Effect of Educational Intervention Based on Health Literacy Model on Knowledge and Lifestyle among Women with Gestational Diabetes

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Abstract

Background: Pregnant mothers and their fetuses are at risk of developing gestational diabetes (GDM) which is a serious health issue. Individuals' literacy levels significantly impact their decision-making and lifestyle practices, which in turn have an impact on managing and preventing persistent diseases like diabetes .**The aim of the study** was to evaluate the effect of educational intervention based on a health literacy model on knowledge and lifestyle among women with gestational diabetes. **Research design:** Quazi experimental design was used to conduct the present study. **Setting:** The study was carried out at Zagazig University Hospital's outpatient clinics at the antenatal care unit. **Subjects:** Purposive sample of 90 pregnant women with gestational diabetes. **Tools of data collection:** Three tools were used for data collection. **Tool I**: A structured interviewing questionnaire; **Tool II:** Self-administered Health Literacy Questionnaire (HLQ); and **Tool III:** Health Promotion Lifestyle Profile Scale (HPLP). **Results:** The study revealed a significant improvement in all subscales of women's knowledge, health literacy and health promotion lifestyle, with a highly statistically significant difference ($p < 0.01$). Additionally, a highly statistically significant positive correlation was found between total women's knowledge score, total health literacy and total health promotion lifestyle score at pre and post implementation of the educational intervention ($p = 0.000$).**Conclusion**: It was concluded that the investigated women's total knowledge, health literacy, and health promotion lifestyles improved significantly after the intervention. **Recommendations:** Incorporating health literacy principles alongside traditional maternity care services is essential for effectively managing gestational diabetes.

Key words: Health Literacy Model, Knowledge, Lifestyle, Gestational Diabetes.

Introduction

Gestational diabetes (GDM) is a disorder characterized by elevated blood sugar levels during pregnancy, regardless of whether the patient has a history of diabetes. It can occur in women with insulin resistance or those who have never been diagnosed with diabetes before ***(de Mendonça etal., 2022)***. The prevalence of gestational diabetes varies greatly around the globe, ranging from 1% to 28%, depending on screening methodologies and population variables. In Egypt, approximately 7.2% of pregnant women suffer from gestational diabetes.***(Fathy et al., 2018).*** GDM is more prevalent among women with specific risk factors, such as a history of abortion, induced labor, delivering large babies, living in urban areas, high blood pressure, preeclampsia, and advanced maternal age ***(Eltoony et al., 2021)***.

The exact cause of gestational diabetes remains unclear. However, it may be linked to the hormones released by the placenta to support the fetus's growth and development during pregnancy. These hormones can interfere with the mother's insulin function, leading to insulin resistance. This makes it harder for cells to absorb glucose properly, causing blood glucose levels to remain high and continue to rise (***Desoky etal ., 2022)***.

Gestational diabetes symptoms may include increased appetite, frequent urination, excessive thirst, or fatigue, particularly in the second or third trimester. However, many women with gestational diabetes may show no symptoms. Regardless of risk factors, all pregnant women

should be evaluated for gestational diabetes between 24 and 28 weeks of pregnancy; earlier screening is advised for those with risk factors ***(Muche, Olayemi, & Gete, 2020*)**.

Gestational diabetes can cause several obstetrical problems, including macrosomia, hypoglycemia, hyperbilirubinemia, respiratory distress syndrome, preterm labor, polyhydramnios, infections, cesarean delivery, fetal death, fetal malformations, and perinatal mortality. Furthermore, both the mother and child may face long-term health difficulties later in life, such as obesity, type 2 diabetes mellitus, cardiovascular disease, and cognitive deficits (***Yew et al., 2021).***

The ability to comprehend and apply health information to make wise decisions is known as health literacy. Women can more successfully navigate this crucial time of life by increasing their health knowledge and readiness before to conception ***(Mohamady etal ., 2022).***

Health literacy plays a key role in promoting healthier lifestyle behaviors, enhancing overall well-being, and improving quality of life. For pregnant mothers, being aware of their health is essential for two main reasons. First, pregnancy may mark a woman's first encounter with the healthcare system. For those with adequate literacy skills, navigating such a complex system might still feel overwhelming. However, for women with low health literacy, accessing new information and following medical instructions can be particularly challenging. Second, a mother's health and her understanding of health information can have a profound impact on the health of her fetus (***Shieh & Halstead ,. 2020).***

Knowledge is crucial in creating effective health concepts. Research indicates that individuals often misinterpret medical information when they lack comprehension of their illness. This misunderstanding can lead to poorer pregnancy outcomes and decreased adherence to treatment plans. Additionally, various cultural factors significantly influence the tendency to seek medical care, particularly among pregnant women ***(Saboula, Ahmed and Rashad,2018).***

Changing one's lifestyle is fundamental to the treatment of gestational diabetes mellitus (GDM). Adopting healthier habits is essential for effectively managing gestational diabetes. Timely interventions, along with lifestyle changes and appropriate medical care, can significantly reduce the risk of complications during pregnancy**(Morris et al., 2020)** .

Women with gestational diabetes can benefit from educational programs that increase their understanding of the disease, how to manage it, and how to maintain normal blood sugar levels. Additionally, these programs can support participants in making beneficial adjustments to their eating and exercise routines, ultimately resulting in lower anxiety levels ***(Magbool et al., 2021)***.

Maternity nurses play a crucial role in decreasing morbidity and mortality rates for women diagnosed with gestational diabetes. By educating mothers on topics such as nutrition, exercise, self-monitoring, and insulin use, nurses can assist women in effectively managing their condition and minimizing the chances of negative pregnancy outcomes. Additionally, nurses can offer vital information to women, boosting their knowledge of gestational diabetes and fostering a positive perspective on their health ***(Mohamedet al., 2020).***

Significance of the Study:

The prevalence of Gestational Diabetes Mellitus (GDM) varies significantly across the globe, with rates ranging from 1% to 28%. Due to its seriousness and the sharp rise in cases, GDM has emerged as one of the most pressing health issues of the twenty-first century. A lack of sufficient health education is considered a worldwide challenge. It is essential for pregnant women to engage actively in health promotion and preventive care, as this can enhance their lifestyle choices and lower the risk of serious conditions like gestational diabetes. The level of understanding among pregnant mothers plays a vital role in this endeavor. Therefore, it is critical to improve women's awareness of gestational diabetes and to mitigate the repercussions related to its diagnosis***(Magbool et al., 2021)***. So the current study was conducted.

Aim of the study:

The aim of the study was to evaluate the effect of educational intervention based on health literacy model on knowledge and lifestyle among women with gestational diabetes.

Research hypotheses:

To achieve the aim of this study, the following research hypotheses were developed:

H1. Educational interventions based on the health literacy model will enhance the knowledge of pregnant women with gestational diabetes mellitus (GDM).

H2. Pregnant women with GDM who receive the educational intervention will exhibit higher health literacy model scores.

H3. Pregnant women with GDM who receive the educational intervention are more likely to maintain a healthy lifestyle during pregnancy.

Subjects and Methods:

- **Research design:**

A quasi-experimental approach with pre- and post-tests was adopted.

- **Study Setting:**

The study was carried out at Zagazig University Hospital's antenatal care unit, which is part of its outpatient clinic. This location was chosen because it serves as the principal healthcare center for expecting women in the Zagazig area. It provided an ideal setting for offering prenatal care and important educational materials. The unit is located on the second floor of the outpatient clinic, next to the gynecological unit, and is made up of two rooms: a spacious, well-equipped examination room and a smaller space reserved for the assisting nurse. The unit is open every day from 9 a.m. to 2 p.m.

- **Study Subjects:**

The study comprised 90 pregnant mothers diagnosed with gestational diabetes who were getting treatment at the prenatal care department of the outpatient clinic and met the following criteria:: -

- ***Inclusion criteria: -***
  - Pregnant women with a single fetus between 24 and 28 weeks.
  - Not taking medications that could raise blood sugar levels, such as corticosteroids.
  - Previously had no history of chronic conditions such as hypertension or gestational diabetes.
  - **Sample size calculation:**

Sample size: Gharachourlo , et al 2018, found that Mean score of environment health practice as a domain of lifestyle health, pre intervention program was (17.78±3.48) and upraised to be (20.98± 10.1) at follow up intervention program, with a power of 80% and a confidence level of 95% , added two to be round number , Sample size was calculated using Open Epi, is **90** women.

$$n = [(Z\alpha/2/2 + Z\beta)^2 \times \{2(ó)^2\}]/(\mu1 - \mu2)^2$$

where n = sample size required ,
μ1 = mean pre intervention confidence score,
μ2 = mean of confidence score post intervention
ó = standard deviation
Zα /2: This depends on level of significance, for 5%
Zβ: This depends on power, for 90%
Reference of sample size calculation
Sakpal, V.T.:2010 Sample Size Estimation in Clinical Trial ,
PICR ,Vol 1 Issue 2

- **Tools for data collection:**

Three tools were employed to gather the data required to meet the study's goals:

Tool I: A structured interviewing schedule. The researchers created it in plain Arabic in order to gather the data required to meet the goals of the study. It was divided into three sections:

Part 1: ***Demographic characteristics*** of the study sample: Five questions were used to gather information on the study sample's demographics: age, education level, residence, occupation, and phone number.

Part 2: *Obstetric history*, including current gestational age, mode of delivery, number of para, and number of gravida.

Part 3: *knowledge about the gestational diabetes mellitus.*

The researchers created it in plain Arabic, using the literature that was available as a guide, to gauge women's understanding of gestational diabetes **(Nguyen et al., 2021; Eltoony et al., 2021)**. It included seventeen multiple-choice questions.

Scoring system of knowledge

The total score ranged from 0-34 grades for each item and was assigned: a score (2) was provided when the answer was totally correct, a score (1) was given when the answer was incomplete correct and a score (0) was given when the answer was wrong or don't know.

- **The following formula was used to determine total knowledge of gestational diabetes mellitus:**
  - Knowledge that is satisfactory≥ 70% of total points.
  - Knowledge that is Unsatisfactory <70% of total points.

Tool (II) Self-administered Health Literacy Questionnaire (HLQ):

It was adapted from ***Montazeri et al.(2014)*** and modified by the researchers .The scale consisted of five sub scales and **33 items** on a four-point

Likert-type scale ranging from 1 to 4 (always = 4, sometimes = 3, rarely = 2 and never = 1).). ***The researchers modified the likert scale from five to four points (Always to Never) in view of the validity modifications (jury opinion).*** The subscales evaluated both the internal and external aspects of health literacy, which included the capacity to read health care data, comprehend it, assess its validity, access health resources, and make informed health decisions.

A full explanation of the HLQ and its ***five subscales*** was described as follow:

1- Reading health information:

This four-question subscale assessed the participants' proficiency in reading booklets, pamphlets, and posters that include health education information. Scores ranged from **4 to 16**. Greater reading ability is indicated by a higher score.

2- Understanding health information:

This seven-item subscale assessed participants' understanding of their doctor's explanations regarding their illness. Scores ranged from **7 to 28**, higher scores suggest a greater understanding of health information.

3-Ability to access health information: This six-item subscale assessed the participants' ability to obtain information about their condition. Higher scores indicated a greater ability to retrieve health information; values ranged from **6 to 24.**

4- Appraisal of health information:

Participants' capacity to judge the veracity of health information from radio and television was evaluated using this four-item subscale. Higher scores indicated a greater ability to evaluate health information; values ranged from **4 to 16**.

5- Decision making:

A subscale containing twelve items was utilized to evaluate the participant's ability to make decisions regarding health-related actions. One example of this is the statement, "I will continue taking the medications prescribed by my doctor for my illness, even if the symptoms of the disease go away, unless I receive his approval to stop." In this subscale, a higher score indicated improved decision-making skills. On this subscale, the overall score varied from **12 to 48**.

Tool III: <u>Health Promotion Lifestyle Profile scale (HPLP).</u>

This questionnaire adapted and expanded from ***Walker and Hill-Polerecky (1996),*** measures pregnant women's health-related behaviors. Diet, exercise, health responsibility, spiritual development, interpersonal support, and stress management are the six subscales that comprise its 48 items. Participants used a 4-point Likert scale to score how frequently they engage in particular health-promoting behaviours: **never (1), rarely (2), sometimes (3), and always (4).** The total score was ranged between **48-192** grades.

***Total score :**

- Satisfactory level ≥ 70% of total scores
- Unsatisfactory level <70% of total scores

Content Validity

The tools' validity was evaluated by three experts, consisting of two professors from the obstetrics and gynecology nursing departments and one professor specializing in community health nursing, focusing on content validity. These experts reviewed the tools considering factors such as their understanding, application, thoroughness, clarity, and relevance. All recommended modifications to the tools were implemented. Based on the needs highlighted by the study participants and existing literature, the researchers developed a comprehensive guidebook that addresses all facets of gestational diabetes. The brochure was revised and validated by the same experts who evaluated the tool, and all suggested changes were incorporated.

<u>Reliability</u>

Tools' reliability was tested by Alpha Cronbach reliability analysis.

Tools	Alpha Cronbach	Internal consistency
Women knowledge about the gestational diabetes	0.869	Good
Self-administered Health Literacy Questionnaire (HLQ)	0.961	Excellent
Health Promotion Lifestyle Profile scale (HPLP)	0.988	Excellent

<u>Pilot study</u>

Prior to the main investigation, a pilot study was conducted to evaluate the feasibility and understandability of the research tools. This pilot, which was finished one month prior to the start of the primary data collection, involved nine women, or 10% of the study's entire eligible population. The pilot study's objectives were to evaluate the tools' usefulness and spot any problems with the questions, such their vagueness

or illogical sequence. The pilot study also assisted in estimating how long it would take participants to finish the questionnaires. After reviewing the results of the pilot study, it was concluded that, with a few minor clarifications, the questions were relevant and easy to understand. The data collection form was subsequently finalized based on the feedback from the pilot study. Those who took part in the pilot were excluded from the primary study population.

- **Field work:**

The researchers utilized an interview questionnaire to gather data for their study. After identifying pregnant women with gestational diabetes mellitus (GDM) who met the inclusion criteria, they informed them about the study's goals and collected their contact information. These women were granted permission to participate. The researchers conducted visits to the study setting twice a week, specifically on Mondays and Wednesdays, from 9 a.m. to 1 p.m. in the outpatient clinic's waiting area. The women completed the questionnaires, while the researchers dedicated approximately 30 to 45 minutes for each interview. The study lasted five months, from the beginning of June 2024 to the end of October 2024. Based on an assessment of the educational needs of the participants, the researchers designed educational sessions aimed at enhancing their knowledge and encouraging self- Care activities related to GDM. These sessions were developed with reference to various existing studies and literature, addressing both theoretical and practical aspects of GDM management and control, and were presented in straightforward Arabic. The following phases were chosen and carried out in order to complete the study's aim: the assessment, planning, implementation, and evaluation phases.

Assessment phase:

This initial step was completed after consent was obtained in the study setting. Using the collection and analysis of baseline data from the completed tools, the needs in knowledge and lifestyle about GDM were determined in the pre-test. Therefore, a portion of the program's development was based on an assessment of women's GDM knowledge and lifestyle.

- **Planning & Implementation phase:**

The researchers created the intervention program and its session contents based on the findings of the assessment phase, taking into consideration the needs of the identified women as well as relevant literature. The goals and objectives of the intervention sessions (four scheduled sessions) were derived from the identified needs, requirements, and gaps in knowledge and lifestyle. Every session lasted between 30 and 45 minutes, and it was scheduled according to the day the woman chose at her prenatal follow-up appointments. Additionally, in accordance with study ethical guidelines, the researchers created a GD educational booklet to assist the women in following the instruction sessions and using as a guide at home. It covers the definition, prevalence, risk factors, impact of pregnancy on diabetes mellitus (DM), the complications of DM on both the mother and the fetus, and lifestyle and treatment improvements.

The training program was divided into two main sections: a **theoretical section** that addressed the fundamentals of gestational diabetes and included two sessions, and a **practical section** emphasized the need of maintaining a healthy lifestyle for the purpose of managing the disease and contained **2 sessions.**

The initial session began with an overview of the topics covered in the GDM educational program for women. At the conclusion of each session, the women were informed about the timing of the next one. Prior to the first session, participants received a brief recap of the previous one, along with a clear explanation of its objectives in basic Arabic. Mothers were given the chance to ask questions to clear up any misunderstandings at the end of each session. Diabetes mellitus, its effects during pregnancy, and the possible long-term health hazards for children delivered to moms with the illness were the subjects of the first session. The implications of gestational diabetes on pregnancy and its potential long-term health effects on infants were the main topics of the second session. The significance of maintaining a healthy lifestyle in the management of gestational diabetes was underlined in the third and fourth sessions. The women were organized into 10 groups, with each subgroup consisting of 9 women who attended these sessions again. A variety of teaching methods were employed during the

study, including discussions, brainstorming activities, and hands-on demonstrations. To enhance learning, all participants were provided with educational materials, including PowerPoint presentations, images, and videos that encompassed the entire topic of healthy lifestyles for mothers with gestational diabetes.

Evaluation phase:-

Using the same evaluation tools as the pre-test, a post-test was conducted two weeks after the program's implementation to gauge its efficacy.

***Ethical consideration:**

The study was approved by Zagazig University's Faculty of Nursing's scientific and ethics committee. The **Zu.Nur.REC#: 0118/8/5/2024** was the code of ethics. Each woman was informed of the study's objectives before using the tools to gain her trust and confidence. After assuring each woman that the information gathered will be handled in confidence and that the study's procedures won't have any negative consequences on the participating pregnant women, she verbally consented to participate. The women were made aware that they might leave the study at any moment and for any reason.

Administrative design.

The researchers obtained formal authorization from the administration of Zagazig University to gather the sample by sending a letter to the dean of the faculty of medicine, initiated by the dean of the faculty of nursing. During meetings and discussions, the researchers communicated the ethical aspects of the study to the participants.

❖ **Statistical Analysis:**

IBM compatible computers running the Statistical Package for Social Science (SPSS) version 25 for Windows were used to organise, tabulate, and statistically analyse the acquired data. The use of descriptive statistics, such as frequency, percentages, mean, and standard deviation, was implemented. The analysis of variance (ANOVA) test was used to compare the means of more than two categories, while the significance test, paired T test (t), and independent T test were used to compare the means of quantitative variables. The correlation between the variables under study was examined using the correlation coefficient test (r). $P < 0.05$ was regarded as a significant level value, and $p < 0.01$ as a highly significant level value. When $p \geq 0.05$, no statistically significant difference was taken into account.

Results:

Table (1) clarifies that, 41.1% of studied women were in the age group 30-<35 years, with a mean age of 31.73 ± 3.99 years and it was obvious that 41.1% of them have secondary school. 57.8% of the women in the study were housewives, and 61.1% lived in rural areas.

Table (2) shows that 96.7% of the women in the study have no family history of diabetes. Forty percent of them had a family history of gestational diabetes, and ninety-seven percent were first-degree relatives. Moreover, 40.0% & 51.1% respectively of studied women have 1-2 pregnancies and previous birth. In addition, 48.9% of them had normal vaginal delivery. Moreover, the gestational age at recruitment in the study was ranged between 24-28 weeks with a mean age of 25.10 ± 1.32 weeks.

Figure (1) shows that, following the implementation of the educational intervention, women's overall knowledge score regarding gestational diabetes improved significantly, with a highly statistically significant difference at (P=< 0.01) when compared to before the educational sessions were given. It is evident that 23.3% of the women in the study had a satisfactory level of overall knowledge regarding gestational diabetes before the intervention, and this percentage improved to 85.6% after the intervention, with a mean SD of 29.96 ± 5.16.

Table (3): explains a significant increase in the overall mean of all women's health literacy subscales following the educational intervention's implementation compared to before, with a highly statistically significant difference at (P=< 0.01). The mean SD for the overall health literacy score was 62.26 ± 16.46 before the intervention and changed to 110.83 ± 12.45 after the intervention.

Table (4): shows that, there was a marked improvement in all subscales of women's health promotion lifestyle after implementation of educational intervention compared to pre providing educational sessions with a highly statistically significant difference at (P= < 0.01). As evidence, 18.9% of participants have satisfactory practices regarding health promotion lifestyle with mean SD 99.96 ± 25.59 in the pre-intervention phase. While changed to be 82.2% with mean SD 159.85 ± 19.07 in the post-intervention phase.

Figure (2) shows that, 18.9% the women in the study have satisfactory practices regarding health promotion lifestyle in the pre-intervention phase. While changed to be 82.2% in the post-intervention phase.

Table (5) indicates that, there was highly statistically significant positive correlation between total women's knowledge score and total health literacy score (r= 0.517, p=0.000) in the pre-intervention phase and (r= 0.328, p=0.002) in the post-intervention phase. Additionally, the overall women's knowledge score and the total health promotion lifestyle score showed a very statistically significant positive correlation. (r= 0.607, p=0.000) in the pre-intervention phase and (r= 0.567, p=0.000) in the post-intervention phase. Moreover, there was highly statistically significant positive correlation between total women's health literacy score and total health promotion lifestyle score (r= 0.629, p=0.000) in the pre-intervention phase and (r= 0.574, p=0.000) in the post-intervention phase.

Table 6: as for total knowledge score post intervention it summarizes that, educational level, residence and total health promotion life style were statistically significant independent positive predictors of women knowledge score. The model explains 49.5% of variation in knowledge score.

Table 7: In multivariate analysis, it shows that family history for gestational diabetes was statistically significant independent negative predictors of women's health promotion lifestyle score pre intervention. Before an educational intervention was carried out, the model explained 78.5% of the variation in women's overall health-promoting lifestyle. Meanwhile at post intervention phase it was obvious that the statistically significant independent positive predictor of studied women's health promotion lifestyle score were total health literacy score and total knowledge sore. Following the implementation of an educational intervention, the model accounts for 49.0% of the variation in the overall health-promoting lifestyle of women.

Discussion:

There are serious health hazards associated with gestational diabetes mellitus (GDM) for both expectant mothers and their fetues. The incidence of this condition has been rising. Elevated blood sugar levels during pregnancy can negatively impact both the mother and the fetus, potentially leading to adverse perinatal outcomes ***(Magbool et al ., 2021)***. Ongoing education and support for patients regarding self-management are crucial for preventing immediate issues and reducing the risk of long-term complications. Additionally, educating pregnant mothers about GDM and providing them with the necessary information will help them lead healthier lives***(Magbool et al ., 2021)***. One of the primary approaches to managing and preventing gestational diabetes includes lifestyle changes such as dietary modifications, heightened physical activity, and regular monitoring of blood glucose levels ***(Takele et al.,2024).*** In fact, People's literacy skills greatly influence their choices and daily habits, which subsequently affect their ability to manage and prevent chronic conditions such as diabetes ***(Eyüboğlu & Schulz,2016)*** .

The purpose of the current study was to evaluate the study hypotheses, specifically that women with gestational diabetes will have better knowledge, lifestyle, and health literacy after implementing an educational intervention. The study's findings supported the research hypotheses by showing that the women's health literacy, knowledge, and lifestyle had improved.

In terms of demographics, the current study found that the women under investigation had a mean age of 31.73 ± 3.99 years. This was in accordance with ***Ko and Lee.,(2024)*** study to evaluate the impact of a training Program on Comprehensive Lifestyle Modification for Women with Gestational Diabetes Mellitus," which found that the majority of pregnant women in the study were in the age category ≤35, with a mean age of 30.61 ± 3.6 years. Moreover; ***Carroll et al., 2018*** reported that the mean age of women was 29.31 ± 4.30. On the other hand, ***El-Ansary & Fouad, 2020*** was found that the mean age of the participants in the study was 26.6 ± 5.9 years. This variation could be due to differences in the study setting and the characteristics of the subjects involved.

The findings of this study revealed that less than half of the studied women had a family history of gestational diabetes. This is consistent with a **study** by **Al-Hashmi et al., 2023 at** Sultan Qaboos University Hospital's antenatal clinic in Muscat, Oman, which discovered that one-third of the participating women had a family history of gestational diabetes. Additionally, nearly one-third of the women in the study had a family history of GDM, according to **Abdel-Moaty et al.**

(2023). This can be explained by the fact that diabetes mellitus is a common hereditary disorder that may run in families.

Regarding the research hypothesis that needs to be addressed, women's knowledge will be improved after the educational intervention is implemented. **Concerning the overall knowledge score among the studied participants**, the current study demonstrated that around one fifth of the studied sample have satisfactory level of knowledge regarding gestational diabetes before implementation of educational intervention. While changed to be more than three quarters of them after implementation of the educational intervention. The reason for this could be attributed to the focused and comprehensive teaching program that filled in some information gaps regarding gestational diabetes in pregnant mothers. Participants were probably able to gain a comprehensive understanding of the topic by attending the scheduled sessions designed to enhance knowledge about gestational diabetes. This was consistent with a quasi-experimental study carried out in Assiut City, Upper Egypt, by **Abd Elsalam (2021)**, which assessed the impact of an educational program on maternal and fetal outcomes in 50 pregnant women with gestational diabetes, the results of the study showed a post-intervention considerable improvement in total knowledge scores. Furthermore, **Abdel-Moaty et al., 2023** showed that majority of the expectant mothers had inadequate knowledge about GDM prior to the intervention. This percentage was dramatically reduced to one-tenth following the intervention.

Regarding total health literacy scores, the study found a significant improvement in all women's health literacy subscales and mean SD for overall health literacy score after the educational intervention ($P < 0.01$) compared to before. These results emphasize the significance of counseling and the contribution of counselor midwives in enhancing the health literacy of pregnant women with gestational diabetes. This result aligns with the research conducted by **Gharachourlo et al., 2018** at Alborz and Kamali Hospitals in Karaj, Iran, which discovered that both immediately following the intervention and three weeks later, the intervention group's average health literacy score improved noticeably more than that of the control group. Also in line with **Vila-Candel et al., 2020**, who investigated the influence and function of midwifery counseling in enhancing health literacy among women with diabetes, including gestational diabetes, and investigated interventions meant to improve the health of low-literate women of reproductive age. This ensured the success of the educational intervention.

As for the health promotion life style average score , the present study found a marked improvement in all subscales of women's health promotion lifestyle after implementation of the educational intervention. A rational interpretation of this result could be due to the support and ongoing education provided by the educational sessions to the women under study. To regulate their blood sugar, they made an effort to follow appropriate, healthful behaviors as a result of being more conscious of their illness. This finding was in the same line with the findings of a study conducted by **Desoky et al. (2022)**who found a significant difference in women's lifestyles related to GDM, including nutrition, physical activity, stress management, and health responsibility ($P < 0.001$). Furthermore, this was consistent with the findings of **Abdel-Moaty et al. (2023)**, who discovered that the tele-nursing training program had a substantial impact on the average scores across all criteria of the health promotion lifestyle scale for the women involved in the study, both pre and post intervention.

In terms of the HPLP scale's total scores between pre and post-intervention, the current study found that only less than one-fifth of the studied women had satisfactory health promotion practices in the pre-intervention phase, which improved for the majority of them in the post-intervention phase**.** This finding is congruent with that of **Sadeghi et al.'s (2022)** study, which assessed the impact of a training program based on the Pender model on healthy behaviors among Iranian women of reproductive age. The statistics reveal that the experimental group's overall lifestyle score improved significantly following six sessions of the scheduled intervention. Similarly, a study conducted by ***Abdel-Moaty et al., (2023)*** also reported that less than one-fifth of the studied women exhibited satisfactory practices regarding health promotion lifestyle before the intervention, while this number significantly improved among the majority of them after the intervention. This improvement in

health promotion lifestyle practices among the studied women can be explained by the tendency for healthy habits to develop in parallel with increasing knowledge levels. The educational intervention likely prompted women to apply their newly acquired knowledge about healthy measures to enhance their own lifestyle practices.

The study results showed that there was highly statistically significant positive correlation between total women's knowledge score, total health literacy and total health promotion lifestyle score at pre and post implementation of the educational intervention. These results were quite similar to a study by **Desoky et al., 2022** which showed a substantial beneficial correlation between the total knowledge, total lifestyle, and overall health belief model scores before and after the GDM educational package was implemented. In addition; ***Abdel-Moaty et al., (2023)*** illustrated; the study revealed a significant association ($p < 0.05$) between health promotion lifestyle profile, post-self-efficacy scores, and post-knowledge scores in participant with GDM following the intervention. This implies that educational nursing interventions are crucial for the comprehensive management of gestational diabetes.

The Multiple linear regression model for women's knowledge at pre and post intervention revealed that educational level, residence, and total health promotion lifestyle were statistically significant independent positive predictors of women's knowledge score. The model explains 49.5% of variation in knowledge score with an R-squared value of 0.495. This was partially consistent with ***Abdel-Moaty et al., (2023)*** was noted that, after the intervention, the location of residence significantly predicted the overall knowledge level independently. Furthermore, **Ogu et al. (2020)** identified some similarities with the present study, as their model indicated that place of residence positively influenced general knowledge about gestational diabetes mellitus (GDM) with a 95% confidence interval. On the other hand, **Lis-Kuberka & Orczyk-Pawiłowicz's (2021)** study discovered no significant correlation between residence and knowledge of GDM. This disparity could be attributable to the fact that many women nowadays have easy access to a wide range of information through numerous mass media channels.

Regarding to Multiple linear regression model for women's health promotion lifestyle at pre and post intervention, the current study summarized that family history for gestational diabetes was statistically significant independent negative predictors of women's health promotion lifestyle score pre intervention. Before the educational intervention, the model explained 78.5% of the variation in total women's health promotion lifestyle (R-squared = 0.785). After the intervention, the model explained 49.0% of the variation in total women's health promotion lifestyle (R-squared = 0.490). Total health literacy and total knowledge scores were the only statistically significant independent positive predictors of women's post-intervention health promotion lifestyle scores. This was partially in agreement with ***Abdel-Moaty et al., (2023)*** it was reported that following the intervention, both knowledge and self-efficacy emerged as positive predictors of the overall health promotion lifestyle score. The model was able to explain 54% of the variance in the total lifestyle score after the intervention. In contrast, this finding contradicts the work of **Al Hashmi (2021),** who indicated that multiple regression analysis revealed that women's perceived self-efficacy and educational level only accounted for 20% of the overall variance in commitment to a healthier way of life. This relationship was deemed statistically significant overall ($F(1, 88) = 23.60$, $p < 0.000$).

Conclusion:

Considering the findings of the present study it was concluded that; the educational program based on the health literacy model enhanced the level of knowledge and lifestyle among women with gestational diabetes, supporting the research hypotheses. Furthermore, a significant positive correlation was discovered between the overall knowledge score, total health literacy, and overall health-promoting lifestyle score in these women, both before and after the educational intervention**.**

Recommendation:

The following suggestions are made in light of the results of the current study:

1. Incorporating health literacy principles alongside traditional maternity care services is

essential for effectively managing gestational diabetes.

2. The health literacy model should be used to guide the implementation of straightforward, uncomplicated educational programs that will raise women's awareness and encourage a healthy lifestyle.

3. A large-scale application of this model across different regions aims to enhance women's knowledge and healthy lifestyles must be established.

Future researches:

- A training program designed around a health literacy model aimed at enhancing maternity nurses' knowledge and practices related to the management of gestational diabetes.

Table (1): Frequency distribution of the studied women according to their demographic characteristics (n=90).

Demographic characteristics	No.	%
Age (Years)		
25-<30	27	30.0
30-<35	37	41.1
35-40	26	28.9
Range	**(25 - 39)**	
Mean ± SD	**31.73 ± 3.99**	
Educational level		
Read & write	2	2.2
Primary school	14	15.6
Preparatory school	4	4.4
Secondary school	37	41.1
University	33	36.7
Occupation		
Working	38	42.2
Housewife	52	57.8
Residence		
Urban	35	38.9
Rural	55	61.1

SD= Standard deviation.

Table (2): Frequency distribution of the studied women according to their health history (n=90).

Items	No.	%
Family history of diabetes		
Yes	3	3.3
No	87	96.7
Family history of gestational diabetes		
Yes	36	40.0
No	54	60.0
IF there is family history, what is the relation? (n=36)		
First degree relation	33	91.7
Second degree relation	3	8.3
Previous obstetrical history		
Gravida		
1-2	28	31.1
3-4	36	40.0
>4	26	28.9
Parity		
None	5	5.6
1-2	46	51.1
3-4	39	43.3
Mode of last delivery		
None	5	5.6
Normal vaginal delivery	44	48.9
Cesarean section	41	45.5
Present obstetric history		
Gestational age (Weeks)		
24-25	66	73.3
26-27	13	14.5
28	11	12.2
Range	**(24-28)**	
Mean ± SD	**25.10 ± 1.32**	

SD= Standard deviation.

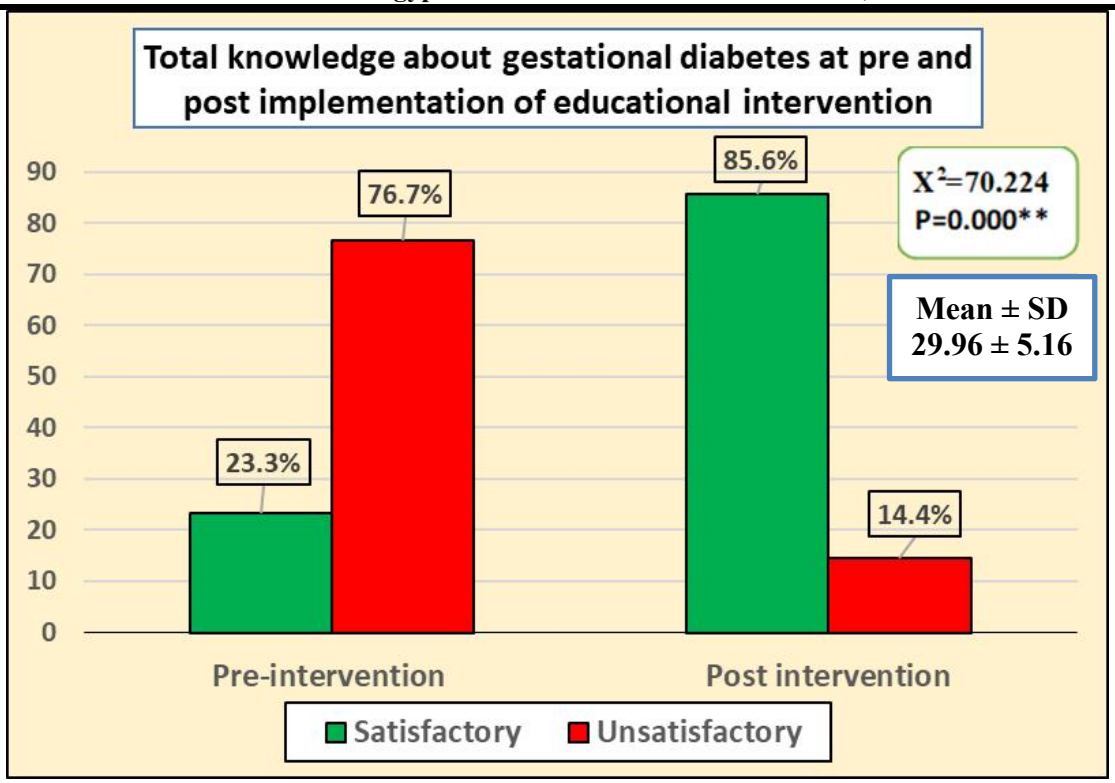

Figure (1): Percentage distribution of the studied women according to their total knowledge about gestational diabetes at pre and post implementation of educational intervention (**n=90).**

Table (3): Comparison between the studied women according to their total health literacy at pre and post implementation of educational intervention (n=90).

Health literacy sub scales	No. of items	Pre intervention	Post intervention	T	P-value
		Mean ± SD	Mean ± SD		
Reading health information	4	6.977 ± 2.54	12.31 ± 2.09	25.44	0.000**
Understanding health information	7	13.77 ± 3.99	24.47 ± 2.69	24.30	0.000**
Ability to access health information	6	12.67 ± 3.87	19.75 ± 2.64	14.55	0.000**
Appraisal of health information	4	8.15 ± 1.82	13.48 ± 1.74	23.80	0.000**
Decision making	12	20.67 ± 7.40	40.80 ± 5.91	25.41	0.000**
Total health literacy score	**33**	**62.26 ± 16.46**	**110.83 ± 12.45**	**31.38**	**0.000****

t= Paired t. test, **SD=** Standard deviation **Highly significant at p ‹ 0.001.

Table (4): Comparison between the studied women according to their total health promotion lifestyle at pre and post implementation of educational intervention (n=90).

Health Promotion Lifestyle subscales	Pre intervention				Post intervention				X^2	P-value
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
	No.	%	No.	%	No.	%	No.	%		
Nutrition	26	28.9	64	71.1	72	80.0	18	20.0	**47.39**	**0.000****
Physical Activity	15	16.7	75	83.3	65	72.2	25	27.8	**56.25**	**0.000****
Health responsibility	21	23.3	69	76.7	74	82.2	16	17.8	**62.61**	**0.000****
Spiritual growth	16	17.8	74	82.2	80	88.9	10	11.1	**91.42**	**0.000****
Interpersonal relations	24	26.7	66	73.3	84	93.3	6	6.7	**83.33**	**0.000****
Stress management	18	20.0	72	80.0	75	83.3	15	16.7	**72.28**	**0.000****
Total health promotion lifestyle	**17**	**18.9**	**73**	**81.1**	**74**	**82.2**	**16**	**17.8**	**72.20**	**0.000****
Range	**65 - 146**				**128 - 188**				**t= 27.241**	**0.000****
Mean ± SD	**99.96 ± 25.59**				**159.85 ± 19.07**					

X^2: Chi-square test, **SD=** Standard deviation **Highly significant at p ‹ 0.001.

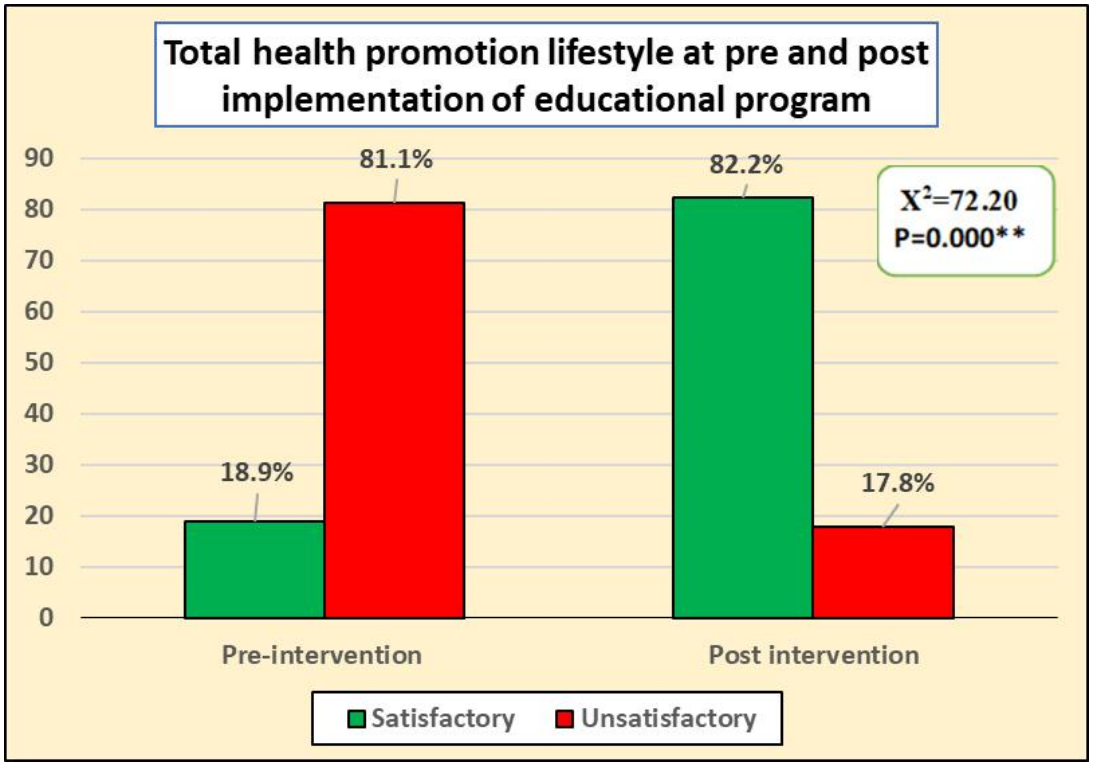

Figure (2): Percentage distribution of the studied women according to their total health promotion lifestyle at pre and post implementation of educational intervention (n=90).

Table (5): Correlation matrix between total knowledge score, total health literacy score, total health promotion lifestyle score among the studied women at pre and post implementation of educational intervention (n=90).

Variables		Total knowledge score		Total health literacy score	
		Pre intervention	Post intervention	Pre intervention	Post intervention
Total knowledge score	r p	1	1		
Total health literacy score	r p	0.517 0.000**	0.328 0.002**	1	1
Total health promotion lifestyle score	r p	0.607 0.000**	0.567 0.000**	0.629 0.000**	0.574 0.000**

r= coefficient correlation test. **p**= p-value *Significant at p ‹ 0.05. **highly significant at p ‹ 0.01.
Interpretation of r: **Weak** (0.1-0.24) **Intermediate** (0.25-0.74) **Strong** (0.75-0.99) **Perfect** (1).

Table (6): Multiple linear regression model for women's knowledge at pre and post implementation of educational intervention (n=90).

Items	B	Std. Error	Beta	t	P. value	95% Confidence interval		R^2	ANOVA	
						Lower	Upper		F	P. value
Total knowledge at pre –intervention										
Model 1								0.576	38.99	0.000**
(Constant)	2.136	3.124		0.684	0.496	-4.074-	8.346			
Occupation	-3.220-	0.909	-0.270-	-3.542-	0.001**	-5.027-	-1.413-			
Family history of gestational diabetes	3.406	0.922	0.284	3.695	0.000**	1.574	5.239			
Total health promotion lifestyle score	0.144	0.017	0.621	8.618	0.000**	0.110	0.177			
Total knowledge at post –intervention										
Model 2								0.495	28.04	0.000**
(Constant)	-0.129-	3.555		-0.036-	0.971	-7.197-	6.938			
Educational level	1.509	0.388	0.326	3.893	0.000**	0.738	2.279			
Residence	3.456	0.814	0.328	4.246	0.000**	1.838	5.075			
Total health promotion lifestyle score	0.116	0.023	0.429	5.150	0.000**	0.071	0.161			

Variables entered and excluded in model 1: Age, educational level, residence, family history of diabetes and total health literacy score.
Variables entered and excluded in model 2: Age, occupation, family history of diabetes, family history of gestational diabetes and total health literacy score.
B=Unstandardized Coefficients. **Beta**=Standardized Coefficients. **t:** Independent t-test. R^2 = Coefficient of multiple.
**highly significant at p ‹ 0.01.

Table (7): Multiple linear regression model for women's health promotion lifestyle at pre and post implementation of educational intervention (n=90).

Items	B	Std. Error	Beta	t	P. value	95% Confidence interval		R^2	ANOVA	
						Lower	Upper		F	P. value
Total health promotion lifestyle at pre –intervention										
Model 1								0.785	50.61	0.000**
(Constant)	-7.345-	10.345		-0.710-	0.480	-27.92-	13.23			
Age	7.553	1.966	0.228	3.841	0.000**	3.643	11.46			
Family history of gestational diabetes	-21.29-	3.115	-0.410-	-6.837-	0.000**	-27.491-	-15.10-			
Family history of diabetes	35.53	7.669	0.251	4.634	0.000**	20.284	50.79			
Educational level	4.590	1.308	0.200	3.511	0.001**	1.990	7.191			
Total health literacy score	0.680	0.099	0.437	6.886	0.000**	0.483	0.876			
Total knowledge score	1.542	0.272	0.357	5.666	0.000**	1.001	2.083			
Total health promotion lifestyle at post –intervention										
Model 2								0.490	41.78	0.000**
(Constant)	39.063	13.818		2.827	0.006**	11.599	66.528			
Total health literacy score	0.666	0.124	0.435	5.369	0.000**	0.420	0.913			
Total knowledge score	1.566	0.299	0.424	5.231	0.000**	0.971	2.162			

Variables entered and excluded in model 1: Occupation and residence.

Variables entered and excluded in model 2: Age, educational level, occupation, residence, family history of diabetes and family history of gestational diabetes**.**

B=Unstandardized Coefficients. **Beta**=Standardized Coefficients. **t:** Independent t-test. R^2 = Coefficient of multiple.

**highly significant at p ‹ 0.01.

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