IJBMC
International Journal of Body, Mind and Culture

Volume 12, Issue 6, pp 275-286
DOI: 10.61838/ijbmc.v12i6.1084

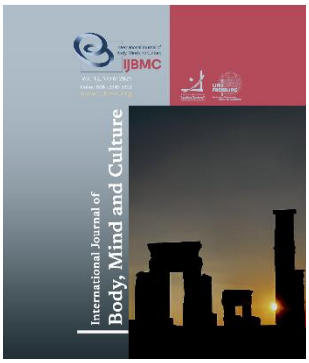
Article type:
Original Research

Effectiveness of Cognitive-Behavioral Therapy Combined with Virtual Lifestyle Training on Glucose Control, Psychological Distress, and Neonatal Outcomes in Women with Gestational Diabetes

Zahra. Karimpour Aramaki[1], Ezzatollah. Kordmirza Nikouzadeh[2*], Mojgan. Aghaharis[3], Mahdieh. Rahmanian[4]

1 Ph.D. Student, Department of Health Psychology, Payame Noor University, Tehran, Iran.
2 Associate Professor, Department of Psychology, Payame Noor University, Tehran, Iran.
3 Associate Professor, Department of Psychology, Payame Noor University, Tehran, Iran.
4 Associate Professor, Department of Psychology, Payame Noor University, Tehran, Iran.

Corresponding author email address: Kordmirza@pnu.ac.ir



Article history:

Received 21 Feb 2025
Revised 14 May 2025
Accepted 24 June 2025
Published online 01 Sep 2025

How to cite this article:
Karimpour Aramaki, Z., Kordmirza Nikouzadeh, E., Aghaharis, M., & Rahmanian, M. (2025). Effectiveness of Cognitive-Behavioral Therapy Combined with Virtual Lifestyle Training on Glucose Control, Psychological Distress, and Neonatal Outcomes in Women with Gestational Diabetes. International Journal of Body, Mind and Culture, 12(6), 275-286.

ABSTRACT

Objective: Gestational diabetes mellitus (GDM) is a major health risk for both mother and fetus and is often associated with poor glycemic control and elevated psychological distress. Integrating cognitive-behavioral therapy (CBT) with lifestyle education may improve maternal outcomes by addressing both behavioral and emotional factors. This study evaluated the effectiveness of CBT combined with virtual lifestyle training on blood glucose levels, psychological distress, and neonatal outcomes in women with GDM.

Methods and Materials: A quasi-experimental pretest-posttest control group design was employed. A total of 100 women with GDM and comorbid overweight and thyroid conditions were selected through purposive sampling and randomly assigned to experimental (n = 50) and control (n = 50) groups. The intervention group received six weekly sessions of CBT alongside virtual healthy lifestyle training. Primary outcomes included fasting blood glucose, oral glucose tolerance, depression (measured by EPDS), anxiety (measured by GAD-7), birth weight, and Apgar score. Data were analyzed using MANCOVA and ANCOVA.

Findings: The intervention led to significant improvements in fasting glucose ($F= 157.6$, $p< .001$, $\eta^2 = 0.738$), oral glucose tolerance ($F= 56.1$, $p< .001$, $\eta^2 = 0.501$), depression ($F = 111.4$, $p< .001$, $\eta^2 = 0.662$), and anxiety ($F = 49.1$, $p< .001$). Birth weight also improved significantly ($t= 5.95$, $p< .001$). No significant difference was found in Apgar scores between groups.

Conclusion: CBT integrated with virtual lifestyle intervention effectively improves glycemic control and emotional well-being in women with GDM. Its application in prenatal care could enhance maternal and neonatal outcomes.

Keywords: Cognitive Behavioral Therapy, Gestational Diabetes, Blood Glucose, Depression, Anxiety, Virtual Health.

Introduction

Gestational diabetes is one of the most common metabolic disorders during pregnancy, resulting from increased insulin resistance and hormonal changes. This condition can lead to various biological complications for both the mother and fetus, and if not properly controlled, may result in acute and chronic adverse outcomes (Greco et al., 2024). Biological complications associated with

gestational diabetes include preeclampsia, preterm delivery, fetal macrosomia, shoulder dystocia, neonatal hypoglycemia, and an increased risk of type 2 diabetes in mothers. Fetal macrosomia (birth weight over 4 kg) is among the most serious complications, often leading to difficult labor, birth trauma to both mother and infant, and increased likelihood of cesarean delivery. Furthermore, infants born to mothers with gestational diabetes face a higher risk of obesity, metabolic disorders, and insulin resistance later in life (Eleftheriou et al., 2024).

On the maternal side, gestational diabetes elevates the risk of gestational hypertension, excessive weight gain, and future type 2 diabetes. Studies show that women with gestational diabetes are up to seven times more likely than healthy women to develop type 2 diabetes later in life, significantly impacting personal health and increasing healthcare costs and psychological burdens (Semnani-Azad et al., 2024).

Approximately 70% of women with gestational diabetes eventually develop type 2 diabetes, with the highest risk occurring within the first five years postpartum, then declining around year ten (Reddy et al., 2023). Epidemiological studies estimate that about 14% of pregnant women globally are affected by gestational diabetes. However, variations in screening approaches and diagnostic criteria result in inconsistent estimates (Roustaei et al., 2023). A recent review of 51 population-based studies estimated the global prevalence to be 4.4%, with other meta-analyses reporting 5.4% in developed European countries and 10.9% across Europe. Further analyses reported prevalence rates of 10.1% in East and Southeast Asia and 13.6% in Africa (Eades et al., 2024).

Infant birth weight is a key indicator of neonatal health. Studies have shown that mothers with gestational diabetes are more likely to deliver macrosomic infants (over 4000 grams). This condition increases the risk of shoulder dystocia, birth trauma, and cesarean delivery. Macrosomic infants are also at greater risk for childhood obesity and type 2 diabetes later in life (Gao et al., 2024). Furthermore, Apgar scores, used to assess neonatal well-being at 1 and 5 minutes after birth, may be lower in infants born to mothers with gestational diabetes due to metabolic imbalances, elevated insulin levels, and neonatal hypoglycemia (Kc et al., 2015). Neonatal hypoglycemia, a common complication, can lead to respiratory distress, reduced muscle tone, and even brain damage if untreated.

Given the broad impacts of gestational diabetes on neonatal outcomes, understanding these associations and exploring effective interventions—such as lifestyle modification, dietary regulation, physical activity, and pharmacological treatment when necessary—can help reduce associated risks. Thus, the present study aims to investigate the relationship between gestational diabetes, neonatal birth weight, and Apgar scores, providing applicable insights for improving maternal and infant health (Gao et al., 2022).

Anxiety and depression are also heightened among women with gestational diabetes due to concerns over fetal complications, strict blood glucose monitoring, the potential need for insulin therapy, and the increased risk of complicated delivery. Hormonal changes combined with elevated cortisol levels from stress may exacerbate insulin resistance, creating a vicious cycle of stress, hyperglycemia, and worsened psychological symptoms (Alqahtani et al., 2024).

Depression is similarly prevalent in this population and may lead to poor adherence to treatment regimens, greater risk of macrosomia, preterm labor, and adverse neonatal outcomes (Jin et al., 2024). Women with gestational diabetes are reportedly twice as likely as healthy women to experience perinatal depression (Ling et al., 2020). Chronic stress and anxiety can disrupt the hypothalamic-pituitary-adrenal (HPA) axis and glucose metabolism, thereby increasing insulin resistance and blood glucose levels. Women experiencing anxiety and depression may also demonstrate lower adherence to dietary and exercise regimens, further complicating glycemic control and elevating pregnancy risk (Han et al., 2024).

Research shows that women with gestational diabetes are more vulnerable to anxiety, depression, stress, and decreased quality of life, all of which may elevate cortisol levels and insulin resistance. As such, psychological interventions like cognitive-behavioral therapy (CBT) may significantly enhance both mental and physical health in this population (Kiani et al., 2024). CBT helps manage stress, develop emotional regulation, and incorporate relaxation techniques to reduce cortisol and blood glucose levels (Melisse et al., 2024). Negative beliefs and excessive worry can hinder adherence to dietary, exercise, and pharmacological regimens. CBT

Ijbmc.org
E-ISSN: 2345-5802

promotes behavioral compliance by restructuring dysfunctional thinking and improving patient self-efficacy (Shariatpanahi et al., 2023). Many pregnant women with gestational diabetes are at risk for weight gain and metabolic issues due to poor dietary habits and physical inactivity. CBT techniques such as cognitive restructuring, goal-setting, and motivational enhancement are useful for changing these patterns (Van et al., 2014). Emerging studies demonstrate that CBT interventions lead to significant reductions in HbA1c levels, stress, improved sleep, and enhanced quality of life in women with gestational diabetes. Furthermore, combining CBT with nutritional and physical activity strategies yields better glucose control than standard care alone (Kiani et al., 2024).

One of the most effective strategies for preventing and managing gestational diabetes is adopting a healthy lifestyle, including dietary changes, regular exercise, and stress management. Evidence indicates that such lifestyle modifications can substantially prevent gestational diabetes, stabilize blood glucose levels, and reduce adverse maternal and neonatal outcomes. A healthy lifestyle—comprising balanced nutrition, physical activity, weight control, adequate sleep, and stress management—improves insulin sensitivity and glucose metabolism. High-fiber foods, lean proteins, healthy fats, and complex carbohydrates help mitigate glucose fluctuations. Research supports that both Mediterranean and DASH diets can reduce gestational diabetes risk (Zakaria et al., 2023).

Regular physical activity, particularly aerobic and light resistance exercises, enhances glucose uptake by muscle cells and lowers insulin resistance. Studies suggest that prenatal exercise may reduce gestational diabetes risk by up to 30%. Excessive weight gain during pregnancy is a known risk factor for gestational diabetes, and weight control programs combining diet and exercise can minimize this risk (Retnakaran et al., 2023). Sleep deprivation is another contributor, with poor sleep linked to elevated glucose levels and insulin resistance. Sleeping less than 6 hours per night increases the risk of gestational diabetes. Maintaining sleep hygiene and circadian rhythm regulation is beneficial for glucose metabolism and disease prevention (Le et al., 2023).

Based on the above, this study seeks to answer the question: Does virtual cognitive-behavioral therapy combined with healthy lifestyle training effectively improve blood glucose, anxiety, and depression in pregnant women with gestational diabetes?

Methods and Materials

Study Design

This study employed a quasi-experimental design with two groups—experimental and control—using a pre-test and post-test framework. The statistical population included all pregnant women diagnosed with gestational diabetes mellitus (GDM) receiving primary care services in Qatar. The sampling method was purposive, and participants were randomly assigned to groups. Individuals included in the study were those who responded to a public invitation and visited the primary healthcare center in Qatar.

The sample consisted of 50 pregnant women. Participants in the control group received standard prenatal care, while those in the intervention group received standard prenatal care supplemented with Cognitive Behavioral Therapy (CBT) and healthy lifestyle education. Sampling was purposive, and group allocation was randomized.

Inclusion Criteria

Participants met the following inclusion criteria: age between 18 and 30 years; first pregnancy; gestational age less than 28 weeks; body mass index (BMI) less than 30; diagnosed with GDM through fasting blood glucose or a 75g oral glucose tolerance test (OGTT); no current medication for GDM; ability to use smartphones; literacy and numeracy skills; and provision of signed informed consent.

Exclusion Criteria

Exclusion criteria included: pre-existing type 1 or type 2 diabetes; diagnosed hypertension; severe hyperthyroidism; multiple pregnancy; significant psychiatric disorders or known cognitive impairments; and current substance abuse or dependence at the time of screening.

Data Collection Instruments

Data were collected using questionnaires as follows:

Demographic Questionnaire

A researcher-designed demographic questionnaire was developed to account for the influence of background and biological characteristics on emotional states. It included items such as personal information, date of birth, marital status, and duration of illness.

Generalized Anxiety Disorder Scale (GAD-7)

Developed by Spitzer et al., (2006) this 7-item scale assesses psychological issues experienced in the past two weeks. Response options range from "not at all" to "nearly every day" and are scored from 0 to 3, resulting in a total score ranging from 0 to 21. The scale was initially validated on 2,740 adults in 15 U.S. primary care clinics between 2004 and 2005. The Cronbach's alpha was reported as 0.85, with internal consistency rated excellent (α = 0.92) and test-retest reliability as good (r = 0.83). In Iran, a psychometric evaluation by Naeinian et al., (2009) found a Cronbach's alpha of 0.85 and test-retest reliability of 0.48.

Edinburgh Postnatal Depression Scale (EPDS)

Developed by Cox et al., (1987) to assess postpartum depression, the EPDS consists of 10 items rated on a 4-point Likert scale, measuring symptoms of depression, anxiety, guilt, and suicidal ideation over the past 7 days. Items 1, 2, and 4 are scored directly, while the remaining items are reverse-scored. Total scores range from 0 to 30, with a cut-off point of 12–13 for screening purposes. Reported reliability is 0.88, and validity is 0.90 (Rahmani et al., 2024).

Food Intake and Blood Glucose Monitoring Chart: Fasting blood glucose level; Foods consumed for breakfast; Post-breakfast glucose level; Morning snack; Foods consumed for lunch; Post-lunch glucose level; Afternoon snack; Foods consumed for dinner; Post-dinner glucose level and Evening snack

Target Blood Glucose Levels for Pregnant Women with GDM: Fasting: <95 mg/dL (5.3 mmol/L); 1 hour post-meal: <140 mg/dL (7.8 mmol/L); 2 hours post-meal: <120 mg/dL (6.7 mmol/L)

Intervention Protocol

Objectives of CBT and Healthy Lifestyle Sessions:

Session 1: Clinical education on GDM: onset, development, and consequences of hyperglycemia; Setting treatment goals for hyperglycemia; Education on self-monitoring and psychological screening (anxiety and depression)

Session 2: Explanation of standard pharmacological and non-pharmacological GDM treatments; Training in healthy lifestyle practices and problem-solving techniques; Deep breathing exercises; Emphasizing the relationship between CBT lifestyle education and glucose management; Encouraging adherence; Reviewing and distributing food intake and glucose monitoring charts; Sending SMS with educational links and Referral to a nutritionist if no appointment is booked

Session 3: Analysis of poor glucose control; Emphasizing the role of dietary strategies in lowering glucose levels; Identifying high-risk foods (e.g., sugary, high-glycemic index items); Identifying healthy foods (e.g., high-fiber foods); Promoting self-management of healthy diets; Recognizing negative emotions and how to accept them; Reinforcing positive emotional expression and Describing the relationship between emotions and glucose levels during pregnancy

Session 4: Review of healthy lifestyle topics, problem-solving, and deep breathing exercises; Evaluation of food records and glucose monitoring charts; Discussion of new physical or psychological symptoms and management strategies; Sleep hygiene education and Assessment of lifestyle changes.

Session 5: Same as session 4

Session 6: Review of prior topics; Final assessment of lifestyle changes and Final screening for mental health (anxiety and depression).

Statistical Analysis

Given the limited sample size and study design, a significance level of α = 0.05 was selected to enhance test power. Data were analyzed using SPSS version 24, employing both descriptive and inferential statistics.

Descriptive statistics included mean, standard deviation, frequency, and percentage.

Inferential statistics involved: Kolmogorov–Smirnov test for normality of score distribution, Levene's test for homogeneity of variances, ANOVA to compare dependent variables individually between groups, MANOVA to examine interaction effects among variables across groups and Levene's test and Box's M test for additional assumption checks.

Findings and Results

The minimum age of participants in the experimental group was 19, and the maximum was 29 years. The mean age in the experimental group was 24.3 years with a standard deviation of 2.92. Similarly, in the control group, the minimum and maximum ages were also 19 and 29, respectively, with a mean of 24.5 years and a standard deviation of 2.78. Given that the significance level was greater than 0.05, there was no statistically

Ijbmc.org
E-ISSN: 2345-5802

significant difference between the two groups in terms of age, indicating homogeneity.

The minimum Body Mass Index (BMI) in the experimental group was 19.1 and the maximum was 29. The mean BMI was 23.9 with a standard deviation of 3.07. In the control group, the BMI ranged from 19.1 to 19.5, with a mean of 23.28 and a standard deviation of 3.28. The significance level being greater than 0.05 indicated no significant difference in BMI between groups, confirming homogeneity in this variable as well. Furthermore, with a significance level of $p > 0.05$, no significant difference was observed between the groups in terms of the number of pregnancies, indicating homogeneity on this measure too.

Table 1

Comparison of Mean and Standard Deviation of Blood Glucose Indices Before and After the Intervention

Variable	Group	Before Intervention (Mean ± SD)	After Intervention (Mean ± SD)
Fasting Blood Glucose	Experimental	195.3 ± 14.1	187.5 ± 13.3
	Control	197.2 ± 14.3	196.2 ± 14.3
Oral Glucose Tolerance	Experimental	223.8 ± 20.1	215.7 ± 19.1
	Control	221.5 ± 18.3	220.5 ± 18.4

As shown in Table 1, there was little difference between the two groups in pre-test scores, but post-intervention scores showed a substantial improvement in the experimental group compared to the control group.

Table 2

Comparison of Mean and Standard Deviation of Depression Scores Before and After the Intervention

Variable	Group	Before Intervention (Mean ± SD)	After Intervention (Mean ± SD)
Depression	Experimental	13.7 ± 4.72	8.26 ± 2.51
	Control	13.4 ± 4.63	12.8 ± 4.26

As seen in Table 2, depression scores in the two groups were similar before the intervention. However, post-intervention results show a significant improvement in the experimental group compared to the control group.

Table 3

Comparison of Mean and Standard Deviation of Anxiety Scores Before and After the Intervention

Variable	Group	Before Intervention (Mean ± SD)	After Intervention (Mean ± SD)
Anxiety	Experimental	9.7 ± 3.86	6.0 ± 3.63
	Control	9.73 ± 3.86	9.06 ± 3.50

As shown in Table 3, no notable differences in anxiety scores were observed before the intervention. Post-intervention, the experimental group showed significant improvements compared to the control group.

Table 4

Comparison of Mean and Standard Deviation of Infant Birth Weight After the Intervention

Variable	Group	After Intervention (Mean ± SD)
Weight	Experimental	3566.7 ± 296.1 g
	Control	3148.2 ± 245.3 g

According to Table 4, post-intervention birth weight was notably higher in the experimental group than in the control group.

Ijbmc.org
E-ISSN: 2345-5802

Table 5

Comparison of Mean and Standard Deviation of Apgar Scores After the Intervention

Variable	Group	After Intervention (Mean ± SD)
Apgar Score	Experimental	8.88 ± 0.56
	Control	8.86 ± 0.504

As seen in Table 5, the Apgar scores between groups post-intervention did not show significant differences. To verify the normal distribution of the variables, the Shapiro–Wilk test was applied, and all variables had significance levels above 0.05. The homogeneity of the covariance matrix was confirmed using Box's M test (Box's M = 0.534, F = 0.171, df1 = 3, df2 = 605520, p = 0.916). Levene's test showed that homogeneity of variances for post-test variables was not strictly met ($p < 0.05$), but this assumption was relaxed due to equal group sizes.

Table 6

Summary of MANCOVA to Evaluate the Effect of CBT and Healthy Lifestyle Education on Blood Glucose Indices

Test	Value	F	df1	df2	Sig.	Partial Eta Squared
Pillai's Trace	0.778	96.2	2	55	0.001	0.778
Wilks' Lambda	0.222	96.2	2	55	0.001	0.778
Hotelling's Trace	3.49	96.2	2	55	0.001	0.778
Roy's Largest Root	3.49	96.2	2	55	0.001	0.778

These results indicate that, after controlling for pre-test effects, there is a statistically significant difference between the groups in at least one variable (Wilks' Lambda = 0.222, F = 96.2, p = 0.001).

Table 7

ANCOVA Results for Fasting Blood Glucose and Oral Glucose Tolerance

Variable	Source	SS	df	MS	F	Sig.	Eta^2
Fasting Blood Glucose	Group	711.7	1	711.7	157.6	0.001	0.738
	Error	252.8	56	4.51			
OGTT	Group	736.2	1	736.2	56.1	0.001	0.501
	Error	734.5	56	13.1			

Controlling for pre-test scores, both outcome measures showed significant improvement in the experimental group. CBT and lifestyle education accounted for 73.8% of the improvement in fasting blood glucose and 50.1% in oral glucose tolerance.

Table 8

ANCOVA Results for Depression

Source	SS	df	MS	F	Sig.	Eta^2
Group	344.4	1	344.4	111.4	0.001	0.662
Error	176.1	57	3.09			

The results show that the CBT intervention significantly reduced depression scores in the experimental group (F = 111.4, $p < 0.01$, $Eta^2 = 0.662$), confirming the second hypothesis.

Table 9

Independent t-test Results for Neonatal Weight

Assumption	F	Sig.	t	df	Sig.	Mean Diff.	Std. Error	CI Lower	CI Upper

Equal variances assumed	4.04	0.049	5.95	58	0.001	418.4	70.2	277.8	558.9
Unequal variances			5.95	56.06	0.001	418.4	70.2	277.7	559.08

The t-test showed a statistically significant difference in neonatal weight between the two groups.

Table 10

Independent t-test Results for Apgar Score

Assumption	F	Sig.	t	df	Sig.	Mean Diff.	Std. Error	CI Lower	CI Upper
Equal variances assumed	0.005	0.944	0.138	58	0.891	0.019	0.137	-0.256	0.294
Unequal variances			0.138	57.3	0.891	0.019	0.137	-0.256	0.294

The Apgar scores did not differ significantly between the experimental and control groups.

Discussion and Conclusion

The results indicated that online Cognitive Behavioral Therapy (CBT) combined with healthy lifestyle education was effective in improving blood glucose regulation among pregnant women with gestational diabetes mellitus (GDM). This finding aligns with the results of studies conducted by (Chen, 2024; Zhang et al., 2024; Perera, 2023), and Moorey & Hollon, (2021).

This outcome can be explained by recognizing that GDM is one of the common challenges faced by pregnant women, necessitating comprehensive and multidimensional approaches for effective management. CBT, as an evidence-based intervention, helps individuals identify and restructure negative thought patterns, which are often influenced by anxiety and fears related to GDM. Pregnant women may experience concerns about how diabetes could affect their own or their baby's health. CBT equips them with strategies to understand and manage their anxieties, such as deep breathing techniques and stress management skills, which may contribute to reduced blood glucose levels and improved quality of life.

In addition, education on healthy lifestyle practices offers significant benefits in managing GDM. This training includes guidance on balanced nutrition, healthy food choices, and regular blood glucose monitoring. By integrating scientific knowledge with practical experience, women are better able to implement necessary dietary changes. These changes not only aid in glycemic control but also contribute to maintaining appropriate pregnancy weight and preventing GDM complications. Studies have shown that proper nutrition and regular physical activity can reduce the risk of serious outcomes such as preeclampsia in women with GDM (Coleman et al., 2024).

The results also showed that CBT combined with healthy lifestyle education significantly reduced depression in pregnant women with GDM. These findings are consistent with those of (Ebrahimi et al., 2024; William et al., 2024; Luan et al., 2025; and Laidlaw, (2021).

CBT has been shown to be particularly effective in managing depression, especially among pregnant women with diabetes. Grounded in the theory that maladaptive thought patterns can lead to negative emotions and behaviors, CBT helps individuals identify and replace these patterns with more constructive and positive thinking. This is particularly beneficial for women facing concerns over blood glucose control and its implications for the fetus. By altering their cognitive patterns, these women can gain a greater sense of control over their health and circumstances, which in turn reduces depressive and anxious symptoms.

Furthermore, combining CBT with healthy lifestyle education enhances both psychological and physical well-being. Lifestyle education covers aspects such as balanced diet, regular physical activity, and stress management. Especially during pregnancy, dietary improvements and increased physical activity can enhance blood sugar control, leading to a more positive perception of one's overall health. Physical exercise, in particular, not only aids in weight management but also releases mood-enhancing hormones like endorphins, which play a key role in reducing negative emotions.

Ijbmc.org
E-ISSN: 2345-5802

Therefore, this integrated approach creates a positive cycle of change that improves the quality of life and alleviates depression in pregnant women with GDM.

The study also found that the intervention significantly reduced anxiety levels in the intervention group, consistent with the findings of (Lumsdale et al., 2024; Aljarid & Alonazi, 2025; Mohammadnejad et al., 2021), and Pelicic et al., (2021).

CBT combined with healthy lifestyle education effectively prevents anxiety in women with GDM for several scientific and practical reasons. CBT specifically targets cognitive mechanisms that underlie emotional and behavioral responses. Research by Aljarid & Alonazi, (2025) demonstrated that when women are taught to critically examine their thoughts and concerns, they are better able to identify and correct irrational beliefs. For instance, shifting from "What if my blood sugar rises?" to "I can control my blood sugar through better nutrition and exercise" can significantly reduce anxiety and empower women in managing their condition.

Healthy lifestyle education complements CBT by promoting proper nutrition, physical activity, and stress management. Studies have shown that nutrients such as omega-3 fatty acids and B vitamins not only support glycemic control but also enhance mood and reduce anxiety. These nutrients play a critical role in brain function and emotional regulation, and pregnant women can support their mental health by choosing nutrient-rich foods (Saeed et al., 2023).

The findings further demonstrated that the intervention had a positive impact on infant birth weight in women with GDM, consistent with the results of (Gonçalves et al., 2024; Siyad et al., 2022; Manilgama et al., 2022) and Beetham et al., (2022).

A healthy lifestyle that includes proper nutrition, regular physical activity, and stress management directly influences maternal and fetal health. For pregnant women with GDM, adhering to a balanced diet and maintaining glycemic control can positively affect fetal growth and birth weight. Healthy eating can prevent complications such as macrosomia (excessive fetal growth) and improve glycemic regulation. When these two approaches—CBT and lifestyle education—are delivered virtually, they offer additional benefits such as flexibility and ease of access, enabling women to better manage both their health and that of their babies.

Research has shown that effective interaction within virtual groups can enhance motivation and adherence to healthy behaviors (Gonçalves et al., 2024; Siyad et al., 2022). Pregnant women often face unique anxieties and challenges, and social support and shared experiences in a virtual setting can positively influence behavioral and dietary changes. CBT can help women with GDM develop stress management and glycemic control skills, while lifestyle education enables them to regulate their diet and physical activity. This combination can contribute to improved infant weight and overall health outcomes.

However, the fifth hypothesis—that CBT combined with healthy lifestyle education would affect Apgar scores at birth—was not supported. This finding contrasts with studies by (Chen, 2024; Zhang et al., 2024; Perera, 2023) and (Moorey & Hollon, 2021; Gonçalves et al., 2024; Perera, 2023; Ebrahimi et al., 2024; William et al., 2024; Luan et al., 2025 and Laidlaw, (2021).

The ineffectiveness of the virtual CBT and lifestyle education intervention on Apgar scores could be attributed to several factors. First, psychosocial factors, while important, may have limited impact on Apgar scores, which are primarily influenced by biological and physiological conditions at birth. While CBT helps manage stress and enhance positive behaviors, Apgar scores reflect neonatal health status, which is also determined by glycemic control, pregnancy complications, and delivery conditions. Moreover, limitations of virtual education—such as reduced personal interaction and support—may hinder effectiveness. Pregnant women often require emotional and interpersonal support that may be lacking in digital formats. Without adequate opportunities for practice and reinforcement, behavioral change may be limited, reducing the intervention's potential to influence outcomes like Apgar scores.

Additionally, individual and environmental factors play major roles during pregnancy. Socioeconomic, cultural, and familial conditions significantly affect disease management and adoption of healthy lifestyles. If such factors are not addressed in the educational design, pregnant women may not fully benefit from the intervention. Therefore, the ineffectiveness of this intervention on Apgar scores may be due to a combination of unmet individual needs, digital platform limitations, and powerful non-modifiable influences on neonatal outcomes.

Ijbmc.org
E-ISSN: 2345-5802

Cultural and social beliefs may also play a role. In many cultures, pregnancy and childbirth are highly sensitive and tradition-bound periods, and educational content that contradicts cultural norms may face resistance. This could reduce adherence and thereby prevent positive changes in neonatal outcomes. Additionally, lack of spousal or family involvement may lead to emotional isolation, which increases anxiety and negatively affects pregnancy outcomes, including Apgar scores.

This study relied on self-report questionnaires, which are inherently prone to limitations such as distraction, inaccuracy, judgment error, and misinterpretation. Moreover, the influence of subcultures and socioeconomic conditions may also have impacted the findings. The study sample consisted of patients receiving primary care in Qatar, which may limit generalizability to other populations. Another limitation was the absence of follow-up sessions due to challenges in long-term access to participants.

To enhance future research, it is recommended that data collection include interviews and observational methods. Future studies should account for moderating variables such as cultural and socioeconomic contexts. Sampling should also extend to different social settings, and culturally adapted questionnaires should be used. Follow-up evaluations should be conducted in both short- and long-term phases. Organizing online educational programs for pregnant women with diabetes, including modules on diabetes management, stress-reduction techniques, and healthy eating habits, can help them benefit from CBT-based interventions. Creating online peer-support groups for pregnant women with diabetes may reduce feelings of isolation, enhance confidence, and improve diabetes self-management. Given that the intervention had no effect on Apgar scores, it is suggested that complementary programs be designed to target specific factors influencing Apgar outcomes—such as prenatal nutrition and care. Continuous monitoring of blood glucose, depression, anxiety, and neonatal weight can facilitate early detection of issues and timely intervention. Incorporating relaxation and meditation techniques into the training may help reduce anxiety and depression, thereby enhancing overall quality of life for pregnant women.

Acknowledgments

The authors express their gratitude and appreciation to all participants.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

Authors' Contributions

All authors equally contribute to this study.

References

Aljarid, S., & Alonazi, W. (2025). Examining factors contributing to mortality in Saudi Arabia: proposing effective healthcare management approaches. *BMC Public Health*, *25*(1), 1801. https://doi.org/10.1186/s12889-025-22421-z

Alqahtani, S. A. S., Alasmre, F. A., Alasmre, H. A., Alasmre, L. A., Mohammed, Y. M., Aljuaid, N., Alzahrani, F. A. R., Alghamdi, S. J. H., Alzahrani, Y. M. M., & Abanmi, S. N. (2024). The relationship between gestational diabetes and postpartum depression: A systematic review. *Cureus*, *16*(7). https://doi.org/10.7759/cureus.64219

Beetham, K. S., Spathis, J. G., Hoffmann, S., Brown, W. J., Clifton, V., & Mielke, G. I. (2022). Longitudinal association of physical activity during pregnancy with maternal and infant outcomes: findings from the Australian longitudinal study of women's health. *Women's Health*, *18*, 17455057221142357. https://doi.org/10.1177/17455057221142357

Chen, S. (2024). Cognitive behavior therapy for social anxiety disorder. *Lecture Notes in Education Psychology and Public Media*, *37*(1), 72-77. https://doi.org/10.54254/2753-

7048/2025.NS27937 https://doi.org/10.54254/2753-7048/37/20240506

Coleman, J. J., Owen, J., Wright, J. H., Eells, T. D., Antle, B., McCoy, M., & Soma, C. S. (2024). Using Artificial Intelligence to Identify Effective Components of Computer-Assisted Cognitive Behavioural Therapy. *Clinical psychology & psychotherapy*, *31*(6), e70023. https://doi.org/10.1002/cpp.70023

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. *The British journal of psychiatry*, *150*(6), 782-786. https://doi.org/10.1192/bjp.150.6.782

Eades, C. E., Burrows, K. A., Andreeva, R., Stansfield, D. R., & Evans, J. M. (2024). Prevalence of gestational diabetes in the United States and Canada: a systematic review and meta-analysis. *BMC pregnancy and childbirth*, *24*(1), 204. https://doi.org/10.1186/s12884-024-06378-2

Ebrahimi, S., Moheb, N., & Alivani Vafa, M. (2024). Comparison of the effectiveness of cognitive-behavioral therapy and acceptance and commitment therapy on cognitive distortions and rumination in adolescents with social anxiety disorder. *Practice in Clinical Psychology*, *12*(1), 81-94. https://doi.org/10.32598/jpcp.12.1.922.1

Eleftheriou, D., Athanasiadou, K. I., Sifnaios, E., Vagiakis, E., Katsaounou, P., Psaltopoulou, T., Paschou, S. A., & Trakada, G. (2024). Sleep disorders during pregnancy: an underestimated risk factor for gestational diabetes mellitus. *Endocrine*, *83*(1), 41-50. https://doi.org/10.1007/s12020-023-03537-x

Gao, L., Chen, C.-R., Wang, F., Ji, Q., Chen, K.-N., Yang, Y., & Liu, H.-W. (2022). Relationship between age of pregnant women with gestational diabetes mellitus and mode of delivery and neonatal Apgar score. *World Journal of Diabetes*, *13*(9), 776. https://doi.org/10.4239/wjd.v13.i9.776

Gao, Q., Xu, G., Wang, G., Wang, W., Zhu, C., Shi, Y., Guo, C., Cong, J., Ming, H., & Su, D. (2024). RNA-seq analysis-based study on the effects of gestational diabetes mellitus on macrosomia. *Frontiers in Endocrinology*, *15*, 1330704. https://doi.org/10.3389/fendo.2024.1330704

Gonçalves, H., Soares, A. L. G., Domingues, M. R., Bertoldi, A. D., Santos, M. G. d., Silveira, M. F. d., & Coll, C. d. V. N. (2024). Why are pregnant women physically inactive? A qualitative study on the beliefs and perceptions about physical activity during pregnancy. *Cadernos de Saude Publica*, *40*, e00097323. https://doi.org/10.1590/0102-311xen097323

Greco, E., Calanducci, M., Nicolaides, K. H., Barry, E. V., Huda, M. S., & Iliodromiti, S. (2024). Gestational diabetes mellitus and adverse maternal and perinatal outcomes in twin and singleton pregnancies: a systematic review and meta-analysis. *American journal of obstetrics and gynecology*, *230*(2), 213-225. https://doi.org/10.1016/j.ajog.2023.08.011

Han, R. r., Xiang, Z. x., Zhang, S. h., & Gao, L. l. (2024). Predictors of anxiety among pregnant women with gestational diabetes mellitus and their partners: The mediating role of marital satisfaction. *International Journal of Nursing Practice*, *30*(1), e13155. https://doi.org/10.1111/ijn.13155

Jin, Y., Wu, C., Chen, W., Li, J., & Jiang, H. (2024). Gestational diabetes and risk of perinatal depression in low-and middle-income countries: a meta-analysis. *Frontiers in Psychiatry*, *15*, 1331415. https://doi.org/10.3389/fpsyt.2024.1331415

Kc, K., Shakya, S., & Zhang, H. (2015). Gestational diabetes mellitus and macrosomia: a literature review. *Annals of Nutrition and Metabolism*, *66*(Suppl. 2), 14-20. https://doi.org/10.1159/000371628

Kiani, R. M., Haghi, A., & Yousefvand, M. (2024). Effectiveness of Cognitive Behavioral Therapy on Body Image Concern in Women with Depression Symptoms. https://doi.org/10.61838/kman.pdmd.3.1.11

Laidlaw, K. (2021). Cognitive behavioral therapy with older people. https://doi.org/10.1037/0000219-024

Le, D. C., Vu, T. B., Tran, T. N., Nguyen, T. L., Nguyen, T. B., Nguyen, D. C., & Hoang, V. T. (2023). The effectiveness of lifestyle changes in glycemic control among pregnant women with gestational diabetes mellitus. *Medicina*, *59*(9), 1587. https://doi.org/10.3390/medicina59091587

Ling, C., Evans, D., Zhang, Y., Luo, J., Hu, Y., Ouyang, Y., Tang, J., & Kuang, Z. (2020). The effects of cognitive behavioural therapy on depression and quality of life in patients with maintenance haemodialysis: a systematic review. *BMC psychiatry*, *20*(1), 369. https://doi.org/10.1186/s12888-020-02754-2

Luan, T., Wang, Y., Li, B., Qin, R., Li, Z., Lei, X., & Guo, H. (2025). The Effectiveness of Cognitive Behavioral Therapy on Loneliness among Older Adults: A Systematic Review and Meta-Analysis. *Archives of Gerontology and Geriatrics*, 106053. https://doi.org/10.1016/j.archger.2025.106053

Lumsdale, G. S., Frith, H., & Hale, L. (2024). 'Cheering on from the side-lines': The perceived impact of romantic partner's commentary and behaviour on maintaining women's appearance anxiety. *Psychology and Psychotherapy: Theory, Research and Practice*, *97*(4), 606-625. https://doi.org/10.1111/papt.12546

Manilgama, S., Hettiarachchi, N., & Liyanage, A. (2022). Maintaining universal healthcare and its sustainability in the Sri Lankan set up. *Asian Journal of Internal Medicine*, *1*(2). https://doi.org/10.4038/ajim.v1i2.46

Melisse, B., van den Berg, E., & de Beurs, E. (2024). Effectiveness of web-based guided self-help cognitive behavioral therapy-enhanced for binge-eating disorder: An implementation study. *International Journal of Eating Disorders*, *57*(6), 1379-1389. https://doi.org/10.1002/eat.24079

Mohammadnejad, E., Keshavarzi Arshadi, F., & Hasani, F. (2021). Comparison of the effectiveness of exposure and response prevention (ERP) with mindfulness-based cognitive-behavioral therapy (MBCBT) on obsessive-compulsive syndrome and depression in women with obsessive-compulsive disorder. *Journal of Psychological Science*, *20*(108), 2269-2284. https://doi.org/10.52547/JPS.20.108.2269

Moorey, S., & Hollon, S. D. (2021). Cognitive behavioral therapy for depression. In *Oxford Research Encyclopedia of Psychology*. https://doi.org/10.1093/acrefore/9780190236557.013.837

Naeinian, M., Babapour, J., Shaeiri, M., & Rostami, R. (2009). The Effect of Neurofeedback Training on the Decrement of Generalized Anxiety Disorder (GAD) Symptoms and Patients' Quality of Life. *Journal of Modern Psychological Researches*, *4*(15), 175-202. https://psychologyj.tabrizu.ac.ir/article_4237.html?lang=en

Pelicic, D., Saveljic, M., & Nejkov, S. (2021). Significance of chronic non-communicable diseases and their threat to the health of the population. *Biomedical Journal of Scientific & Technical Research*, *34*(5), 27118-27119. https://doi.org/10.26717/BJSTR.2021.34.005612

Perera, R. (2023). Transformation of cognitive behavior therapy as a psychotherapeutic intervention in contemporary health care: A review. *Vidyodaya Journal of Humanities and Social Sciences*, *8*(02). https://doi.org/10.31357/fhss/vjhss.v08i02.13

Rahmani, M., Zafari, M., & Akbar Nattaj Bishe, K. (2024). Investigating the Relationship between Body Image and Postpartum Depression in Women with Their First Pregnancy.

Clinical Psychology Achievements, *10*(3), 1-8. https://doi.org/10.22055/jacp.2024.47280.1395

Reddy, S. S., Gadiraju, M., Preethi, N. M., & Rao, V. (2023). A Novel Approach for Prediction of Gestational Diabetes based on Clinical Signs and Risk Factors. *EAI Endorsed Transactions on Scalable Information Systems*, *10*(3). **:** https://doi.org/10.4108/eetsis.v10i3.2697

Retnakaran, M., Viana, L. V., & Kramer, C. K. (2023). Lifestyle intervention for the prevention of type 2 diabetes in women with prior gestational diabetes: a systematic review and meta-analysis. *Diabetes, Obesity and Metabolism*, *25*(5), 1196-1202. https://doi.org/10.1111/dom.14966

Roustaei, Z., Anttonen, S., Räisänen, S., Gissler, M., & Heinonen, S. (2023). Socioeconomic status, maternal risk factors, and gestational diabetes mellitus across reproductive years: a Finnish register-based study. *BMJ Open Diabetes Research and Care*, *11*(4), e003278. https://doi.org/10.1136/bmjdrc-2022-003278

Saeed, A., Saeed, A. B., & AlAhmri, F. A. (2023). Saudi Arabia health systems: challenging and future transformations with artificial intelligence. *Cureus*, *15*(4). https://doi.org/10.7759/cureus.37826

Semnani-Azad, Z., Gaillard, R., Hughes, A. E., Boyle, K. E., Tobias, D. K., & Perng, W. (2024). Precision stratification of prognostic risk factors associated with outcomes in gestational diabetes mellitus: a systematic review. *Communications medicine*, *4*(1), 9. https://doi.org/10.1038/s43856-023-00427-1

Shariatpanahi, M., Faramarzi, M., Barat, B., Farghadani, A., & Shirafkan, H. (2023). The effect of computer-based cognitive-behavioral therapy on emotion regulation of pregnant women with anxiety disorders. *Journal of Psychological Science*, *22*(131), 153-168. https:// doi:10.52547/JPS.22.131.2321

Siyad, S., Mustafa, N., Banu, S. S., Buharoon, M. A., Al Mulla, M. A., Ankarali, H., Carrick, F. R., & Abdulrahman, M. (2022). Pregnant women's perceptions of physical activity: Adaptation of the pregnancy physical activity questionnaire in Dubai, a multicultural society. *Journal of Public Health Research*, *11*(1), jphr. 2021.2261. https://doi.org/10.4081/jphr.2021.2261

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine*, *166*(10), 1092-1097. https://doi.org/10.1001/archinte.166.10.1092

Van, T. D., Dinh, Q.-D., Vu, P. D., Nguyen, T. V., Van Pham, C., Dao, T. T., Phung, C. D., Hoang, H. T. T., Tang, N. T., & Do, N. T. (2014). Antibiotic susceptibility and molecular epidemiology of Acinetobacter calcoaceticus–baumannii complex strains isolated from a referral hospital in northern Vietnam. *Journal of Global Antimicrobial Resistance*, *2*(4), 318-321. https://doi.org/10.1016/j.jgar.2014.05.003

William, S., Horrocks, M., Richmond, J., Hall, C. L., & French, B. (2024). Experience of CBT in adults with ADHD: a mixed methods study. *Frontiers in Psychiatry*, *15*, 1341624. https://doi.org/10.3389/fpsyt.2024.1341624

Zakaria, H., Abusanana, S., Mussa, B. M., Al Dhaheri, A. S., Stojanovska, L., Mohamad, M. N., Saleh, S. T., Ali, H. I., & Cheikh Ismail, L. (2023). The role of lifestyle interventions in the prevention and treatment of gestational diabetes mellitus. *Medicina*, *59*(2), 287. https://doi.org/10.3390/medicina59020287

Zhang, R., Xie, R., Feng, J., Ding, W., Song, S., Yang, Q., & Li, W. (2024). The bidirectional relationship between parental psychological control, negative automatic thoughts, and bullying in Chinese children: A 2-year longitudinal study. *Psychology of Violence*. https://doi.org/10.1037/vio0000585