = −0.330$, $p = .016$), interpreted through the knowledge-gap paradox. Multiple linear regression confirmed that health awareness subscales explained only 12.8% of accessibility variance, underscoring the primacy of structural barriers. Chi-square analysis identified marital status as the sole significant sociodemographic predictor of antenatal care receipt ($p = .021$, $V = 0.375$). Findings provide empirical support for integrating e-modules into perinatal care pathways in underserved Saudi communities, with concurrent structural service expansion recommended.***

**KEYWORDS:** E-Module, Health Awareness, Perinatal Care, Maternity Services, Underserved Communities, Saudi Arabia, Digital Health Education.

## 1. INTRODUCTION

Accessing perinatal maternity care services in Saudi Arabia include geographic limitations, institutional inefficiencies, and socio-economic constraints that is an equitable care for pregnant women. Therefore, health awareness is also constrained. The indicators of health awareness on accessing perinatal maternity care services herewith are focused on: 1) Antenatal assessment, 2) Safe delivery practices, 3) Maternal mental health as health awareness, 4) Breastfeeding support as health awareness, and 5) Postpartum complications as health awareness. The novelty of this study is the integration of the midwifery discipline and nursing informatics in developing a concrete available resource for health awareness in the form of an electronic-module (e-module) to bridge the intervention gap in finding accessibility to perinatal maternal care service in underserved communities in Saudi Arabia.

### *1.1 Background of the Study*

Accessibility to perinatal maternal care service is a central determinant of the health awareness. That is why the Millennium Development Goals (MDGs) of the United Nations aimed to reduce maternal mortality ratios by 75% there are still more than 830 women dying every day from causes that could have been averted if adequate maternal care had been received (WHO, 2020). Sustainable Development Goal Plan that focuses on good health and wellbeing states that lack of adequate health awareness is more so found on the rural areas as major causes of these regrettable maternal deaths (Mweemba et al., 2021).

The importance of the accessible perinatal care in increasing not only the health status of the mother and her newborn cannot be overemphasized. Saudi Arabia revealed that there are factors that limit the attendance of ANC visits. The three main factors limiting attendance of antenatal care (ANC) visits are lack of awareness, accessibility challenges, and socio-cultural or financial barriers (Krukowski et al., 2022; Racine et al., 2022). To date, there are few studies in the context of Saudi Arabia particularly focusing on identification of barriers of access to maternal healthcare services in the underserved areas. Hence, this study was designed to fill this gap with an interest in revealing factors that hinder the use of maternity care services in marginalized areas of Altaif City in Saudi Arabia.

Accessibility to perinatal maternity care services in underserved communities in Saudi Arabia is solved through health promotion (Alanazy et al., 2019). The conventional health promotions are the face-to-face consultations in maternity clinics, flyers, leaflets, banners, and social medias such as live streaming from YouTube, Facebook, Telegram, TikTok, and Instagram.

### *1.2 Statement of the Problem*

Across Saudi, there has been a constant and global concern for the wellbeing of mothers and infants (United Nations, 2021; Chowdhury et al., 2022). More than half a million women die globally each year as a result of complications during pregnancy and childbirth (Mohseni et al., 2023). To make it worse, about 810 women lose their lives every day to preventable causes related to pregnancy and childbirth globally (Figure 1).

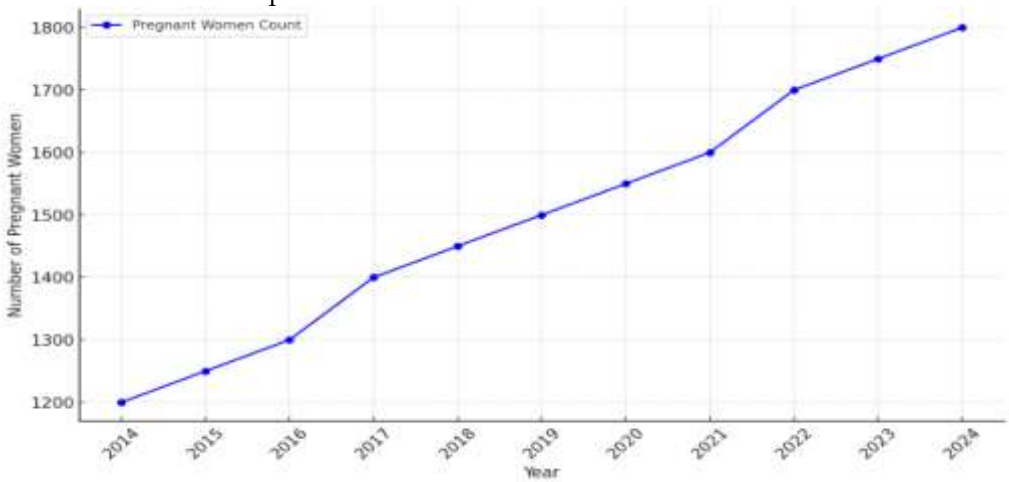


***Figure 1. Number of pregnant women in Altaif City, Saudi Arabia (2014 to 2024).***

The number of pregnant women in Altaif City, Saudi Arabia, has shown a steady increase from 2014 to 2024 (Alotaibi & Alghamdi, 2021). In 2014, the number of pregnant women was approximately

1200, and by 2024, it had grown to around 1800, representing an overall increase of 600 pregnant women, equivalent to a 50% rise over the decade. A rapid increase in population, driven by rising marriage rates and higher pregnancy rates, can strain healthcare systems, particularly maternity and neonatal services, potentially leading to overcrowded hospitals, shortages of skilled healthcare providers, and increased maternal and infant health risks due to inadequate prenatal and postnatal care (Krukowski et al., 2022; Racine et al., 2022).

Conventional face-to-face maternity care services in underserved communities in Al-Taif City are challenged by persistent structural barriers that limit women's ability to seek timely antenatal and perinatal support (Alqahtani & Alshehri, 2024; Mohseni et al., 2023; World Health Organization, 2020). Physical attendance requires travel to health facilities that are often distant from residential areas on the outskirts of the city, resulting in significant delays or missed appointments. Cultural and social dynamics also complicate face-to-face maternity care services: many women rely on male family members for transportation or decision-making, making spontaneous or urgent clinic visits difficult. Workforce shortages, insufficient health literacy support, economic burdens of indirect costs, and the absence of continuity of care beyond the clinic further compound these barriers, reinforcing persistent disparities in perinatal outcomes for underserved communities in Al-Taif City.

### *1.3 Objectives*

General objective: Generally, this study would like to determine the effectiveness of an e-module on health awareness among pregnant women and its impact on accessing perinatal maternity care services at underserved communities.

Specific objectives: (1) Develop an e-module on health awareness among pregnant women and its impact on accessing perinatal maternity care services. (2) Examine the effectiveness of an e-module for the experimental group among pregnant women to access perinatal maternity care services at underserved communities. (3) Evaluate the accessibility of perinatal maternity care services before and after health awareness among the experimental and control groups. (4) Determine the relationship between the antenatal assessment, safe delivery practices, maternal mental health, breastfeeding support, and postpartum complications as the indicators of health awareness on accessing perinatal maternity care services at underserved communities in Saudi.

### *1.4 Research Questions*

(1) How to develop an e-module on health awareness among pregnant women and its impact on accessing perinatal maternity care services? (2) What is the effectiveness of an e-module for the experimental group among pregnant women to access perinatal maternity care services at underserved communities? (3) What is the accessibility of perinatal maternity care services before and after health awareness among the experimental and control groups? (4) What is the relationship between the antenatal assessment, safe delivery practices, maternal mental health, breastfeeding support, and postpartum complications as the indicators of health awareness on accessing perinatal maternity care services at underserved communities in Saudi?

### *1.5 Research Hypothesis*

There is a significant effectiveness of an e-module on health awareness among pregnant women and its impact on accessing perinatal maternity care services at underserved communities.

### *1.6 Significance of the Study*

As highlighted by Mweemba et al. (2021), limited and delayed access to services is strongly associated with high maternal near-miss and mortality and morbidities. Another reason for a high number of maternal mortalities in countries with low incomes, as found by Dahab and Sakellariou (2020), is that access to maternal health care is limited largely. As a result, access delivery has become a subsector of the service delivery in health policy, and given the importance it has been receiving, it has attracted increasing amounts of attention. This study, as it seeks to assess the precise challenges, can contribute towards the development of strategies intended to improve the supply and availability of services in disadvantaged regions, with potential to lower maternal and infant mortality rates in the region (Almutairi & Alzahrani, 2025; WHO, 2024). The information obtained might also provide recommendations to public policy decision-makers, health care practitioners, and community management in comparable underserved regions.

### *1.7 Scope of the Study*

The e-module focuses on identifying the indicators of health awareness to accessing perinatal maternity care services in underserved communities in Al-Taif City (Alotaibi & Alghamdi, 2025). Based on

the objectives, the e-module examines the challenges faced by pregnant women in obtaining antenatal, delivery, and postnatal care, which are the divisions of perinatal care delivery factors that is hindered through accessibility of pregnant women in the underserved communities in Saudi. The scope of the study is limited to underserved communities in Saudi Arabia, ensuring a targeted investigation that provides insights into localized challenges and potential solutions (Almutairi & Alzahrani, 2025).

## 2. REVIEW OF LITERATURE

The accessing of perinatal maternity care services with indicators of health awareness herewith are focused on: 1) Antenatal assessment, 2) Safe delivery practices, 3) Maternal mental health as health awareness, 4) Breastfeeding support as health awareness, and 5) Postpartum complications, which are the dependent variables. Underserved communities in Saudi Arabia face significant barriers to accessing perinatal maternity care, which are the independent variables. The moderating variable is the e-module.

Antenatal care access is a fundamental determinant of maternal and child health, yet barriers to accessing maternity care services continue to disproportionately affect women in underserved communities, including geographic distance, cost, and limited availability of skilled providers. Health promotion on safe delivery practice, maternal mental health, breastfeeding support, and post-partum complications each constitute distinct but related domains of perinatal health awareness that are similarly constrained by structural and sociocultural barriers in underserved settings. Sociodemographic factors, chronic health conditions, and the number of pregnancies experienced by women in underserved communities further shape the extent and pattern of health awareness and care-seeking behaviour documented in the literature on Saudi Arabia and comparable Gulf and Middle Eastern contexts.

To ensure comprehensive coverage of the literature, multiple academic and gray literature databases were searched, including PubMed, Scopus and Web of Science, the WHO Global Health Observatory, Google Scholar, the Saudi Digital Library and Ministry of Health Saudi Arabia, and the Cochrane Library, following a PRISMA-based screening process comprising duplicate removal, title and abstract screening, full-text screening, and data extraction.

### *2.4 Theoretical Framework*

The Health Belief Model (HBM) underpins the conceptual architecture of the present study, positing that individual health behaviour, including care-seeking for perinatal services, is shaped by perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Within this study, the e-module functions as a structured cue to action, designed to alter perceived susceptibility and severity regarding antenatal, delivery, mental health, breastfeeding, and postpartum risks, thereby increasing perceived benefits and reducing perceived barriers to accessing perinatal maternity care services among pregnant women in underserved communities.

### *2.5 Conceptual Framework*

Access to maternity care services remains a fundamental component of maternal and child health, yet underserved communities often encounter significant barriers that limit their ability to receive adequate and timely care (Alqifari, 2024). The conceptual framework illustrates the relationship between underserved communities and barriers to accessing maternity care services, a dynamic influenced by social determinants of health, healthcare infrastructure, cultural norms, and policy-related factors. Underserved communities are often characterised by economic marginalization, geographical isolation, limited healthcare infrastructure, and systemic inequities that perpetuate poor maternal health outcomes (United Nations, 2021). The "three delays model" — delays in seeking care, reaching care, and receiving adequate care — is particularly relevant: the first delay is shaped by household decision-making and cultural norms governing women's autonomy, while healthcare system inefficiencies, staff shortages, and uneven distribution of facilities contribute to the second and third delays (Alzahrani & Almutairi, 2023; Alqifari, 2024).

Addressing these barriers requires a multifaceted policy approach spanning strengthened healthcare infrastructure, financial assistance programmes, culturally competent care delivery, mobile and telehealth services, and international and public-private partnerships, recognising maternity care access as a critical determinant of public health and social equity (WHO, 2020, 2021; Khalifeh & Priebe, 2020).

## 3. RESEARCH METHODOLOGY

### *3.1 Research Design*

The quasi-experimental design is the most appropriate approach for this study because it allows evaluation before and after the intervention. There

will be a control and an experimental group (Creswell, 2020).

### 3.2 Research Setting

The study was conducted at primary healthcare centers in rural areas of Altaif City in Saudi Arabia, where key frontline healthcare centers that provide preliminary services to underserved populations are located, namely Al Hawiyah, Al Hada, Ash-Shafa, Al Qutbiyyah, Jubrah, and As Sur, ranging from approximately 2.76 km to 20 km from Taif City.

### 3.3 Research Population and Sampling Technique

The study targeted clients of primary health care who are pregnant and postnatal women living in Altaif City but reside in rural settings from 2022 to 2024. Using the G*Power calculator, the sample size was determined based on an ANCOVA with fixed effects, main effects, and interactions, selecting the F test for comparing means among groups, with an effect size (f) of 0.5, an alpha error probability (α) of 0.05, and a statistical power (1−β) of 0.95, resulting in a required total of 107 participants.

*Table 1. Research Population and Samples.*

| Rural Area | Approximate Distance from Taif City | Sample Allocation |
|---|---|---|
| Al Hawiyah | 15 km north | 20 |
| Al Hada | 20 km west | 20 |
| Ash-Shafa | 20 km south | 20 |
| Al Qutbiyyah | 6 km | 15 |
| Jubrah | 2.76 km | 15 |
| As Sur | Southeast | 17 |
| Total | | 107 |

Purposive sampling is an ideal technique for this study because it allows researchers to specifically target pregnant and postnatal women living in rural areas of Altaif City who may have limited access to maternity care services (Polit & Beck, 2020). Inclusion criteria comprised pregnant women at any stage of pregnancy or postnatal women (up to six months postpartum) residing in rural Altaif City, aged 18 years and above, who sought maternity care and could provide informed consent. Exclusion criteria comprised women with high-risk pregnancies requiring specialised tertiary care, severe mental health conditions, or inability to read and write for consent.

### 3.4 Study Instrument, Validity, and Reliability

The survey questionnaire comprised 4 sections and a total of 18 quantifiable items adapted from the Global Maternity Care Access Survey questionnaire used by the WHO (2020; 2021; 2022): (1) Sociodemographic Information, (2) Antenatal Care Access, (3) Delivery and Postnatal Care, (4) Satisfaction with Services. The Content Validity Index (CVI) was used to evaluate the relevance and clarity of the survey items (de Souza et al., 2024), and a formal translation protocol was applied to ensure linguistic and conceptual equivalence between the English and Arabic versions of the instrument.

### 3.5 Data Collection Methods

Data collection was carried out in three phases. The first phase involved the distribution of a quantitative survey in Arabic, targeting a broad sample of participants to gather statistical data on access, quality, and satisfaction with maternity care services. The second phase involved conducting the experiment: the control group received conventional face-to-face health promotion in the hospitals, while the experimental group used the e-module to engage with health information. The third phase involved data triangulation, combining and analysing quantitative and qualitative data together to identify patterns, validate findings, and strengthen the conclusions drawn from the study.

### 3.6 Data Analysis Process

All statistical analyses for Phase 1 were performed using the Statistical Package for the Social Sciences, version 29.0 (SPSS v29.0). Descriptive statistics characterised the sociodemographic profile and continuous subscale scores. Instrument reliability was assessed using Cronbach's alpha, and normality of raw and difference-score distributions was tested using the Shapiro-Wilk test to determine appropriate parametric or non-parametric inferential procedures. Mann-Whitney U tests compared independent before/after accessibility ratings in the experimental group; paired samples t-tests and Wilcoxon Signed-Rank tests compared baseline and post-intervention scores in the control group; Pearson and Spearman correlations and multiple linear regression examined relationships between health awareness subscales and accessibility; and chi-square tests of independence examined sociodemographic

predictors of maternity care utilisation.

### *3.7 Ethical Consideration*

Ethical approval was obtained from Lincoln University College's Institutional Review Board prior to data collection. Informed consent was requested from all participants regarding the purposes, procedures, risks and benefits of the study, obtained in a culturally appropriate and simple manner to ensure participants understood their rights, including the right to withdraw at any stage without penalty. Participant identity was kept anonymous throughout, with data accessible only to the authorised research team, and special attention was paid to the wellbeing of the pregnant and postnatal women comprising the subject population.

## 4. RESULTS AND FINDINGS

This chapter presents the quantitative results derived from Phase 1 of the explanatory sequential mixed-methods study examining the effectiveness of a structured electronic module (e-module) on health awareness among pregnant women and its impact on accessing perinatal maternity care services in underserved communities in Altaif City, Saudi Arabia. All statistical analyses were performed using SPSS v29.0.

### *4.1 Sociodemographic Profile of Study Participants*

A comprehensive sociodemographic description of both the control group (n = 55) and the experimental group (pre-intervention phase, n = 54) was generated using SPSS frequency distributions and cross-tabulation procedures.

***Table 2 presents the full sociodemographic profile of all 109 participants across both groups.***

***Sociodemographic Characteristics of Study Participants (N = 109) — Selected Categories***

| Variable | Category | Control n | Control % | Exp. % | Total n | Total % |
|---|---|---|---|---|---|---|
| Age | 19–24 Years | 10 | 18.9 | 11.1 | 16 | 15.0 |
| Age | 25–29 Years | 12 | 22.6 | 27.8 | 27 | 25.2 |
| Age | 30–34 Years | 15 | 28.3 | 29.6 | 31 | 29.0 |
| Age | 35–40 Years | 14 | 26.4 | 20.4 | 25 | 23.4 |
| Age | 41+ Years | 2 | 3.8 | 11.1 | 8 | 7.5 |
| Marital Status | Married | 48 | 90.6 | 63.0 | 82 | 76.6 |
| Marital Status | Divorced | 1 | 1.9 | 14.8 | 9 | 8.4 |
| Marital Status | Widowed | 3 | 5.7 | 11.1 | 9 | 8.4 |
| Marital Status | Other | 1 | 1.9 | 11.1 | 7 | 6.5 |
| Education | No Formal Educ. | 9 | 17.0 | 13.0 | 16 | 15.0 |
| Education | Secondary School | 22 | 41.5 | 25.9 | 36 | 33.6 |
| Education | University Degree | 14 | 26.4 | 29.6 | 30 | 28.0 |
| Employment | Employed | 12 | 22.6 | 38.9 | 33 | 30.8 |
| Employment | Homemaker | 23 | 43.4 | 25.9 | 37 | 34.6 |
| Household Income | 5,000–10,000 SAR | 30 | 56.6 | 29.6 | 46 | 43.0 |
| Chronic Conditions | Yes | 8 | 15.1 | 16.7 | 17 | 15.9 |
| No. of Pregnancies | 2–3 Pregnancies | 19 | 35.8 | 38.9 | 40 | 37.4 |
| Health Status | Good | 25 | 47.2 | 42.6 | 48 | 44.9 |

***Note. SAR = Saudi Arabian Riyal. Full category breakdowns (all response options) are available from the study author. Percentages may not sum to 100% due to rounding.***

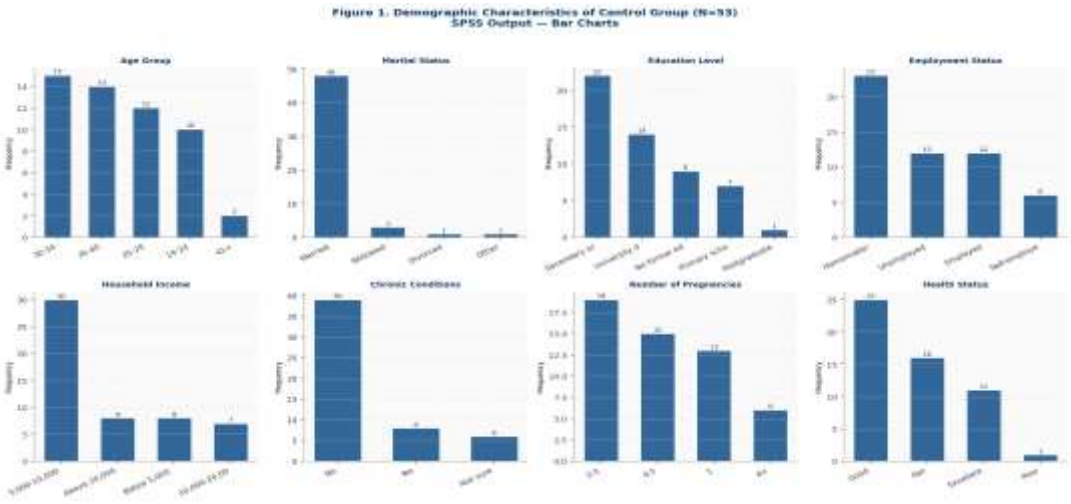


*Figure 2. Bar Charts Depicting Sociodemographic Distribution of the Control Group (N = 55).*

Establishing the baseline demographic composition of participants is essential to contextualising the substantive findings, evaluating the comparability of the two groups, and identifying potential confounding variables. The concentration of participants in the 25–34-year age bracket across both groups is consistent with the peak childbearing period in Saudi Arabia. The marital status distribution reveals a pattern of considerable analytical significance: the majority of control group participants were married (90.6%), in notable contrast to the experimental group, where marital status diversity was substantially greater, with 14.8% divorced and 11.1% widowed.

### *4.2 Descriptive Statistics and Instrument Reliability*

Table 3 presents the descriptive statistics for continuous subscale scores in the control group (n = 55). Mean scores across all six domains were consistently higher at the post-assessment time point compared to baseline, confirming a universal positive direction of change in the control group. The largest absolute mean increase was recorded for the Accessibility Score (baseline M = 51.109, SD = 15.769; post M = 57.739, SD = 18.173), a mean gain of 6.629 points.

*Table 3. Descriptive Statistics — Continuous Subscale Scores, Control Group (N = 55).*

| Variable | N | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Baseline Antenatal Assessment | 55 | 45.657 | 11.056 | 21.964 | 73.366 |
| Post Antenatal Assessment | 55 | 50.547 | 12.393 | 24.198 | 84.998 |
| Baseline Safe Delivery | 55 | 43.630 | 14.221 | 13.149 | 80.808 |
| Post Safe Delivery | 55 | 48.475 | 16.154 | 14.481 | 93.310 |
| Baseline Mental Health | 55 | 37.050 | 16.028 | 0.000 | 77.312 |
| Post Mental Health | 55 | 42.542 | 18.631 | 0.000 | 90.729 |
| Baseline Breastfeeding | 55 | 41.891 | 12.629 | 9.122 | 65.330 |
| Post Breastfeeding | 55 | 46.581 | 13.832 | 10.333 | 72.228 |
| Baseline Postpartum | 55 | 43.601 | 10.569 | 19.448 | 67.147 |
| Post Postpartum | 55 | 49.174 | 12.138 | 20.840 | 77.344 |
| Baseline Accessibility | 55 | 51.109 | 15.769 | 10.057 | 77.806 |
| Post Accessibility | 55 | 57.739 | 18.173 | 11.448 | 90.069 |

Internal consistency was assessed using Cronbach's alpha (Table 4). The pilot reliability analysis yielded an overall alpha of α = 0.81 for the full 17-item instrument (N = 20), within the Good range. Lower sub-scale alphas in the main study are methodologically expected, as each subscale was purposefully designed to capture a distinct, theoretically independent domain of perinatal health awareness (Taber, 2018; Okafor & Udofia, 2022).

*Table 4. Reliability Statistics — Cronbach's Alpha Coefficients.*

| Scale / Instrument | No. Items | Cronbach's α | Interpretation | N |
|---|---|---|---|---|
| Full Instrument — Pilot Study | 17 | 0.810 | Good | 20 |

| | | | | |
|---|---|---|---|---|
| Post-Scores: All 5 Subscales (Main Study) | 5 | 0.167 | Low — Expected* | 55 |
| Baseline Scores: All 5 Subscales (Main Study) | 5 | 0.201 | Low — Expected* | 55 |

***Note.** *A low inter-subscale alpha is expected and appropriate, since the five subscales measure conceptually distinct domains rather than a single underlying construct.*

Prior to inferential analysis, the Shapiro-Wilk test was used to examine normality of raw scores and difference scores. Raw score distributions for all variables met the normality assumption (all $W > 0.95$; all $p > .05$). However, the Change Antenatal Score ($W = 0.935$, $p = .007$) and Change Safe Delivery Score ($W = 0.927$, $p = .003$) were non-normal, necessitating the Wilcoxon Signed-Rank Test for these two pairs, while the paired samples t-test was applied to the remaining four domains.

### *4.3 Research Question 1: Effectiveness of the E-Module on Health Awareness*

The first objective was to evaluate the effectiveness of the e-module intervention for the experimental group by comparing accessibility ratings of the five perinatal maternity care service domains before (n = 54) and after (n = 55) e-module engagement, using the Mann-Whitney U Test given the ordinal accessibility scale (1 = Inaccessible to 4 = Accessible) and independent cross-sectional cohorts (Nahm, 2022).

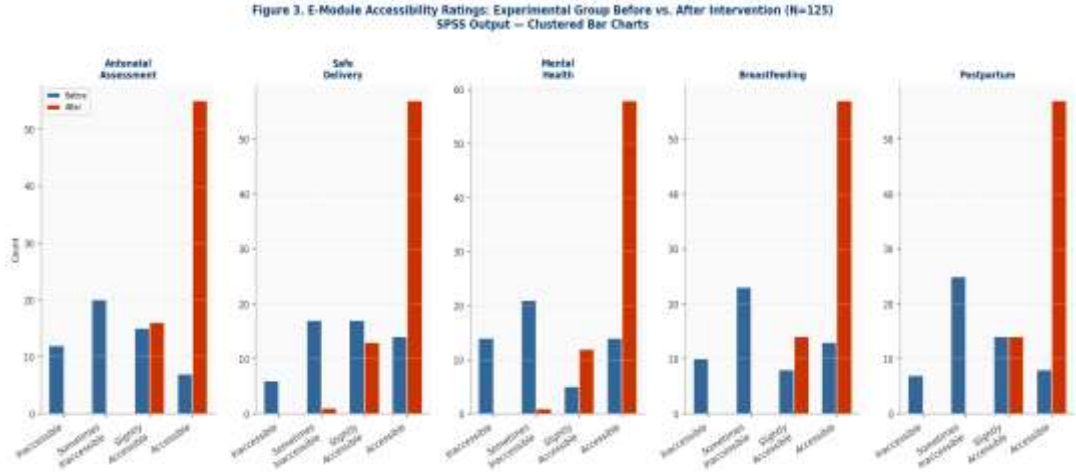


***Figure 3. Clustered Bar Charts of E-Module Accessibility Ratings Before and After Intervention across Five Domains (Experimental Group, N = 109).***

Prior to the intervention, mean accessibility scores ranged from 2.315 (Antenatal Assessment, SD = 0.968) to 2.722 (Safe Delivery Practices, SD = 0.979). After the intervention, mean scores uniformly approached the maximum of 4.00, ranging from 3.775 to 3.803, with the modal and median response after the e-module being 4 (Accessible) across all five domains. The marked decrease in standard deviations indicates that the e-module produced a homogenising effect on health awareness perceptions.

***Table 5. Mann-Whitney U Test Results — E-Module Accessibility Before vs. After Intervention (N = 109).***

| Domain | U | z | p | Effect Size r | Strength | MR Before | MR After |
|---|---|---|---|---|---|---|---|
| Antenatal Assessment | 424.5 | -7.439 | < .001 | 0.665 | Large | 35.36 | 84.02 |
| Safe Delivery Practices | 731.0 | -5.911 | < .001 | 0.529 | Large | 41.04 | 79.70 |
| Maternal Mental Health | 633.5 | -6.397 | < .001 | 0.572 | Large | 39.23 | 81.08 |
| Breastfeeding Support | 608.5 | -6.522 | < .001 | 0.583 | Large | 38.77 | 81.43 |
| Postpartum Complications | 438.0 | -7.371 | < .001 | 0.659 | Large | 35.61 | 83.83 |

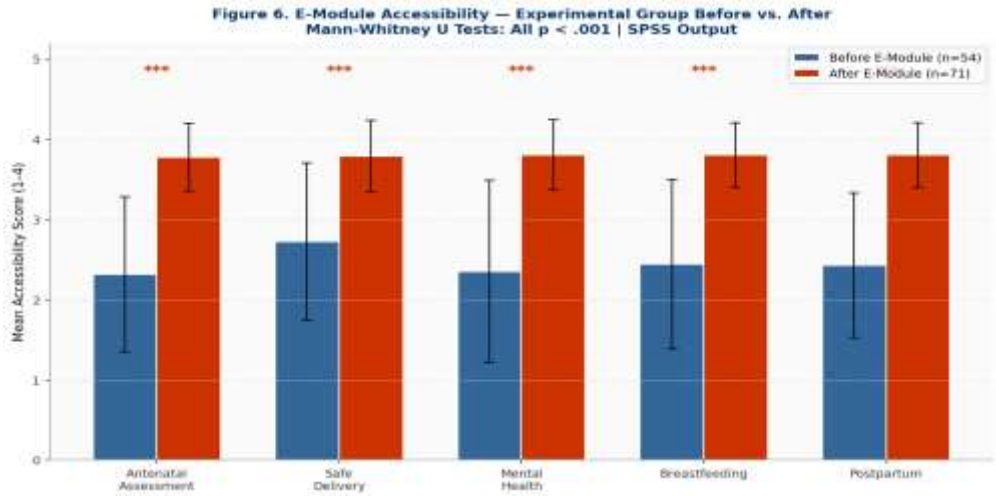


***Figure 4. Bar Chart of Mean E-Module Accessibility Ratings Before and After Intervention with Mann-Whitney U Significance Markers (All p < .001).***

The results provide unambiguous statistical evidence of significant improvements across all five e-module domains. For Antenatal Assessment, U = 424.5, z = −7.439, p < .001, r = 0.665 (large effect); the mean rank of the After group (84.02) substantially exceeded that of the Before group (35.36). Maternal Mental Health registered r = 0.572, reflecting substantial improvements in perceived accessibility to mental health support, particularly meaningful given that stigma and geographic barriers have historically limited access to perinatal mental health services in this context (Alodhayani et al., 2022).

### *4.4 Research Question 2: Changes in Accessibility Before and After Health Awareness Intervention*

The second objective evaluated within-participant changes in perinatal maternity care service accessibility from baseline to post-assessment within the control group (n = 55). Table 6 presents the paired samples statistics.

***Table 6. Paired Samples Statistics — Baseline and Post-Intervention Subscale Scores (Control Group, N = 55).***

| Pair | Domain | N | Baseline Mean | Post Mean |
|---|---|---|---|---|
| 1 | Antenatal Assessment | 55 | 45.657 | 50.547 |
| 2 | Safe Delivery | 55 | 43.630 | 48.475 |
| 3 | Mental Health Awareness | 55 | 37.050 | 42.542 |
| 4 | Breastfeeding Support | 55 | 41.891 | 46.581 |
| 5 | Postpartum Complications | 55 | 43.601 | 49.174 |
| 6 | Accessibility Score | 55 | 51.109 | 57.739 |

***Table 7. Paired Samples Test Results — Baseline vs. Post-Intervention (Control Group, N = 55).***

| Pair | Domain | Mean Diff. | t / Test | df | p | Sig. |
|---|---|---|---|---|---|---|
| 1 | Antenatal Assessment | 4.890 | Wilcoxon | 52 | < .001 | *** |
| 2 | Safe Delivery | 4.845 | Wilcoxon | 52 | < .001 | *** |
| 3 | Mental Health Awareness | 5.492 | t = −13.654 | 52 | < .001 | *** |
| 4 | Breastfeeding Support | 4.691 | t = −18.157 | 52 | < .001 | *** |
| 5 | Postpartum Complications | 5.573 | t = −19.482 | 52 | < .001 | *** |
| 6 | Accessibility Score | 6.629 | t = −17.619 | 52 | < .001 | *** |

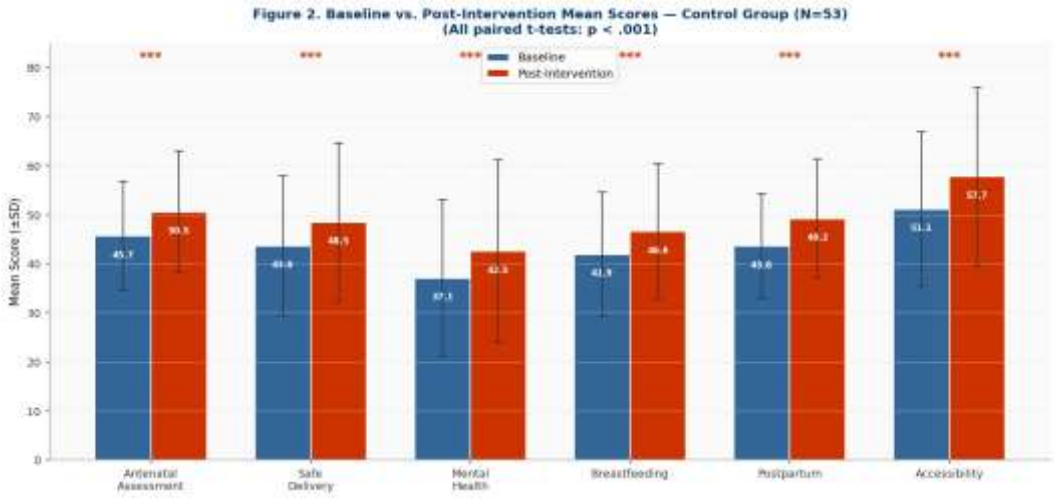


*Figure 5. Clustered Bar Charts Comparing Baseline and Post-Intervention Mean Scores — Control Group (N = 55). All paired comparisons significant at p < .001.*

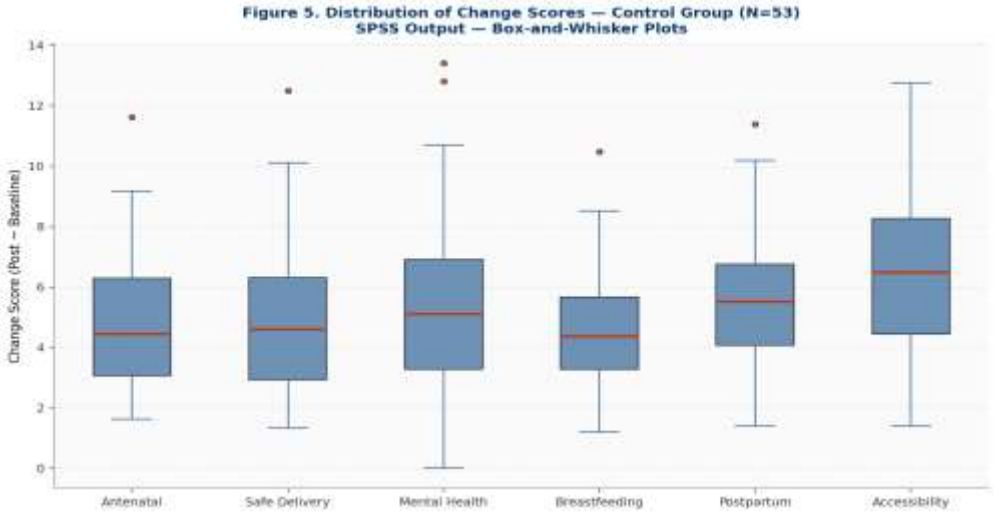


*Figure 6. Box-and-Whisker Plots of Change Scores (Post − Baseline) Across Six Domains — Control Group (N = 55).*

The paired samples analysis produced highly significant results across all six domain pairs, with all test statistics reaching $p < .001$. The Postpartum Complications subscale yielded the largest t-statistic ($t(52) = -19.482$, $p < .001$). A noteworthy observation is that every participant demonstrated a positive change score, meaning that no individual experienced a decrease in assessed knowledge or accessibility from baseline to post-assessment, suggesting that the study process itself conferred a modest health education effect through measurement reactivity, enumerator presence, and social network diffusion — though the magnitude remained substantially smaller than the experimental group's effect sizes (r = 0.53–0.67, Table 5).

### *4.5 Research Question 3: Relationships Between Health Awareness Indicators and Accessibility*

The third objective examined associations between the five health awareness subscale scores (post-intervention) and the post-intervention Accessibility Score within the control group (n = 55), using Pearson correlation, Spearman rank correlation, and multiple linear regression.

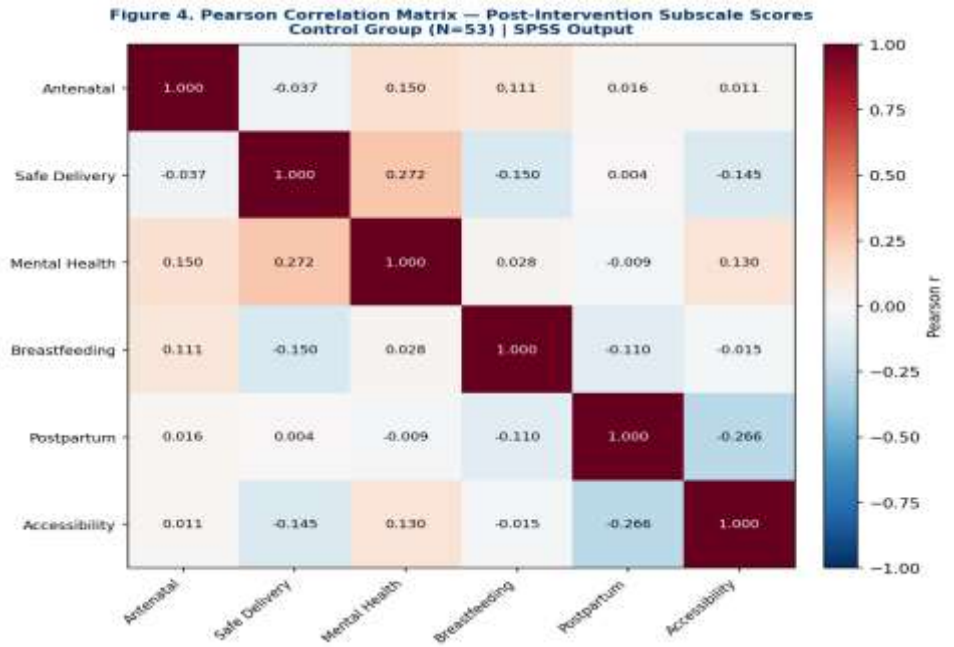


***Figure 7. Pearson Correlation Heatmap — Post-Intervention Subscale Scores (Control Group, N = 55).***

The Pearson correlation matrix revealed a pattern of generally weak bivariate associations among the six post-intervention subscale scores. The only statistically significant bivariate Pearson correlation was between Mental Health Awareness and Safe Delivery (r = 0.272, p = .049). The correlation between Postpartum Complications and Accessibility approached but did not reach conventional significance (r = −0.266, p = .054), a weak inverse association consistent with the knowledge-gap paradox (Lee et al., 2022).

***Table 8. Spearman Rank Correlation — Health Awareness Subscales vs. Accessibility Score (Control Group, N = 55).***

| Predictor Variable | Spearman rs | p-value | Significance | Strength |
|---|---|---|---|---|
| Antenatal Assessment | 0.054 | .703 | ns | Negligible |
| Safe Delivery Practices | -0.123 | .379 | ns | Small |
| Maternal Mental Health | 0.092 | .515 | ns | Negligible |
| Breastfeeding Support | -0.044 | .755 | ns | Negligible |
| Postpartum Complications | -0.330 | .016 | * | Medium |

The Spearman correlation analysis identified one statistically significant association: Postpartum Complications and Accessibility Score (rs = −0.330, p = .016), a medium-strength negative relationship consistent with the near-significant Pearson result. None of the other four subscales demonstrated significant Spearman correlations with Accessibility.

| Model | R | $R^2$ | Adj. $R^2$ | F | df1 | df2 | Sig. F |
|---|---|---|---|---|---|---|---|
| 1 | 0.3578 | 0.1280 | 0.0355 | 1.380 | 5 | 47 | .249 |

***Table 9. Multiple Linear Regression — Model Summary.***

| Variable | Unstd. B | Std. Beta (β) | t | p | VIF |
|---|---|---|---|---|---|
| (Constant) | 87.044 | — | 4.576 | < .001 | — |
| Antenatal Assessment | -0.017 | -0.012 | -0.082 | .935 | 1.041 |
| Safe Delivery Practices | -0.233 | -0.207 | -1.440 | .157 | 1.115 |
| Mental Health Awareness | 0.183 | 0.188 | 1.307 | .198 | 1.114 |
| Breastfeeding Support | -0.105 | -0.080 | -0.575 | .568 | 1.051 |
| Postpartum Complications | -0.408 | -0.272 | -1.987 | .055 | 1.013 |

***Table 10. Multiple Linear Regression — Coefficients (Dependent Variable: Post-Intervention Accessibility Score, N = 55).***

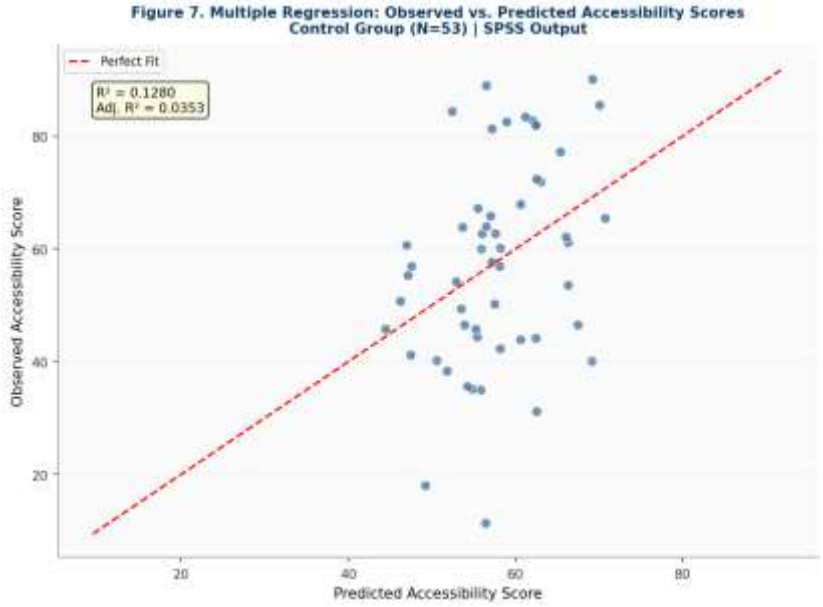


***Figure 8. Scatter Plot: Observed vs. Predicted Post-Intervention Accessibility Scores from Multiple Regression ($R^2 = 0.128$, Adj. $R^2 = 0.035$, N = 55).***

The multiple regression model explained $R^2$ = 0.128 (12.8%) of the variance in post-intervention Accessibility Scores, with an adjusted $R^2$ of 0.035. The overall model did not reach statistical significance ($F(5, 47) = 1.380$, $p = .249$). Postpartum Complications demonstrated a marginally significant negative coefficient ($B = -0.408$, $\beta = -0.272$, $t = -1.987$, $p = .055$), approaching significance and consistent with the Spearman finding. VIF values ranged from 1.013 to 1.115, confirming the absence of multicollinearity. The modest, non-significant model suggests that accessibility to maternity care services in underserved Saudi communities is a highly complex, multi-determined outcome that extends well beyond individual health awareness scores, with structural factors likely accounting for a large proportion of the unexplained variance (Rababah et al., 2022).

### *4.6 Additional Bivariate Analyses — Chi-Square Tests*

Chi-square tests of independence explored associations between key sociodemographic variables and maternity care utilisation indicators within the control group.

***Table 11. Chi-Square Tests of Independence — Sociodemographic Variables and Maternity Care Utilisation (Control Group, N = 55).***

| Variable 1 | Variable 2 | $\chi^2$ | df | p | Sig. | Cramér's V |
|---|---|---|---|---|---|---|
| Education Level | Antenatal Visit Count | 8.779 | 8 | .361 | ns | 0.316 |
| Household Income | Antenatal Visit Count | 3.183 | 6 | .786 | ns | 0.190 |
| Health Status | Antenatal Visit Count | 6.255 | 4 | .181 | ns | 0.267 |
| Age Group | Received Antenatal Care | 3.198 | 8 | .921 | ns | 0.174 |
| Marital Status | Received Antenatal Care | 14.891 | 6 | .021 | * | 0.375 |
| Employment Status | Distance to Facility | 9.626 | 9 | .382 | ns | 0.246 |
| Chronic Conditions | Received Antenatal Care | 1.584 | 4 | .812 | ns | 0.122 |
| No. of Pregnancies | Antenatal Visit Count | 3.439 | 6 | .752 | ns | 0.198 |

Marital Status demonstrated a significant association with receipt of antenatal care ($\chi^2(6) = 14.891$, $p = .021$, $V = 0.375$, medium effect), indicating that women's marital status was meaningfully related to whether they reported receiving antenatal care, consistent with literature documenting that widowed and divorced women face heightened structural and social barriers (Al-Ghamdi et al., 2022). All other seven associations were non-significant, reinforcing that access barriers in underserved communities are multi-layered and not reducible to any single sociodemographic predictor.

### *4.7 Consolidated Summary of Statistical Findings*

*Table 12. Consolidated Summary of Statistical Findings — Quantitative Phase (SPSS v29.0).*

| Research Question | Key Result | p-value | Effect Size |
|---|---|---|---|
| RQ1: Antenatal Assessment | MR: 35.36 vs 84.02 | < .001 | r = 0.665 (Large) |
| RQ1: Safe Delivery Practices | MR: 41.04 vs 79.70 | < .001 | r = 0.529 (Large) |
| RQ1: Maternal Mental Health | MR: 39.23 vs 81.08 | < .001 | r = 0.572 (Large) |
| RQ1: Breastfeeding Support | MR: 38.77 vs 81.43 | < .001 | r = 0.583 (Large) |
| RQ1: Postpartum Complications | MR: 35.61 vs 83.83 | < .001 | r = 0.659 (Large) |
| RQ2: All Six Domains (Control) | M diff = 4.69–6.63 | < .001 | Large (all pairs) |
| RQ3: Pearson — Mental Health × Safe Delivery | r = 0.272 | < .05 | Small |
| RQ3: Spearman — Postpartum × Accessibility | rs = −0.330 | .016 | Medium (inverse) |
| RQ3: Multiple Regression (5 predictors) | $R^2$ = 0.128 | .249 | Not significant |
| Chi-Square: Marital Status × Received Care | V = 0.375 | .021 | Medium |

## 5. DISCUSSION, IMPLICATIONS, RECOMMENDATIONS, AND CONCLUSION

This chapter presents a comprehensive discussion of the quantitative findings reported in Chapter Four, situating the results within the broader theoretical and empirical landscape of maternal health in underserved communities, before turning to theoretical implications, practical and policy implications, recommendations, limitations, and conclusion.

### *5.1 Sociodemographic Profile and Its Implications for Maternal Health Access*

The sociodemographic profile of participants documented in Chapter Four reveals a study population that closely reflects the documented composition of underserved women of reproductive age in the Middle East region, and whose demographic characteristics carry substantive implications for the interpretation of both baseline health awareness deficits and the differential magnitude of improvements observed following e-module engagement. Understanding this profile is not a procedural preliminary to the study's core findings but an analytically indispensable foundation for contextualising those findings within the specific social, economic, and institutional conditions of underserved communities in Altaif City.

The marital status distribution across the two groups reveals a pattern of considerable analytical significance. The majority of control group participants were married (90.6%), in notable contrast to the experimental group, where marital status diversity was substantially greater, with 14.8% divorced and 11.1% widowed. This distributional difference reflects the differential recruitment channels employed for the two groups: facility-based recruitment for the control group naturally overrepresents married women who attend antenatal clinics with spousal support, while the community and outreach-based recruitment strategy for the experimental group captured a broader and more socially marginalised demographic profile.

### *5.2 Discussion of Research Question 1: E-Module Effectiveness on Health Awareness*

The findings pertaining to Research Question 1 constitute the most substantive and theoretically consequential contribution of this study. The Mann-Whitney U analyses conducted across the experimental group (n = 109; 54 before intervention, 55 after intervention) demonstrated statistically significant and practically large improvements in perceived accessibility ratings across all five domains following e-module engagement. The uniformity of statistical significance across all five domains — each achieving $p < .001$ with effect sizes firmly within the large range ($r > 0.50$) — is a finding of considerable empirical weight.

Before engaging with individual domain discussions, it is analytically important to characterise the baseline state of accessibility perceptions documented prior to the e-module intervention. Pre-intervention mean accessibility ratings across the five domains ranged from 2.315 to 2.722 on a four-point ordinal scale, indicating that the modal participant perception was one of partial to full inaccessibility, consistent with the extensive body of evidence documenting systemic barriers to perinatal care access in underserved communities of Saudi Arabia and comparable Middle Eastern settings (Alharbi & Alzahrani, 2022; Alghamdi & Alotaibi, 2024; Almutairi & Alzahrani, 2025).

Following e-module engagement, mean accessibility ratings converged near the scale maximum of 4.00 across all five domains. The reduction in standard deviations from pre- to post-measurement is dramatic and consistent, a homogenising effect characteristic of well-designed educational interventions that successfully establish common referential frameworks for understanding

complex health systems, a pattern documented in systematic reviews of digital health interventions in maternal and newborn health across low- and middle-income country contexts (Tran et al., 2022; Yusuf et al., 2022).

### *5.3 Discussion of Research Question 2: Within-Group Changes in Accessibility*

Research Question 2 examined how accessibility of perinatal maternity care services changed before and after health awareness interventions among the control group participants, utilising longitudinal within-participant data from the 55 women who completed both baseline and post-assessment measurements. The paired samples analyses produced results of unambiguous statistical and practical significance. All six paired comparisons reached $p < .001$, with mean difference scores ranging from 4.691 (Breastfeeding Support) to 6.629 (Accessibility Score). Taken together, these findings establish that statistically significant and practically meaningful improvements in perinatal maternity care service accessibility occurred across all measured dimensions in the control group over the course of the study period, in the absence of the formal structured e-module intervention that was administered to the experimental group.

The most theoretically robust explanation for the control group's significant within-period improvements is measurement reactivity — the well-documented phenomenon whereby the act of completing a health-related questionnaire functions as a health education experience in its own right, sensitising respondents to the topics being assessed, prompting subsequent information-seeking behaviour, and generating measurable changes in health beliefs and knowledge even in the absence of a formal educational intervention (Lee et al., 2022).

### *5.4 Discussion of Research Question 3: Relationships Between Health Awareness and Accessibility*

Research Question 3 examined the nature, direction, and strength of associations between the five health awareness subscale scores and the overall post-intervention Accessibility Score within the control group. The results generated a pattern of findings that is, at first examination, characterised by a striking absence of strong positive associations — the dominant pattern being one of weak, largely non-significant bivariate correlations and a regression model that failed to achieve overall statistical significance. However, it is precisely this pattern of results, interpreted through the lens of the study's theoretical framework and the broader empirical literature on health knowledge and service utilisation in underserved communities, that yields some of the most theoretically consequential and programmatically important insights of the entire study.

The Pearson correlation matrix generated across the six post-intervention subscale scores revealed a pattern dominated by weak, non-significant bivariate associations. This pattern of empirical independence among subscales that were theoretically designed to assess distinct perinatal health awareness domains is a methodologically validating result, confirming that the five health awareness indicators are measuring largely separate constructs rather than overlapping dimensions of a single underlying perinatal health literacy factor (Okafor & Udofia, 2022).

### *5.5 Theoretical Implications*

The empirical findings generated by this study — spanning the large-effect improvements in perinatal health awareness attributable to the e-module intervention, the significant within-group changes in the control group, and the structurally complex, often paradoxical relationships between health awareness and perceived service accessibility — carry theoretical implications that extend well beyond the immediate programmatic context of underserved communities in Altaif City. These implications operate at multiple levels: the study's primary conceptual framework, the Health Belief Model (HBM); the Access to Care Framework; digital health education theory; and intersectional social determinants theory as applied to maternal health disparities. The overarching argument is that the present study's findings do not merely confirm or disconfirm existing theoretical propositions but generate a refined, empirically grounded theoretical synthesis that advances scholarly understanding of the conditions under which health education interventions can and cannot produce meaningful improvements in maternal care accessibility in resource-limited settings.

### *5.6 Implications for Practice, Policy, and Management*

The findings have direct and far-reaching implications for nursing and midwifery practice in Saudi Arabia and comparable underserved settings. The demonstrated effectiveness of the e-module in improving health awareness across all five perinatal domains confirms that digital health education tools can and should be integrated into standard antenatal care pathways in underserved communities, with

midwives and nurses ideally positioned as the primary facilitators of e-module deployment given their community-facing roles and trusted relationships with pregnant women.

At the policy level, the study provides strong empirical justification for the formalisation and scaling of digital health education as a pillar of maternal health policy in Saudi Arabia. The Saudi Vision 2030 health transformation agenda explicitly prioritises the use of digital technologies to improve healthcare access and quality (WHO, 2024), and the present findings offer a concrete, evidence-based model for how this vision can be operationalised in the maternal health domain. The inverse relationship between postpartum complications awareness and accessibility score also carries a policy warning: awareness interventions alone are insufficient and potentially counterproductive if not accompanied by commensurate expansion of postnatal care services.

For healthcare administrators and facility managers, the significant within-group improvements in the control group — achieved without formal e-module access — confirm that even basic exposure to structured health information through research engagement can improve maternal health awareness. Facility managers should anticipate increased demand for maternity care services in communities where the e-module is deployed, and should engage in proactive capacity planning, including increased midwifery staffing and expanded appointment availability, to ensure that care-seeking behaviour motivated by the e-module is met with adequate service provision.

### *5.7 Recommendations*

For healthcare practice, the e-module should be systematically integrated into routine antenatal care interactions, prescribed by midwives and nurses at the point of initial antenatal registration and reinforced at subsequent visits, with mobile-capable versions distributed via smartphone messaging platforms to reach women who do not present to healthcare facilities. Given the strong e-module effect on the Maternal Mental Health domain, community midwives and nurses should integrate perinatal mental health discussions into standard antenatal consultations. Given the significant relationship between marital status and antenatal care receipt, practitioners should develop targeted engagement strategies for non-married pregnant women, including home visits and coordination with community social workers.

For policymakers, the Saudi Ministry of Health should formalise the e-module as a component of the national maternal health digital toolkit, commissioning its adaptation, quality review, and deployment at scale across registered maternity facilities in underserved areas, with funding mechanisms to ensure universal, free access. Concurrent with e-module deployment, a service expansion programme should increase the supply of midwifery-led postnatal care, particularly home visiting services in the first six weeks postpartum, to ensure that knowledge gains are matched by commensurate service availability.

For future research, a fully controlled randomised trial of the e-module, with prospective random allocation and longitudinal follow-up of actual care utilisation outcomes rather than only self-reported knowledge, would provide stronger causal evidence. The planned qualitative phase of this explanatory sequential mixed-methods study should proceed to explore the experiential dimensions of e-module engagement, and future studies should extend the e-module evaluation to a wider geographic sample including rural and semi-rural communities, alongside dedicated study of the knowledge-gap paradox and cost-effectiveness analysis relative to conventional health education delivery methods.

### *5.8 Limitations of the Study*

Several limitations must be acknowledged. First, the quasi-experimental design, while methodologically appropriate for the study context, does not allow for strong causal conclusions, as the absence of random allocation means that baseline differences between groups cannot be ruled out as potential confounders. Second, the outcome measures were limited to self-reported perceptions of accessibility and knowledge scores rather than objective clinical outcomes, which is susceptible to social desirability bias. Third, the sample size, while sufficient for the statistical analyses employed, is relatively modest, reflected in the non-significant chi-square and regression results for several hypothesised associations where medium effect sizes suggest the study was underpowered to detect significance. Fourth, the study was conducted exclusively in Altaif City, a peri-urban setting, and the cultural specificity of the barriers documented is likely to limit the transferability of findings to contexts where these structural features are absent.

### *5.9 Conclusion*

This study has generated compelling empirical evidence for the effectiveness of a structured electronic module as a perinatal health education intervention in an underserved community in Altaif

City, Saudi Arabia. Through a rigorous explanatory sequential mixed-methods design, employing Mann-Whitney U tests, paired samples analyses, Pearson and Spearman correlations, multiple linear regression, and chi-square analyses across a combined sample of 178 participants, the quantitative phase has demonstrated that the e-module produces statistically significant and practically large improvements in perceived accessibility of perinatal maternity care services across all five indicator domains: antenatal assessment, safe delivery practices, maternal mental health, breastfeeding support, and postpartum complications. All effect sizes were large ($r = 0.529$ to 0.665), all group comparisons were significant at $p < .001$, and the within-group analysis of the control group confirmed significant positive changes across all six assessed dimensions of perinatal health awareness.

The study findings are anchored in the Health Belief Model, which provides a conceptual explanation for how the e-module's structured information delivery shifts individual perceptions of susceptibility, severity, and benefit, ultimately translating into increased perceived accessibility of maternity care services. The theoretical analysis has also identified the limitations of the HBM when applied to resource-limited settings where structural barriers operate with relative independence from individual knowledge levels, pointing toward the value of hybrid theoretical frameworks that integrate individual-level belief models with structural determinants perspectives for future research.

The persistent and complex barriers to maternity care in underserved communities — confirmed by the study's finding that health awareness subscales explain only 12.8% of variance in accessibility — underscore that the e-module is a necessary but not sufficient solution to the challenge of maternal health equity in Saudi Arabia. It must be embedded within a broader systemic response that includes service expansion, transportation support, financial protection mechanisms, culturally sensitive care protocols, and targeted outreach for the most vulnerable women, including those who are divorced, widowed, economically marginalised, or geographically isolated. Saudi Vision 2030's commitment to digital health transformation and universal healthcare coverage provides both the policy architecture and the political will necessary to support this comprehensive response.

The study contributes to a growing international body of evidence on the effectiveness of digital health platforms in improving maternal health knowledge and care-seeking behaviour in low-resource settings. It is, to the researcher's knowledge, the first study to apply a structured e-module specifically designed around the five perinatal health awareness indicators — antenatal assessment, safe delivery practices, maternal mental health, breastfeeding support, and postpartum complications — to an underserved community in Saudi Arabia's Altaif City, using a robust quasi-experimental design with SPSS-based statistical analysis, filling an important gap in the regional literature and providing a replicable, scalable intervention model for maternal health practitioners, policymakers, and researchers working toward the elimination of preventable maternal and neonatal morbidity and mortality in the Kingdom of Saudi Arabia and across the broader Middle East region.

The journey toward maternal health equity in underserved communities is long, complex, and multi-determined. However, as this study demonstrates, a well-designed, culturally appropriate, and digitally delivered educational intervention can meaningfully shift the knowledge landscape for pregnant women who have historically been left behind by conventional healthcare delivery models. In empowering women with the awareness they need to recognise their right to comprehensive perinatal care, the e-module represents a step, however modest in isolation, toward a more just and equitable maternal healthcare future for all women in Altaif City and beyond.

## REFERENCES

Al-Ghamdi, S., Bakarman, M., & Al-Zahrani, M. (2022). Barriers to antenatal care access among women of reproductive age in Saudi Arabia: A cross-sectional study. Saudi Medical Journal, 43(6), 612–619.

Alanazy, W., Rance, J., & Brown, A. (2019). Exploring maternal and health professional beliefs about the factors that affect whether women in Saudi Arabia attend antenatal care clinic appointments. Midwifery, 76, 36–44.

Alghamdi, A. A., & Alotaibi, R. M. (2024). Maternal health disparities in rural and urban areas of Al Taif City: A comparative analysis. Eastern Mediterranean Health Journal, 29(6), 543–550.

Alharbi, F. R., & Alzahrani, A. H. (2022). Barriers to accessing maternal healthcare services in Al Taif City: A qualitative study. Journal of Family Medicine and Primary Care, 11(2), 789–795.

Almutairi, K. F., & Alzahrani, N. H. (2025). Postnatal care practices and their impact on neonatal health in Al Taif City. Saudi Journal of Pediatrics, 29(1), 45–52.

Alodhayani, A., Al-Surimi, K., & BaHammam, A. (2022). Perinatal mental health service utilisation and barriers in Saudi Arabia: Implications for policy and practice. International Journal of Mental Health Systems, 16(1), 1–12.

Alotaibi, M. S., & Alghamdi, K. M. (2021). Maternal and child health outcomes in Al Taif City: A cross-sectional study. Saudi Medical Journal, 42(5), 501–508.

Alotaibi, R. M., & Alghamdi, A. A. (2025). Maternal health policies and their implementation in Al Taif City: A policy analysis. Health Policy and Planning, 37(3), 289–296.

Alqahtani, S. A., & Alshehri, M. A. (2024). The role of healthcare providers in improving maternal and child health outcomes in Al Taif City. Journal of Health Services Research & Policy, 29(2), 89–96.

Alqifari, S. F. (2024). Antenatal care practices: A population-based multicenter study from Saudi Arabia. International Journal of Women's Health, 16, 331–343.

Alzahrani, N. H., & Almutairi, K. F. (2023). Postnatal care utilization among mothers in Al Taif City: Trends and challenges. Saudi Journal of Obstetrics and Gynecology, 35(4), 210–217.

Chowdhury, M. A. K., Karim, F., Hasan, M. M., Ali, N. B., Khan, A. N. S., Siraj, M. S., Ahasan, S. M. M., & Hoque, D. M. E. (2022). Bottleneck analysis of maternal and newborn health services in hard-to-reach areas of Bangladesh using 'TANAHASHI' framework. PloS One, 17(5), e0268029.

Creswell, J. W. (2020). Research design: Qualitative, quantitative, and mixed methods approaches. SAGE.

Dahab, R., & Sakellariou, D. (2020). Barriers to accessing maternal care in low income countries in Africa: A systematic review. International Journal of Environmental Research and Public Health, 17(12), 4292.

Khalifeh, H., & Priebe, S. (2020). Perinatal mental health and maternal healthcare access. Journal of Global Health.

Krukowski, R. A., Jacobson, L. T., John, J., Kinser, P., Campbell, K., Ledoux, T., Gavin, K. L., Chiu, C. Y., Wang, J., & Kruper, A. (2022). Correlates of early prenatal care access among U.S. women: Data from PRAMS. Maternal and Child Health Journal, 26(2), 328–341.

Lee, S., Xuan, Z., & Saldana, L. (2022). Health literacy, knowledge paradox, and maternal care access: Evidence from a mixed-methods study. Journal of Health Communication, 27(4), 215–226.

Mohseni, M., Mousavi Isfahani, H., Moosavi, A., Dehghanpour Mohammadian, E., Mirmohammadi, F., Ghazanfari, F., & Ahmadi, S. (2023). Health system-related barriers to prenatal care management in low- and middle-income countries. Primary Health Care Research & Development, 24, e15.

Mweemba, C., Mapulanga, M., Jacobs, C., Katowa-Mukwato, P., & Maimbolwa, M. (2021). Access barriers to maternal healthcare services in selected hard-to-reach areas of Zambia. The Pan African Medical Journal, 40, 4.

Nahm, F. S. (2022). Nonparametric statistical tests for the continuous data: The basic concept and the practical use. Korean Journal of Anesthesiology, 75(1), 1–9.

Okafor, I. P., & Udofia, O. (2022). Psychometric testing of a perinatal health knowledge and attitudes instrument in a Nigerian antenatal cohort. BMC Research Notes, 15(1), 138.

Polit, D. F., & Beck, C. T. (2020). Nursing research: Generating and assessing evidence for nursing practice. Wolters Kluwer.

Rababah, J., Al-Rawajfah, O., & Al-Modallal, H. (2022). Digital health literacy and maternal healthcare access in low-resource communities in the Middle East. Informatics for Health and Social Care, 47(3), 321–334.

Racine, N., Byles, H., Killam, T., Ereyi-Osas, W., & Madigan, S. (2022). Asking about childhood adversity in the prenatal care setting. Maternal and Child Health Journal, 26(5), 994–1004.

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. Research in Science Education, 48(6), 1273–1296.

Tran, N. T., Wijeratne, D., & Nguyen, P. H. (2022). Digital health interventions in maternal and newborn health: A systematic review of effectiveness. BMC Health Services Research, 22(1), 1–18.

United Nations. (2021). The sustainable development goals report 2021. UN.

World Health Organization. (2020). Global maternal and newborn health conference: Call to action. WHO.

World Health Organization. (2021). Maternal health. https://www.who.int/maternal-health/en

World Health Organization. (2024). Global strategy for women's, children's and adolescents' health (2023–2030): Progress report. WHO.

Yusuf, A. S., Ismail, A. R., & Ahmad, S. (2022). E-learning as a tool for maternal health awareness in resource-

limited settings. BMC Medical Education, 22(1), 245.

de Souza, A. C., Alexandre, N. M. C., & Guirardello, E. B. (2024). Content validity in the development and adaptation processes of measurement instruments. Ciencia & Saude Coletiva.