RESEARCH

Awareness of gestational diabetes problem among Sohag Governorate women

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Abstract

Background Gestational diabetes mellitus (GDM) is the most frequent and prevalent medical condition in pregnancy. Well-controlled GDM results in reduction of these unfavorable outcomes.

Aim To assess women's knowledge of many elements of gestational diabetes mellitus, including general awareness of the condition, risk factors, diabetic patients' diets, and consequences among the women in the governorate of Sohag.

Patients and methods In this research, 500 women were chosen at random from a population, over a period of 6 months, to participate in a descriptive survey utilizing a questionnaire approach in Sohag Governorate.

Results The mean total knowledge score was 9.62 ± 4.24. A total of 69.6% of study participants showed good knowledge (≥ 9), while 30.4% of them showed low knowledge about gestational diabetes. There was significant positive relation between degree of knowledge and family history of diabetes ($p = 0.038$) as there was substantial increase of high knowledge score in cases who had positive history of family history of diabetes.

Conclusion Awareness about gestational diabetes mellitus was satisfactory among women in Sohag Governorate. Other's experiences or advices were the most common source of general knowledge. There was significant proportional relationship between degree of awareness and occupation, higher age, family history of diabetes, history of gestational diabetes, and level of education. Healthcare workers have to play a greater role in awareness about GDM among women.

Trial registration Awareness of gestational diabetes problem among Sohag Governorate women, NCT05148897. Registered 10 November 2021, https://register.clinicaltrials.gov/prs/app/action/LoginUser?ts=2&cx=-jg9qo3.

Keywords Gestational diabetes, Awareness, GDM

Introduction

The most frequent and widespread medical issue in pregnancy is gestational diabetes mellitus (GDM), which is any degree of glucose intolerance that begins or is first diagnosed during pregnancy. This term is applicable whether or not someone is receiving therapy with insulin [1]. The incidence of gestational diabetes is rising globally, including in Egypt. *According to the (IDF) 2021 Report, the prevalence of GDM is 14.2% of pregnant women*, and Egypt was ranked among the top 21 nations with an incidence rate of 15.9% in 2018 [2–4].

A history of prior GDM, a BMI above 25 kg/m^2, pregnancy-induced hypertension, a family history of diabetes, polycystic ovarian syndrome, a history of abortion, being older than 25 years, and being involved in more than two parties are all risk factors for GDM [5].

Additionally, there is a higher chance of developing long-term diabetes among GDM-positive women. Negative maternal–fetal outcomes from poorly controlled

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GDM include miscarriages, cesarean sections, macrosomia, neonatal hypoglycemia, stillbirths, and neonatal deaths [6].

For information on the safety of contraceptive techniques, women with diabetes should consult the United States Centers for Disease Control (CDC) Medical Eligibility Requirements for Contraceptive Usage guidelines [7]. Women of childbearing age with DM must understand that there are pregnancy-related risks in DM but have limited uptake of preconception planning. Although LARC (long-acting reversible contraceptive) methods are recommended in clinical guidelines, women with DM have substantial uncertainty regarding their safety in DM [8].

These negative consequences are decreased by GDM that is well-controlled. The main element for improved health outcomes is proper GDM treatment. The main factor in managing GDM is the proactive care that women take to maintain normal glycemic levels [9]. It relies on the patient having a suitable level of health literacy, including understanding normal and abnormal glycemic readings and nutritional values [10].

When women are informed about GDM, they are more likely to follow a healthy lifestyle, have better healthcare habits, take better care of themselves, and avoid or detect the illness early. Sohag Governorate women were included in this research to assess their knowledge of several elements of gestational diabetes mellitus, including general understanding of the condition, risk factors, diabetic patients' diets, and consequences.

Materials and methods

Descriptive cross-sectional research was initiated at the Department of Internal Medicine, Faculty of Medicine, Sohag University, during the period from November 2021 to October 2022. Informed consent had been taken from all patients. The research was approved by Medical Ethics Committee of Sohag University Faculty of Medicine.

Five-hundred women were chosen at random as research participants, and they were asked to respond to questions on a prepared and copied questionnaire form.

The ladies themselves used self-administered questionnaires to gather the data. No questionnaire that was explicitly relevant to knowledge assessment among women was discovered after a thorough literature study. Gestational Diabetes Mellitus Knowledge Questionnaire (GDMKQ) was created by a research team. The Diabetes Knowledge Questionnaire (DKN), a well-validated instrument for knowledge evaluation among type 1 and type 2 diabetes mellitus patients, served as the basis for the questionnaire's main themes. A few changes were made, and additional inquiries specifically pertaining to GDM were included. To verify that the questionnaire's

core meaning was retained, it was translated into Arabic and then back into English. The translated version was then assessed for both face and content validity. Final version of questionnaire consists of two parts:

- Part 1: Questions on the patient's personal characteristics and sociodemographic information about the participants, such as name, age, education, employment, place of residence, number of pregnancies, living children, history of preconception planning, and family history, are asked without assigning a score.
- Part 2: The 15 questions used to gauge participants' knowledge of gestational diabetes mellitus were organized into five major categories: basic information about GDM (3 questions), risk factors (3 questions), the importance of food and diet (3 questions), treatment (3 questions), and outcomes/complications (3 questions). To prevent participants from making unneeded assumptions, all questions included multiple-choice answers with the response "I don't know" as one of the options. Every correct response received a 1, while every incorrect response received a 0. A higher score indicates more understanding of GDM. As a result, the greatest score is 15, and the lowest is 0.

Personal information, general understanding of GDM, awareness of risk factors, diet values, complications, and treatment of GDM were the subject of a standardized questionnaire.

Participants were rated as having insufficient knowledge if they had a score of 0–8 and adequate for those who received a score of more than 12.

Statistical analysis

STATA 14.2 was used to examine the data (Stata Statistical Software: Release 14.2 College Station, TX, USA, StataCorp LP). Mean, standard deviation, median, and range were the metrics utilized to express quantitative data. Unpaired Student *t*-tests, Mann–Whitney tests, and chi-square tests were also utilized. If the *p*-value was less than 0.05, it was deemed significant.

Results

Participant demographics

A total of 500 women included in this study, their mean of age was 34.96 ± 11.44 years ranging from 16 to 65 years with age group of ≥ 35 years was the most frequent (46%). More than half of the participants were living in rural areas (58%). Also, more than half of participants had high-level education (54.4%). Occupation distribution was 43.4% employer, 33.6% housewives, 10.2% students, 7% nurse, and 5.8% medical doctors. With reference

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of gravidity, 46.2% had G3 or more with mean gravidity was 2.43 ± 2.12. The mean number of children was 2.18 ± 1.87 with 42.4% of women who had 3 children or more (Table 1).

Knowledge and history of diabetes

A total of 70.6% of participants had knowledge about diabetes mellitus in general. General knowledge as others experience or advices was the most common source of knowledge (40.5%) followed by Internet (32%) then mass media (14.2%), and study (13.3%). Less than half (47.8%) had family history of diabetes mellitus (Fig. 1). A total of

Table 1 Participant demographics in the research

Items	Study participants (no. = 500)	
	No	**%**
Age		
< 25 years	93	18.6%
25–29 years	117	23.4%
30–34 years	60	12.0%
≥ 35 years	230	46.0%
Mean ± SD	34.96 ± 11.44	
Range	16.0–65.0	
Residence		
Rural	290	58.0%
Urban	210	42.0%
Education level		
Low education	24	4.8%
Intermediate education	204	40.8%
High education	272	54.4%
Occupation		
Medical doctor	29	5.8%
Nurse	35	7.0%
Employer	217	43.4%
Housewife	168	33.6%
Student	51	10.2%
Gravidity		
G0	126	25.2%
G1	63	12.6%
G2	80	16.0%
≥ G3	231	46.2%
Mean ± SD	2.43 ± 2.12	
Range	0.0–13.0	
No. of children		
0	137	27.4%
1	64	12.8%
2	87	17.4%
≥ 3	212	42.4%
Mean ± SD	2.18 ± 1.87	
Range	0.0–9.0	

11.4% had history of gestational diabetes. There were 173 (34.6%) women who have preconception planning. There were 55 (11%) current diabetic patients in which 44 out of them were on oral drugs while 11/55 were on insulin therapy, and just 17 (30.1%) of them have preconception planning using contraception method (Table 2).

Response of studied participants to all questionnaire items

The right answers recorded for questions related to basic knowledge were 36% for question 1, 47.2% for question 2, and 39.8% for question 3, whereas the wrong answers were noted for question 1 were 64%, 52.8% for question 2, and 60.2% for question 3. The right answers recorded for questions related to knowledge about risk factors were 78.4% for question 4, 61.6% for question 5, and 57.4% for question 6, whereas the wrong answers were noted for question 4 were 21.6%, 38.4% for question 5, and 42.6% for question 6. The right answers recorded for questions related to knowledge about diet/food values were 74.8% for question 7, 80.8% for question 8, and 88.8% for question 9, whereas the wrong answers were noted for question 7 were 25.2%, 19.2% for question 8, and 11.2% for question 9. The right answers recorded for questions related to knowledge about management of GDM were 81.2% for question 10, 53.2% for question 11, and 78.2% for question 12, whereas the wrong answers were noted for question 10 were 18.8%, 46.8% for question 11, and 21.8% for question 12. The right answers recorded for questions related to knowledge about GDM complications/outcomes were 44.6% for question 13, 70.2% for question 14, and 69.8% for question 15, whereas the wrong answers were noted for question 13 were 55.4%, 29.8% for question 14, and 30.2% for question 15 (Table 3).

Association between degree of knowledge and demographic characteristics

The mean total knowledge score was 9.62 ± 4.24. A total of 69.6% of study participants showed good knowledge (≥ 9), while 30.4% of them showed low knowledge about gestational diabetes.

Higher age showed substantial high knowledge compared to less age ($p < 0.001$). Also, there was substantial proportional connection between degree of knowledge and education level ($p = 0.003$), occupation ($p < 0.001$), gravidity ($p < 0.001$), and number of children ($p < 0.001$). Meanwhile, no substantial relation was observed between degree of knowledge and residence ($p > 0.05$) (Table 4).

Relation between degree of knowledge and history of diabetes

There was substantial relation between degree of knowledge and about source of knowledge ($p < 0.001$) as there

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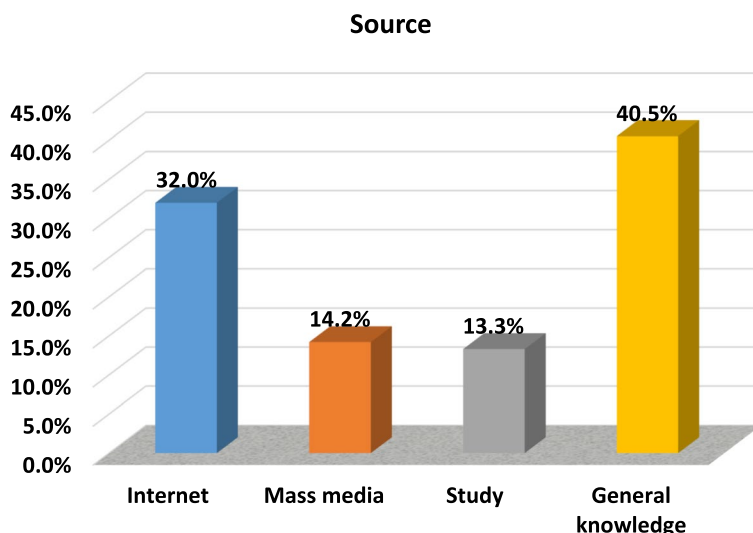
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Source

Fig. 1 Distribution of study participants regarding source

Table 2 Knowledge and history of diabetes among study participants

	Study participants (no. = 500)	
	No	%
Knowledge about diabetes		
No	147	29.4%
Yes	353	70.6%
Source of knowledge (in good knowledge) (n = 353)		
Internet	113	32.0%
Mass media	50	14.2%
Study	47	13.3%
General knowledge as others experiences or advices	143	40.5%
Family history of diabetes		
No	261	52.2%
Yes	239	47.8%
History of gestational diabetes		
No	443	88.6%
Yes	57	11.4%
Preconception planning		
No	327	65.4%
Yes	173	34.6%
Current diabetic patients		
No	445	89.0%
Yes	55	11.0%
Preconception planning in (55 diabetic)		
No	38	69.9%
Yes	17	30.1%
Type of hypoglycemic TTT (55 diabetic)		
Insulin	11	20.0%
Oral	44	80.0%

was substantial increase of high knowledge score in cases with general knowledge. There was substantial positive relation between degree of knowledge and family history of diabetes ($p = 0.038$) as there was substantial increase of high knowledge score in cases who had positive history of family history of diabetes. In addition, there was substantial positive relation between degree of knowledge and history of gestational diabetes ($p < 0.001$) as cases who had positive history of gestational diabetes had substantial higher knowledge score (Table 5).

Discussion

One of the frequent issues that affect the health of pregnant women and babies, gestational diabetes mellitus (GDM), makes gestation a high-risk pregnancy. GDM, a subtype of diabetes mellitus, is identified by the beginning or first identification of glucose intolerance during pregnancy [11].

Due to better glycemic management before and throughout organogenesis, preconception treatment for diabetic women lowers the risk of spontaneous abortion and congenital abnormalities. Optimizing glycemic control during pregnancy includes considering genetic counseling, contraception options, managing diabetic complications, and assessing the psychosocial elements of pregnancy, childbirth, and diabetes care [4].

In our study, a total of 70.6% of participants had knowledge about diabetes mellitus in general. General knowledge as other experiences or advice was the most common source of knowledge (40.5%) followed by Internet (32%), then mass media (14.2%), and study (13.3%). Less than half (47.8%) had family history of diabetes mellitus. A total of 11.4% had history of gestational diabetes.

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Table 3 Response of studied participants to all questionnaire items (*N* = 500)

Items	Study participants (no. = 500)			
	Right answers		Wrong answers	
	No	%	No	%
Basic knowledge about GDM				
Q. 1 Gestational diabetes is a condition	180	36.0%	320	64.0%
Q. 2 The level of sugar in a patient with gestational diabetes is irregular when	236	47.2%	264	52.8%
Q. 3 What is the best way to measure the sugar level for a woman who suffers from gestational diabetes?	199	39.8%	301	60.2%
Knowledge about risk factors				
Q. 4 You are at risk of developing gestational diabetes if you suffer from	392	78.4%	108	21.6%
Q. 5 You are at high risk of gestational diabetes if…	308	61.6%	192	38.4%
Q. 6 You are more likely to develop gestational diabetes if…	287	57.4%	213	42.6%
Knowledge about diet/food values				
Q. 7 If you have gestational diabetes, you should reduce the meals that contain a high percentage of…	374	74.8%	126	25.2%
Q. 8 What meals can a gestational diabetes patient eat without restrictions…	404	80.8%	96	19.2%
Q. 9 What is the nutritional value of rice…?	444	88.8%	56	11.2%
Knowledge about management of GDM				
Q. 10 The most common sign of high blood sugar is	406	81.2%	94	18.8%
Q. 11 The normal value of blood sugar when fasting is	266	53.2%	234	46.8%
Q. 12 Is preconception contraception having a value for women especially diabetic?	391	78.2%	109	21.8%
Knowledge about GDM complications/outcomes				
Q. 13 In case of irregular sugar during pregnancy, your baby may suffer from	223	44.6%	277	55.4%
Q. 14 If you suffer from gestational diabetes, you have	351	70.2%	149	29.8%
Q. 15 With high blood sugar during pregnancy, rates of	349	69.8%	151	30.2%

There were 55 (11%) current diabetic patients in which 44 out of them were on oral drugs while 11/55 were on insulin therapy.

Also, Elmekresh et al. [12] investigated 450 women and found that 73.5% were aware of the disease and found that the media, educational institutions, and family members were said to be the main sources of GDM awareness. However, fewer women (14%) cited doctors and healthcare professionals as their informational source.

A study conducted in India to identify leading sources of information regarding GDM among women found that television and radio were the major sources of information about GDM (40%), followed by doctors (13.3%), and hospital boards and charts (18.3%) [13].

Regarding Thomas et al. [14] and Kondamuri et al. [15], printed and electronic media were the most significant sources of information. Social contacts, educational/professional experiences, and family history of diabetes and GDM were additional sources of information.

Regarding our findings, the right answers recorded for questions related to knowledge about risk factors were 78.4% for question 4, 61.6% for question 5, and 57.4% for question 6, whereas the wrong answers were noted for question 4 were 21.6%, 38.4% for question 5, and 42.6% for question 6.

Price et al. [16] stated that only one lady, out of the 49% who knew gestational diabetes may develop for the first time during pregnancy, correctly recognized all four GDM risk factors.

In our present study, the mean total knowledge score was 9.62 ± 4.24. A total of 69.6% of study participants showed good knowledge (≥ 9), while 30.4% of them showed low knowledge about gestational diabetes.

In the same context, Shriraam et al. [17] who found that overall, 56.7% of women had fair understanding of GDM, 25.8% had poor knowledge, and 17.5% had strong knowledge. Seven was the average knowledge score.

Also, Alnaeem et al. [18] stated that GDM knowledge score among participants ranged from 0 to 95.8%, with an average of $51.5 \pm 17.85\%$. Fair knowledge of GDM was the highest percentage at 64%, while 17.5% of the respondents had poor knowledge, and 18.5% had good knowledge of GDM.

Our results showed that higher age showed significant high knowledge compared to less age ($p < 0.001$). Also, there was substantial proportional connection between

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Table 4 Association between degree of knowledge and demographic characteristics

Items	Low knowledge ≤ 8 (no. = 152)			High knowledge (≥ 9) (no. = 348)			Test value	*p*-value
	No	% (column)	% (row)	No	% (column)	% (row)		
Age								
< 25 years (93)	48	31.6%	51.6%	45	8.4%	12.9%	$\chi^2 = 25.88$	**< 0.001 (HS)**
25–29 years (117)	34	22.4%	29%	83	77%	23.9%		
30–34 years (60)	17	11.2%	28.3%	43	71.7%	12.4%		
≥ 35 years (230)	53	34.9%	23%	177	77%	50.9%		
Mean ± SD	32.34 ± 11.75			36.10 ± 11.13			$Z_{MWU} = 4.068$	**< 0.001 (HS)**
Range	16.0–60.0			18.0–65.0				
Residence								
Rural (290)	81	53.3%	27.9%	209	72.1%	60.1%	$\chi^2 = 1.99$	0.158 (NS)
Urban (210)	71	46.7%	33.8%	139	66.2%	39.9%		
Education level								
Low education (24)	8	5.3%	33.6%	16	4.6%	66.7%	$\chi^2 = 8.784$	**0.003 (HS)**
Intermediate education (204)	67	44.1%	32.8%	137	39.4%	67.2%		
High education (272)	77	50.7%	28.3%	195	56.0%	71.7%		
Occupation								
Medical doctor (29)	0	0.0%	0.0%	29	8.3%	100%	$\chi^2 = 0.516$	**< 0.001 (HS)**
Nurse (35)	8	5.3%	22.9%	27	7.8%	77.1%		
Employer (217)	51	33.6%	23.5%	166	47.7%	76.5%		
Housewife (168)	66	43.4%	39.3%	102	29.3%	60.7%		
Student (51)	27	17.8%	52.9%	24	6.9%	47.1%		
Gravidity								
G0 (126)	57	37.5%	45.2%	69	19.8%	54.8%	$\chi^2 = 22.75$	**< 0.001 (HS)**
G1 (63)	19	12.5%	30.2%	44	12.6%	69.8%		
G2 (80)	27	17.8%	33.8%	53	15.2%	66.3%		
≥ G3 (231)	49	32.2%	21.2%	182	52.3%	78.8%		
Mean ± SD	1.89 ± 2.02			2.67 ± 2.12			$Z_{MWU} = 4.193$	**< 0.001 (HS)**
Range	0.0–8.0			0.0–13.0				
No. of children 53								
0 (137)	59	182%	43.1%	78	22.4%	58.9%	$\chi^2 = 18.49$	**< 0.001 (HS)**
1 (64)	18	11.8%	28.1%	46	13.2%	71.9%		
2 (87)	29	19.1%	33.3%	58	16.7%	66.7%		
≥ 3 (212)	46	30.3%	21.7%	166	47.7%	78.3%		
Mean ± SD	1.74 ± 1.84			2.37 ± 1.85			$Z_{MWU} = 3.831$	**< 0.001 (HS)**
Range	0.0–9.0			0.0–9.0				

degree of knowledge and occupation ($p < 0.001$), gravidity ($p < 0.001$), and number of children ($p < 0.001$).

This came in agreement with Alnaeem et al. [18] that participants with poor knowledge were, on average, younger (26.4 ± 5.6 years old) than were those with fair or good knowledge about the disorder.

Our results showed that there was no substantial relation was observed between degree of knowledge and residence.

In contrast with our results, Prabhu et al. [15] studied that when compared to participants from rural and semiurban regions, individuals from urban areas exhibited statistically substantial knowledge scores on GDM treatment options and prenatal and neonatal problems ($p = 0.015$, $p = 0.028$, respectively).

Our study showed that there was substantial relation between degree of knowledge and about source of knowledge ($p < 0.001$) as there was substantial increase of high knowledge score in cases with general knowledge, but there is no significant relation between high knowledge and residence, and that can be explained by the majority of our governorate which are rural areas, and at hat

Table 5 Relation between degree of knowledge and history of diabetes

Items	Low knowledge ≤ 8 (no. = 152)			High knowledge (≥ 9) (no. = 348)			Test value	*p*-value
	No	% (column)	% (row)	No	% (column)	% (row)		
Source of knowledge (353)								
Internet (113)	13	8.6%	11.5%	100	28.7%	88.5%	$x^2 = 280.0$	**< 0.001 (HS)**
Mass media (50)	0	0.0%	0.0%	50	14.4%	100.0%		
Study (47)	0	0.0%	0.0%	47	13.5%	100.0%		
General knowledge as other experiences or advices (143)	17	11.2%	11.9%	126	36.2%	88.1%		
Family history of diabetes								
No	90	59.2%	34.5%	171	49.1%	65.5%	$x^2 = 4.30$	**0.038 (S)**
Yes	62	40.8%	25.9%	177	50.9%	74.1%		
History of gestational diabetes								
No	146	96.1%	33.0%	297	85.3%	67.0%	$x^2 = 12.01$	**0.001 (HS)**
Yes	6	3.9%	10.5%	51	14.7%	89.5%		
Type of hypoglycemic TTT								
Insulin	2	1.3%	18.2%	9	2.6%	81.8%	$x^2 = 16.4$	**< 0.001 (HS)**
Oral	2	1.3%	4.5%	42	12.1%	95.5%		

$p \leq 0.05$ significant, $p \leq 0.01$ highly significant (HS), χ^2 chi-square test, *ZMWU* Mann–Whitney *U*-test

places, the familial relations build up the general knowledge and experiences among women especially family members.

Damm et al. [19] emphasized that a lack of knowledge about GDM might lead to a delayed diagnosis or failure to comply with recommended medication, thus contributing to poor management of the condition. Therefore, the authors recommended educating women to ensure that they sought a diagnosis before conception.

This came in line with previous studies that have revealed that a family history of DM is related to a greater risk of an individual developing GDM [20, 21].

Conclusions

A total of 70.6% of participants had knowledge about diabetes mellitus in general which is satisfactory result among Sohag Governorate women. General knowledge as other experiences or advices was the most common source of knowledge followed by Internet and then mass media, reading, and study. There was significant positive proportional relationship between degree of knowledge and occupation, higher age, family history of diabetes, history of gestational diabetes, and level of education. This study paves the path for future research to newer methods of increasing the awareness of GDM and its complications; this knowledge awareness is the initial step toward preventing any disease.

The inclusion of GDM information in course curricula should begin at the high school and college levels. It should pay greater attention to women who are younger and have less education. The physicians must educate the healthcare professionals, and both the doctors and the healthcare professionals must do more to raise awareness among pregnant women. Knowledge of the long-term morbidity of GDM on the mother and neonate should be addressed since it affects two generations, which will enhance screening. Health professionals, particularly general practitioners and endocrinologists, need to be proactive in initiating conversations around pregnancy planning and revisiting the topic yearly, including providing advice on safe, effective forms of contraception to avoid unintended pregnancy.

Abbreviations
BMI   Body Mass Index
CDC   United States Centers for Disease Control
DKN   Diabetes knowledge questionnaire
DM   Diabetes mellitus
GDM   Gestational diabetes mellitus
GDMKQ   Gestational Diabetes Mellitus Knowledge Questionnaire
IDF   International Diabetes Federation

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Declarations

References

1. Farrar DJ (2016) Hyperglycemia in pregnancy: prevalence, impact, and management challenges. Int J Women's Health 8:519
2. Eltoony LF et al (2021) Prevalence and Risk Factors for Gestational Diabetes in Aswan, Egypt According to International Association of the Diabetes and Pregnancy Study Groups (IADPSG). Egypt J Hosp Med 82(4):701-707
3. Muche AA, Olayemi OO, Gete YK (2019) Prevalence and determinants of gestational diabetes mellitus in Africa based on the updated international diagnostic criteria: a systematic review and meta-analysis. Arch Public Health 77(1):1–20
4. Wang H et al (2022) IDF Diabetes Atlas: estimation of global and regional gestational diabetes mellitus prevalence for 2021 by International Association of Diabetes in Pregnancy Study Group's criteria. Diabetes Res Clin Pract 183:109050
5. Lee KW et al (2018) Prevalence and risk factors of gestational diabetes mellitus in Asia: a systematic review and meta-analysis. BMC Pregnancy Childbirth 18(1):1-20
6. O'Sullivan E et al (2011) Atlantic Diabetes in Pregnancy (DIP): the prevalence and outcomes of gestational diabetes mellitus using new diagnostic criteria. Diabetologia 54(7):1670–1675
7. Curtis KM et al (2016) US medical eligibility criteria for contraceptive use, 2016. Morb Mortal Wkly Rep 65(3):1–103
8. Hibbert EJ et al (2018) Preconception care and contraceptive use among Australian women with diabetes mellitus. Australian J Gen Pract 47(12):877–883
9. Cheung NW (2009) The management of gestational diabetes. Vasc Health Risk Manag 5:153
10. Hussain Z, Yusoff ZM, Sulaiman SAS (2015) Evaluation of knowledge regarding gestational diabetes mellitus and its association with glycaemic level: a Malaysian study. J Primary Care diabetes 9(3):184–190
11. Gupta Y et al (2022) Continuous glucose monitoring system profile of women diagnosed as gestational diabetes mellitus by International Association of Diabetes and Pregnancy Study Groups criteria and labeled as normoglycemic by alternate criteria in early pregnancy. J Diabetes Investig 13(10):1753–1760
12. Elmekresh A et al (2017) Gestational diabetes awareness in women of childbearing age in Sharjah. Global J Obes Diabetes Metab Syndr 4(2):51–53
13. Morampudi S et al (2017) The challenges and recommendations for gestational diabetes mellitus care in India: a review. Front Endocrinol 8:56
14. Thomas S, Pienyu R, Rajan SK (2020) Awareness and knowledge about gestational diabetes mellitus among antenatal women. Psychology Community Health 8(1):237–248
15. Kondamuri SD, Samal S, Sen M (2021) Knowledge of gestational diabetes mellitus among pregnant women in a semiurban hospital-a cross-sectional study. Clin Epidemiol Glob Health 12:100854
16. Price LA et al (2017) Awareness of gestational diabetes and its risk factors among pregnant women in Samoa. Hawai'i J Med Public Health 76(2):48
17. Shriraam V et al (2013) Awareness of gestational diabetes mellitus among antenatal women in a primary health center in South India. Indian Indian J Endocrinol Metab 17(1):146
18. Alnaeem LS (2019) Awareness of gestational diabetes among antenatal women at the King Fahd Military Medical Complex Hospital in Dhahran, Saudi Arabia. Egyptian J Hosp Med 75(5):2784–2793
19. Damm P et al (2016) Gestational diabetes mellitus and long-term consequences for mother and offspring: a view from Denmark. Diabetologia 59(7):1396–1399
20. Kim C et al (2009) Does frank diabetes in first-degree relatives of a pregnant woman affect the likelihood of her developing gestational diabetes mellitus or nongestational diabetes? Am J Obstet Gynecol 201(6):576-e1-576. e6
21. Moosazadeh M et al (2017) Family history of diabetes and the risk of gestational diabetes mellitus in Iran: a systematic review and meta-analysis. Diabetes Metab Syndr 11:S99–S104

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