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KNOWLEDGE OF GESTATIONAL DIABETES MELLITUS AMONG WOMEN ATTENDING SELECTED HOSPITALS IN NAIROBI COUNTY, KENYA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is pregnancy related diabetes caused by increased insulin resistance and glucose intolerance. Majority of the women have limited or no knowledge on GDM.

Objectives: This study therefore aimed at assessing demographic characteristics and knowledge of GDM among women.

Design; Cross-sectional study was employed.

Setting: The study sites were Pumwani Maternity Hospital (PMH) and Mama Lucy Kibaki Hospital (MLKH) both in Nairobi County, Kenya. These hospitals were purposively sampled because they matched the unique characteristics of the desired population. Period for study was between October to December 2024.

Participants: Fisher's formula was used to determine the sample size, which yielded 141 participants from each facility. Data was collected using an interviewer administered questionnaire guided by Patient Diabetic Knowledge.

Main outcome measure: Level of knowledge among GDM mothers.

Results: A total of 128 (90%) mothers participated in the study, (PMH; 71 [100%]; MLKH 57 [80%]). Most 82% (n=105) of the mothers were married, 75.8% (n=97) self-employed, and 55.5% (n=71) were aged between 35-49 years, there was a strong significant difference between the two hospitals regarding level of education ($X^2=15.687$, $d=3$, $P=0.0001$). Majority 91.4% (n = 117) of women had poor knowledge of GDM, and only 8.6% (n = 11) revealed moderate knowledge.

Conclusion: Many women were in the advanced age and had poor GDM knowledge on risk factors, clinical features, management, prevention and

consequences associated with GDM. Hence, health education to GDM mothers was recommended.

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the subtypes of diabetes mellitus that manifest during pregnancy. Its rate corresponds to 18–20 million births annually^{1,2,3}. Globally GDM prevalence ranges from 9-27%, making it an emerging public health threat to maternal and child health. Although the exact pathogenesis is not well understood, GDM is believed to result from an interaction of genetic, epigenetic and environmental factors^{4,2}. More than 90% of all GDM cases occur in low and middle-income countries, including Kenya, with prevalence varying depending on the population characteristics, screening approaches and diagnostic criteria⁵. Studies have shown that appropriate management strategies such as medical nutrition therapy, physical activity, and weight gain management/control can maintain normoglycemia and improve pregnancy outcomes^{6,7,8,9}. However, GDM is also associated with long-term risks, including progression to type two diabetes mellitus and cardiovascular diseases¹⁰.

Despite its growing risk burden, there is paucity of data on prevalence and awareness of GDM in Kenya, with only a few localized studies reporting low prevalence rates¹¹. Additionally, there is consistency among health care professionals regarding screening policies, diagnostic criteria, and treatment approaches¹². This lack of standardized knowledge contributes to inadequate dissemination of information to pregnant women, resulting in poor awareness of risk factors, clinical features, management, complications, and prevention strategies^{13,14,15}. Evidence from studies conducted in countries

such as Bangladesh, Nigeria, and India indicates that GDM awareness levels are low, often below 27%¹⁶. Furthermore, reports such as those from the Centers for Disease Control and Prevention indicate that significant proportion of women have no prior knowledge of GDM, highlighting a critical gap in health education¹⁴.

Therefore, this study aims to assess the level of knowledge on Gestational Diabetes Mellitus among women attending selected hospitals in Nairobi County, Kenya.

MATERIALS AND METHODS

Design

This was a hospital-based cross-sectional study conducted to assess knowledge gap on GDM among women attending selected health facilities.

Study area

The study was conducted in selected public health facilities in Nairobi County, Kenya, namely Pumwani Maternity Hospital (PMH) and Mama Lucy Kibaki Hospital (MLKH). These facilities were selected due to their high client volumes and provision of maternal health services. PMH is a referral maternity hospital located on the East of Nairobi City, around 4km from City Centre. It's in Kamukunji Sub County, Pumwani ward and is surrounded by the low- income residential areas of Eastleigh, Kariokor, Muthurwa, and Majengo. This hospital is the only mega and busiest maternity hospital, not only in Nairobi County but in East African¹⁷. MLKH is a level five hospital which is located in Kayole estate between Umoja II and Komorock estate in the eastern part of Nairobi County. It is

surrounded by people of low income population.

Study population

The study population included all the ANC mothers and the postnatal mothers following diagnosis of GDM condition from both the PMH and MLKH. All the mothers, new and revisits with GDM regardless of their gestation and those in postnatal period were recruited to help assess the knowledge to GDM. This enabled the researcher to reach the targeted population within three months (October to December 2024).

Sample size determination

The sample size was determined using Fisher et al formula for cross-sectional studies¹⁸.

$$n = z^2pq/d^2$$

Where

n = minimum sample size desired

z = standard normal deviate 1.645 which corresponds to 90% confidence level

p = proportion of the population with the desired characteristic ((80%)⁵

q = proportion of the population without the desired characteristic (1 - 0.8 = 0.2)

d = degree of freedom/precision 0.05

$$n = \frac{1.645^2 \times 0.8 \times (0.2)}{0.05^2} = 174$$

$$n = 174$$

Annually the GDM population for the two hospitals is approximately 480 mothers. Since the population of GDM in PMH and MLKH is < 10,000, the sample size adjustment was done using Finite Population Correction by Mugenda, A. and Mugenda, O¹⁸.

$$nf = \frac{n}{1 + n/N}$$

$$nf = \frac{174}{1 + 174/480} = 127.7$$

Thus sample size is 128

The best estimate of the sample size (n) = calculated sample size + 10% (Fisher et al formula).

$$\text{Thus } (n) = 128 + (10\% \times 128) = 128 + 12.8 = 141$$

$$n = 141$$

This sample size is for both PMH and MLKH, thus each health facility had $141/2 = 71$ GDM mothers.

Sampling procedure

The hospitals were purposively sampled because they match the unique characteristics of the chosen/desired population. Knowledge gap was to be identified from a total of 141 women, each hospital with 71 mothers. The Principal investigator (PI) in collaboration with the Research Assistant (RA) conveniently recruited any woman with GDM attending PMH and MLKH in their ANC period and those in the postnatal period.

Inclusion/Exclusion

Any woman with GDM attending PMH and MLKH in their ANC period from 24 weeks' gestation to term and those in the postnatal period within the first six months. This included new clients and revisits. Women in their first trimester gestation, those past six months after birth and pregnancy secondary to sexual abuse were excluded.

Sampling technique

A survey was done on all mothers who met the inclusion criteria.

Data collection methods

Data was collected using a structured, pretested questionnaire administered through interviewer-guided interviews. The questionnaire was guided by Patient Diabetic Knowledge Questionnaire (PDKQ). The questionnaire captured information on socio-demographic characteristics and knowledge regarding GDM, including predisposing factors, clinical features, management, complication and preventive measures. Data was collected during routine Antenatal Clinic (ANC) and Postnatal clinic (PNC) and analyzed to determine the level of knowledge and identify areas needing improvement.

*Study variables**Independent variable*

Level of knowledge on GDM

Dependent variable

Age, level of education, parity, marital status, religion, Employment status, previous history of GDM

Operational definitions

Good knowledge: correctly answering over 70% of knowledge related questions

Moderate knowledge: correctly answering between 70% to 50% of knowledge related questions

Poor knowledge: correctly answering below 50% of knowledge related questions¹⁹

Data management and Statistical analysis

Data was checked for completeness, coded and entered into Statistical Package for Social Sciences (SPSS) version 26.0 for analysis.

Descriptive statistics were used to analyze respondents' socio demographic characteristics, and levels of GDM knowledge using measures of central tendency of means, frequencies and percentages.

Inferential statistic was conducted using chi-square goodness-of-fit test to determine the differences between the two facilities. A p-value of less than 0.05 was considered statistically significant.

Bias control

The researchers minimized selection bias by clearly defining the inclusion and exclusion criteria. Through use of a standardized and pretested questionnaire, information bias was reduced. By training research assistant interviewer bias was reduced. Through focusing on recent and current information, recall bias was minimized. Routine and regular checks for data completeness and consistency were conducted to ensure data quality.

Ethical considerations

Approval to conduct the research was sought from the Jomo Kenyatta University of Agriculture and Technology Ethics and Research Committee and National Commission for Science, Technology and Innovation (NACOSTI), License No.: NACOSTI/P/24/38945. Permission to access participants was sought from Pumwani Maternity and Mama Lucy Kibaki Hospital CEO. Informed consent was sought and privacy & confidentiality was assured, based on the ethical research principles. No participant identifiers were used. Instead, code numbers were assigned on all data forms, and data were kept in safe custody by the Principal researcher. Participants were assured that their participation was voluntary and that they could withdraw at any time without penalty.

RESULTS

Participant's characteristics

The respondent's characteristics on level of knowledge on GDM among women were drawn from selected hospitals in Nairobi County (PMH and MLKH). Data collection took place over three months; from October to December 2024, using questionnaires administered by the research assistant. A total of 128 mothers participated in the study, representing a 90% response rate from the expected 142 mothers (PMH; 71 [100%]; MLKH 57 [80%]).

At PMH, majority of the respondents (57.7, n=41) were aged between 35-49 years, (66.2%, n=47) had a parity between one and two and (67.6%, n= 48) had attained tertiary education. At MLKH, more than half (52.6%, n=30) of the respondents were aged between 35-49 years, 56% (n=32) had a parity between three and four and 68.4% (n=39) had attained secondary education. The demographic characteristics

from the two facilities had a slight difference, except in parity and education level. There was a strong significant difference in level of

education between the two facilities ($X^2=15.687$, $df=3$, $P=0.0001$) (Table 4.1).

Table 4.1
Participant's demographic characteristics

Variable	Category	PMH		MLKH		Relationship; PMH/MLKH
		Frequency (n=71)	Percentage	Frequency (n=57)	Percentage	
Age in years	18-24	6	8.5	2	3.5	$X^2=1.620$, $df=3$, $P=0.145$
	25-29	13	18.3	7	12.3	
	30-34	11	15.5	8	14.0	
	35-49	41	57.7	30	52.6	
Parity	1-2	47	66	20	35.1	$X^2=7.852$, $df=3$, $P=0.050$
	-3-4	22	31	32	56.1	
	5-6	1	2	5	8.8	
	Above 6	1	1	0	0	
Occupation	Unemployed	6	8.5	6	10.5	$X^2=0.552$, $df=2$, $P=0.729$
	Employed	9	12.7	10	17.5	
	Self employed	56	78.9	41	71.9	
Residence (Sub County)	Makadara	12	16.9	16	28.1	$X^2=6.455$, $df=6$, $P=0.374$
	Starehe	24	33.8	12	21.1	
	Kamukunji	13	18.3	4	7.0	
	Lang'ata	6	8.4	3	5.3	
	Embakasi East	5	7.0	8	14.0	
Educational level	Embakasi North	4	5	8	14.0	$X^2=15.687$, $df=3$, $P=0.0001$
	Primary	6	8.5	3	5.3	
	Secondary	17	23.4	39	68.4	
Religion	Tertiary	48	67.6	15	26.3	$X^2=3.201$, $df=1$, $P=0.074$
	Christianity	62	87.3	54	94.7	
	Islamic	9	12.7	3	5.3	
	Hinduism	0	0	0	0	
Marital status	Pagan	0	0	0	0	$X^2=2.35$, $df=1$, $P=0.628$
	Married	63	88.7	42	73.7	
	Single	7	9.9	10	17.5	
	Separated	1	1.4	4	7.0	
	Divorced	0	0	1	1.8	

Rating of level of Knowledge of GDM

The level of knowledge was assessed using six questions, each addressing different aspect of GDM: risk factors (9 points), Causes (7 points), clinical features (6 points), management (6 points), complications (10 points) and prevention (6 points). This yielded a total

possible score of 44 points. This study found that 91.4% of women (n=117) had poor knowledge of GDM while 8.6% (n=11) had moderate knowledge. Notably, none of the participants demonstrated good knowledge. Majority 68% (n=87) scored between 32% and

43% while only 7% (n=9) participant scored above 50% (Table 4.2).

Table 4.2

Summary of the participant scores

Participants (Frequency)	Participant Rate (n=128)	Frequency score	Percentage score
3	2.3%	11	25%
5	3.9%	12	27%
9	7.0%	13	30%
12	9.4%	14	32%
19	14.8%	15	34%
16	12.5%	16	36%
11	8.6%	17	39%
13	10.2%	18	41%
16	12.5%	19	43%
6	4.7%	20	46%
8	6.3%	21	48%
2	1.6%	22	50%
4	3.1%	23	52%
2	1.6%	24	55%
2	1.6%	25	57%
1	0.8%	27	61%
128	100%	Out 44	

Knowledge on GDM

The variables assessed were; predisposing factors, clinical features, management, complications and prevention of GDM.

In MLKH 91.2% (n=52) had knowledge that GDM was predisposed by obesity while PMH had knowledge that GDM was predisposed by laxity (77.5 %, n=55) and obesity (69%, n=49).

Comparing the two facilities MLKH had more respondents with knowledge on predisposing

factor to GDM. Almost all the respondents (98.3%, n=56) from MLKH knew that GDM is caused by over nutrition. Among the two facilities, more than (80%) of the respondents knew the clinical features of GDM. There was a significant difference on the level of knowledge on complications of GDM between the two health facilities

($X^2 = 13.540$, $df = 6$, $Pv = 0.035$) (Table 4.3).

Table 4.3

Level of Knowledge on GDM per question

Variable	Category	PMH		MLKH		Relationship; PMH/MLKH
		Frequency (n=71)	Percent Age (%)	Frequency (n=57)	Percentage (%)	
Predisposing factors to GDM	Obese	49	69	52	91.2	$X^2=1.207$, $df=3$, $pv = 0.751$
	Laxity	55	77.5	8	14.0	
	Previous history	15	21.1	7	12.3	
	Relative with DM	24	33.8	7	12.3	

	History of Macrosomic baby	2	2.8	0	0	
Macrosomic baby as a risk factor to GDM	Yes	8	11.3	26	45.6	$X^2=2.230$, $df=2$, $pv = 0.084$
	No	17	23.9	10	17.5	
	I don't know	32	45.1	35	61.4	
Causes of GDM	Over nutrition	60	84.5	56	98.3	$X^2=1.626$, $df=3$, $pv = 0.653$
	Inheritance	28	39.4	8	14.0	
	Nature	9	12.7	1	1.7	
	Witchcraft	1	1.4	2	3.5	
Clinical features	Increased Micturition	61	85.9	56	98.3	$X^2=0.035$, $df=2$, $pv = 0.983$
	Increased Thirsty	59	83.1	54	94.7	
	Increased hunger	59	83.1	54	94.7	
Management	Go to hospital	66	93	53	93.0	$X^2=0.988$, $df=3$, $pv = 0.804$
	Eat less fat	15	21.1	41	71.9	
	Follow instruction	4	5.6	13	22.8	
	Nature	0	0	1	1.7	
Complications	Head out body retained	6	8.5	13	22.8	$X^2=13.540$, $df=6$, $Pv = 0.035$
	Severe PV bleed after birth	36	50.7	18	31.6	
	Operation/CS	63	88.7	50	87.7	
	Injury to maternal tissue	33	46.5	5	8.7	
	Baby unable to pass via birth canal	68	95.8	51	89.5	
	Death of mother	5	7.0	2	3.5	
	Death of baby	32	45.1	12	21.1	
Prevention	Do regular exercises	68	95.8	56	98.3	$X^2=1.207$, $df=3$, $pv = 0.751$
	Control weight	68	95.8	54	94.7	
	Eat less fat	66	93	54	94.7	

DISCUSSION

This study found that majority of the GDM women were aged between 35-49 years. This could be due to women concentrating on their academic development than social life, as it was seen most of the GDM women had tertiary education. This is in line with, Yaping, which showed that, GDM was diagnosed in 6.7% of pregnancies in general, but those over 30 years of age was 85%, hence as the age advances the more the risk of developing²⁰. It

is in line with, Lende study that showed the highest risk of developing GDM was at the ages of 35-39 compared with younger pregnant women (OR 95% CI: 10.85 (7.72-15.25) vs. 2.59 (1.84-3.67))²¹.

This study revealed that, women had poor knowledge on GDM, and only a few demonstrating moderate knowledge. This can be attributed to limited health education and awareness programs, irregular ANC attendance, Health Care Workers (HCW) may lack training or time to deliver GDM

education. Financial constraints may hinder the women from accessing quality Health Care Services. This concurs with a study in Egypt revealed that 90% of the women had poor knowledge of GDM²². These findings align with other studies. For instance, a study conducted in Australia (85% and Jamaica (66%) reported similarly low levels of GDM knowledge²³. Likewise, a study in Ethiopia revealed that women had poor knowledge of GDM risk factors (48%)²⁴. It also in line with a study conducted in the United Arab Emirates, where only 18% of mothers had adequate GDM knowledge¹⁶. However, this contrasts with a study in Saudi Arabia which found that 80% of women were knowledgeable about GDM management through lifestyle and diet modification, while 60% had moderate knowledge of risk factors²⁵.

CONCLUSION

This study revealed that many women had poor GDM knowledge; none of the participants had good GDM knowledge. It also revealed that majority of the women with GDM were at advanced maternal age. This study finding highlights the need to further educate mothers on the importance of avoiding the risk factors, understanding predisposing elements and adopting preventive strategies. The researchers recommend a health educational tool for the GDM mothers, covering predisposing factors, causes, clinical features, management, complications and prevention of GDM.

Strengths

Relevance of the study topic, this study addresses a critical public health issue, GDM possess a significant health risk to maternal and neonatal health. Investigating knowledge levels among women, helps fill the gap in early detection and in prevention strategies.

Focusing on pregnant women, the study centers on a population that directly benefits from improved awareness, making the findings actionable and impactful. The data collected gave the current situation, thus real-world insights into women's understanding on GDM and this can guide on local intervention and Kenyan policies. These results can contribute to practice and policy since the findings provide clear implications for health care workers, community health promoters and policy makers, thus strengthening the utility beyond academia.

Limitations

The data has a likelihood of social desirability bias that may arise from the potential issues affecting respondents thus affecting the accuracy of the GDM knowledge levels. The Sample size was from only two health facilities, and this may affect the generalizability. Limited scope of knowledge assessment may have occurred for not asking all the questions on GDM since the tool was guided by PDKQ.

Appendices:

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REFERENCES

1. Association Diabetes Association. Improving care and promoting health in populations: Standards of Medical Care in Diabetes—2021. *Diabetes Care*. 2021; 44 (Suppl_1):S7-14.
2. Rosik J, Szostak B, Machaj F, Pawlik A. The role of genetics and epigenetics in the pathogenesis of gestational diabetes mellitus. *Annals of human genetics*. 2020; 84 (2):114-24.
3. Sharma A, Nermoen I, Qvigstad E, Tran AT, Sommer C, Sattar N, et al. High prevalence and significant ethnic differences in actionable HbA1c after gestational diabetes mellitus in women living in Norway. *BMC Medicine*. 2022; 20 (1):318.
4. Groof Z, Garashi G, Husain H, Owayed S, AlBader S, Mouhsen HA, et al. Prevalence, risk factors, and fetomaternal outcomes of gestational diabetes mellitus in Kuwait: a cross-sectional study. *Journal of Diabetes Research*. 2019; 2019:9136250.
5. Venkatesh KK, Lynch CD, Powe CE, Costantine MM, Thung SF, Gabbe SG, et al. Risk of adverse pregnancy outcomes among pregnant individuals with gestational diabetes by race and ethnicity in the United States, 2014-2020. *JAMA*. 2022; 327 (14):1356-67.
6. Haron Z, Sutan R, Zakaria R, Mahdy ZA. Self-care educational guide for mothers with gestational diabetes mellitus: a systematic review on identifying self-care domains, approaches, and their effectiveness. *Belitung Nursing Journal*. 2023; 9 (1):6.
7. Ponzo V, Ferrocino I, Zarovska A, Amenta MB, Leone F, Monzeglio C, et al. The microbiota composition of the offspring of patients with gestational diabetes mellitus (GDM). *PloS One*. 2019; 14 (12):e0226545.
8. Rasmussen L, Poulsen CW, Kampmann U, Smedegaard SB, Ovesen PG, Fuglsang J. Diet and healthy lifestyle in the management of gestational diabetes mellitus. *Nutrients*. 2020; 12 (10):3050.
9. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world. Geneva: World Health Organization; 2019.
10. ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, et al. Introduction and methodology: standards of care in diabetes—2023. *Diabetes Care*. 2022; 46 (Suppl 1):S1.
11. Pastakia SD, Njuguna B, Onyango BA, Washington S, Christoffersen-Deb A, Kosgei WK, et al. Prevalence of gestational diabetes mellitus, western Kenya: a prospective comparison of point of care diagnostic methods. *BMC Pregnancy and Childbirth*. 2017; 17 (1):226.
12. Agarwal MM, Shah SM, Al Kaabi J, Saquib S, Othman Y. Gestational diabetes mellitus: Confusion among medical doctors caused by multiple international criteria. *Journal of Obstetrics and Gynaecology Research*. 2015; 41 (6):861-9.
13. Henderson CE, Nezam H, Castillo KM. Centers for Disease Control and Prevention—Recognized Diabetes Prevention Program after gestational diabetes mellitus. *AJOG Global Reports*. 2023; 3 (1):100150.
14. Vince K, Perković P, Matijević R. What is known and what remains unresolved regarding gestational diabetes mellitus (GDM). *Journal of Perinatal Medicine*. 2020; 48 (8):757-63.
15. Thomas S, Pienyu R, Rajan SK. Awareness and knowledge about gestational diabetes

- mellitus among antenatal women. *Psychology, Community and Health*. 2020; 8 (1):237-48.
16. Bashir MM, Ahmed LA, Alshamsi MR, Almahrooqi S, Alyammahi T, et al. Gestational diabetes mellitus: knowledge and associated factors among United Arab Emirates university students. *International Journal of Environmental Research and Public Health*. 2022; 19 (14):8381.
 17. Muriithi JW, Kariuki PW, Mwangi GM. Influence of Socio-demographic Characteristics on Burnout among Nurses at Pumwani Maternity Hospital, Nairobi, Kenya. *Asian Journal of Research in Nursing and Health*. 2020 ;3(3):19-29.
 18. Boadu WI, Kugblenu P, Senu E, Opoku S, Anto EO. Prevalence and risk factors associated with gestational diabetes mellitus among pregnant women: a cross-sectional study in Ghana. *Frontiers in Clinical Diabetes and Healthcare*. 2022; 3:854332.
 19. Alharthi AS, Althobaiti KA, Alswat KA. Gestational diabetes mellitus knowledge assessment among Saudi women. *Macedonian Journal of Medical Sciences*. 2018; 6 (8):1522.
 20. Yaping X, Huifen Z, Chunhong L, Fengfeng H, Huibin H, Meijing Z. A meta-analysis of the effects of resistance training on blood sugar and pregnancy outcomes. *Midwifery*. 2020;91:102839.
 21. Lende M, Rijhsinghani A. Gestational diabetes: overview with emphasis on medical management. *International journal of environmental research and public health*. 2020 ;17(24):9573.
 22. Assaf EA, Al Sabbah H, Momani A, Al-Amer R, A. Al-Sa'ad G, Ababneh A. Factors influencing gestational diabetes self-care among pregnant women in a Syrian Refugee Camp in Jordan. *Plos one*.;19(2):e0297051.
 23. Ludowici E. Assessing knowledge on gestational diabetes mellitus and child health. *Hawai'i journal of health & social welfare*. 2023; 82(10):227.
 24. Dissassa HD, Tufa DG, Geleta LA, Dabalo YA, Oyato BT. Knowledge on gestational diabetes mellitus and associated factors among pregnant women attending antenatal care clinics of North Shewa zone Central Ethiopia: a cross-sectional study. *BMJ open*. 2023; 13 (9):e073339.
 25. Khayat AA, Fallatah N. Knowledge of gestational diabetes mellitus among Saudi women in a primary health care center of Almadinah Almunawarah, Kingdom of Saudi Arabia. *Cureus*. 2022; 14 (3).