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PREVALENCE AND RISK FACTORS OF GESTATIONAL DIABETES MELLITUS IN SUB-SAHARAN AFRICA: A SYSTEMATIC REVIEW
Zipporah Kasyoka Kimanthi, Department of Midwifery, School of Nursing, Jomo Kenyatta University of Agriculture and Technology, P.O. Box 60200-00200 Nairobi, Kenya; Cyrus Mutie,; Department of Community & Reproductive Health Nursing, School of Nursing, Mount Kenya University, P.O. Box 342-01000 Thika, Kenya; Jostine Ndunge Mutinda, Department of Medical Surgical Nursing, School of Nursing, Jomo Kenyatta University of Agriculture and Technology, P.O. Box 60200-00200 Nairobi, Kenya; Drusilla Makworo, Department of Community Health Nursing, School of Nursing, Jomo Kenyatta University of Agriculture and Technology P.O. Box 60200-00200 Nairobi, Kenya.

Corresponding author: Zipporah Kasyoka Kimanthi, Department of Midwifery, School of Nursing, Jomo Kenyatta University of Agriculture and Technology, P.O. Box 60200-00200 Nairobi, Kenya; Cyrus Mutie,; Department of Community & Reproductive Health Nursing, School of Nursing, Mount Kenya University, P.O. Box 342-01000 Thika, Kenya;

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Z. K. Kimanthi, C. Mutie, J. N. Mutinda and D. Makworo

ABSTRACT

Background: **Gestational Diabetes Mellitus (GDM) is a major public health concern globally, that carries a double burden of the mother and the fetus.**
Objectives: **This systematic review aimed to investigate the prevalence and risk factors of GDM in Sub-Saharan Africa (SSA).**
Methods: **Researchers systematically searched five databases: PubMed, PubMed Central, ProQuest central, Cochrane and Articles from the reference lists and grey literature. The review included studies conducted (2012 - 2024) and published (2017 - 2024). Eligibility criteria included studies that; reported prevalence or risk factors of GDM, conducted in SSA, published in English, provided full-text access, employed a cross-sectional, cohort or interventional study design. Studies were required to use oral glucose tolerance tests as the diagnostic standard. The risk of bias was assessed using the ROBIS Tool. A total of 47 articles met the inclusion criteria.**
Results: **Out of 55 countries in SSA, only 11 conducted studies meeting the criteria, resulting in 47 relevant studies on GDM risk factors and prevalence. Ethiopia had the highest number of studies (eight), while Gabon had the fewest (one). Kenya had no studies reporting the prevalence rate. The mean prevalence of GDM across the 47 studies was 14%, with individual study prevalence rates ranging from 3% to a high level of 39%. Among the included studies, 16 were hospital-based cross-sectional studies, while 11 were population based studies. Collectively the studies total sample size of 42,952 participants.**

Conclusion: **The study revealed an increasing trend in the prevalence of GDM in SSA. The identified risk factors are largely modifiable and therefore present opportunities for prevention. The researcher recommends targeted intervention to address these risk factors and reduce the prevalence of GDM. Lack of similar evidence in many SSA Countries suggests that existing practices and guidelines may not be based on the most current relevant data.**

INTRODUCTION

Gestational diabetes mellitus (GDM) is a form of obstetric pathology characterized by increased insulin resistance and glucose intolerance. It affects approximately 14% of all pregnancies globally, which corresponds to 18–20 million births annually[1,2]. It is an emerging public health threat to maternal and child health in the world[3]. The condition continues to be a public health concern and a serious threat to Ghana's public health system as well as most other sub-Saharan African nations[4]. For instance, South Africa is witnessing a rapid rise with approximately 2.3 million individuals affected by diabetes, ranking it the second most common cause of death in 2015[5]. Research on offspring whose mothers had prenatal diabetes has revealed that these children have an increased risk of developing type 2 diabetes, renal disease, high blood pressure, obesity, overweight and insulin resistance, and have a higher body mass index[6]. During pregnancy the placenta produces hormones that can interfere with action of insulin causing insulin resistance. In most cases, this hyperglycemia is the result of impaired glucose tolerance due to pancreatic β-cell dysfunction on a background of chronic insulin resistance[7]. Thus a combination of hormonal, metabolic and genetic factors affects insulin sensitivity and secretion; this causes persistent hyperglycemia leading to GDM.

Globally, the prevalence of GDM ranges between 1 – 28% depending on diagnostic criteria, the ethnicity and screening methods. By 2021, it was estimated that 536 million people were living with diabetes mellitus, and this number is projected to reach 783 million by 2025[4,5,6,7]. Prevalence vary by region: Europe stands at 5.4%, with Vietnam at 24.2%, African at 13.6% and Sub Saharan African 14.3%[5,7]. Studies from Eastern and Southeastern Asia suggest a pooled prevalence of approximately 10%, often higher in low and middle income Countries[6]. In Sub Sahara African, a study found GDM prevalence ranging from 0% in Tanzania to 46% in Djibouti, with an average rate of 9%. Additionally, a study conducted in Uganda found that one in every ten pregnant women (10%) attending the antenatal care at Mbarara Regional Referral Hospital was likely to have GDM [8].

The major risk factors for the onset of this condition is; obesity among mothers, gradual overweight & increased pregnancy body mass index, high fat and low carbohydrate diet /high calorific diet, previous diabetic history, gestational hypertension, sedentary lifestyle, history of diabetes in parents, advanced maternal age and stress[9,10]. GDM has been found to be high in middle income countries, SSA countries been in this category[4,11].

Given the burden and the potential maternal perinatal complications of GDM, the identification of relevant associated clinical factors can potentially result in risk stratification and targeted screening, early diagnosis, and initiation of treatment. Further, knowledge about GDM will be generated &

updated and better interventions will be employed to reduce the poor maternal and perinatal birth outcomes related to GDM. Thus, this review aims to determine the prevalence and risk factors of GDM in SSA so that it can guide on the intervention and knowledge update.

METHODOLOGY

Study Design

A systematic review of National and International literature was conducted guided by Preferred Reporting Items for Systematic Meta- Analysis (PRISMA). The protocol of this systematic review was sought and registered by International Prospective Register of Systematic Review (PROSPERO) database number; CRD42023467616. The studies were selected according to the study design and the Country that were from SSA.

Eligibility criteria

The researcher identified articles electronically that met the predetermined characteristics to include those showing the prevalence and risk factors of GDM from SSA. The appropriate studies were those published in English language and those published between 2017 and 2024. Interventional, Cohort, Case Control and Cross-sectional studies were included for they are best suited for estimating the prevalence and risk factors. Case reports, case series, qualitative, editorials, commentaries and expert opinions studies were excluded because they lack robustness.

Search strategy

A comprehensive literature search was conducted online on credible database including pub med, pub med central, Pro Quest Central, Cochrane and grey literature to identify all the studies that fitted the inclusion criteria. Manual search was also done to identify more relevant studies from the references list of the full text articles retrieved and other relevant reviews to maximize the identification of eligible studies. The Pub med, pub med central, Pro Quest Central and Cochrane search string were used by dividing the terms into five categories i.e Expectant mothers, Diabetes, Prevalence, Risk factors, Africa. The search included all the other terms with same meaning of the category MESH terms. Similar words were joined with word "OR" and the categories were combined by the word "AND". Using the Boolean method, the search was done.

Study Selection

Three reviewers independently screened the title, abstract and full text of the retrieved articles for eligibility in three stages. Stage one; duplicates were identified and removed by using the Zotero bibliography software. The second stage was screening of the titles and abstracts using the Rayyan online platform, to verify whether they met the inclusion criteria. The third stage, full-text articles were downloaded and assessed for eligibility by a thorough physical check. The studies that did not meet the eligibility criteria were removed and their bibliographic details listed in the exclusion folder with specific reasons for exclusion. Any discords between the three reviewers were resolved by a supervisor as the Forth author. Additional studies were also selected from the reference list of the retrieved articles which underwent a thorough physical perusal for eligibility.

Data extraction

Two reviewers independently used Microsoft excel sheet to record the data extracted from the specific studies. The entry in excel form enabled easy synthesis and analysis of the extracted variables. For each eligible study, a predetermined data extraction form was used

with the following details: Authors name and year of publication, Study period¸ Country, Study design, Sample size, Mean Age of Participants, Age Range (years), Number of Diabetics, Prevalence and Risk Factors. The third author solved any discrepancies arising from the two reviewers.

Quality assessment and Risk of bias

Critical appraisal from the retrieved eligible studies was done by the two reviewers to assess the credibility of each study using the methodological structure and results presentation. Five domains related to risk of bias were assessed in each cross-sectional study including: bias in the assessment of exposure, development of the outcome of interest in case and controls, bias in the selection of cases, selection of controls, and control of prognostic variables. Two reviewers assessed the retrieved eligible studies for quality and risk of bias using the Joanna Briggs Institute (JBI) critical appraisal tools and Newcastle Ottawa Scale (NOS).

Data analysis strategy

Due to heterogeneity of the study population and the diagnostic criteria used, the study findings were analyzed and synthesized narratively.

RESULTS

Study selection

The final search strategy conducted in November 2024 yielded 1414 potentially relevant studies from five data bases: pub med 270, pub med central 1049, Pro Quest Central 43, Cochrane 38. Additional 28 articles were identified from reference list and grey literature. A total of 14 articles were duplicates and were removed at this initial stage. Then the remaining 1414 studies were screened for eligibility based on the inclusion/exclusion criteria of which 1256 illegible articles were excluded, and the remaining 126 articles were retrieved as full text. Then 89 full text articles were removed with reasons. All the selected 47 studies were included for critical appraisal using PRISMA flow chart of the study process.

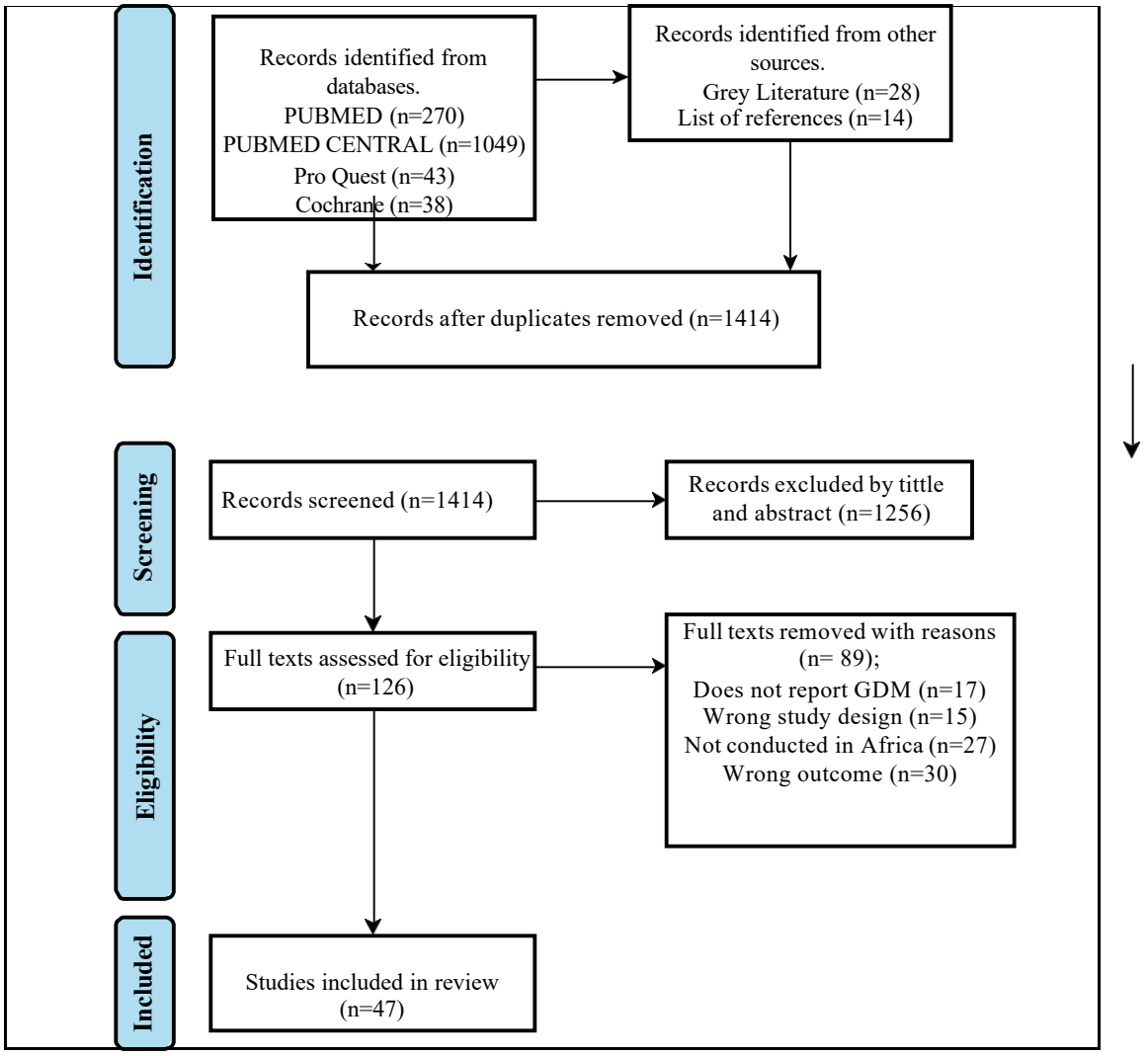

Figure 1: Prisma flow chart

General characteristics of the selected studies

Out of 55 countries in SSA, between the period of review 2017 to 2024, only 11 (20%) countries had done 41 studies related to risk factors and prevalence of GDM. Ethiopia leading with eight (17%) studies followed by Uganda six (15%), Nigeria and Tanzania five (12%), South Africa four (10%) with the least being Gabon and Gambia one (2%), followed by Kenya, Ghana, Cameroon and Rwanda each two (5%). Four Countries (10%) did not highlight the Country of study.

Among the 47 studies included, 16 (34.04%) were hospital based cross-sectional studies;[12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,.] A total of 11 (23.40%) used population based cross sectional study design:[27,28,29,30,31,32,33,34,35.] Studies that used prospective cohort studies were 8 (17.03%) [36,37,38,39,40,41,42,43,], 6 (17.77%)had not stated their design: [44,10,45,] [11,46,47] and 6 (17.77%) used Case Control Studies[48,49,50,51,52,53] .

Although most of the years of publication are recent, the studies were conducted between 2012 to 2024. Out of 40 studies that showed the period of study, more than half 31 (77.5%) of the studies were conducted between 2018 to 2022. Most of the studies were published in 2018 (n=9), and 2022 (n=9), then 2019 &2023

each had (n=7), 2017 (n=5), 2021 & 2024 (n=3). Most of the studies were conducted in Ethiopia with (n=11). The age range was within the age between 15- 49 years. The mean age for the studies reported was averagely at 27±6 years. Almost all the studies posted their sample (42 out of 47 studies). Each study had a different sample size, ranging from 139 to 10950 with a range of 10817. Majority 23 (61%) of the studies had a sample size between 200 – 600, 19% (9) had a sample size above 1000 and the least 21% (10) ranging between 501 to 1000. The total sample size was 47,427.

Prevalence of GDM in Africa

Out of 47 studies, 30 studies portrayed a GDM mean prevalence of 14% with the highest recording 39% and the least 3%. Half of the studies had a GDM prevalence of more than 10%. The prevalence of GDM varied differently from one region to another and with yearly advancement. ln Tanzania the prevalence of a study in 2017 was 4.3%[21] and another one done in 2018 it was 27.5%[19]. In South Africa a study done in 2012 showed that the prevalence was 3%[28] and another study done in 2015 it was 9.1%[31]. In Ethiopia a study done in 2017 had a prevalence of 4.2%[25], in 2018 12.8%[7] and in 2019 26.2% among other studies[43,54,55,56,57,58] . Therefore, as we advance in years, the prevalence rate increases. There was no study from Kenya and Gabon showing the for prevalence.

Risk factors of GDM in SSA

The risk factors identified from the review were almost cross cutting, though some studies identified few while others a wide range. The risk factors included advanced maternal age of 35 years and above, history of macrosomic baby above 4.5kg birth weight, history of still births, history of known diabetes, BMI of above 30kg/m^2, first hand relative who is diabetic, history of preterm delivery, mothers with previous history of spontaneous abortion, mothers with pica of coffee drink and sugar sweetened beverages (SSB). History of alcohol and tobacco consumption, previous Caesarean Section, widowed marital status, advanced age at first conception, urban residence, type ii DM, high parity, previous history of GDM, history of pre-eclampsia, history of hypertension, low physical activity or sedentary behavior, family history diabetes, history of contraceptive use, anaemia, inadequate dietary diversity, unemployed woman, antenatal depression, low level of education, household of higher social economic status and people of living with HIV/AIDS.

Table 3: Summary of the 47 included studies on prevalence and risk factors of GDM among pregnant mothers in SSA

Authors and year of publication	Study period	Country	Study design	Sample size	Mean Age of Participants (years)	Age Range (years)	Number of Diabetics	Prevalence	Risk Factors
Abindu *etal*, 2024	NR	Uganda	Analytical cross-sectional study	233	25.09+5.196	15 to 39	NR	8%	Advanced maternal age Early pregnancy increased BMI History of family DM
Akinyemi. O. *et al*,2023	2016-2017	Nigeria	Hospital based Cross sectional	270	30	27-32	NR	7.8%	History of macrosomia History of congenital anomaly History of known diabetes Obese First hand relative who is diabetic
Basil *etal*, 2024	2018-2019	Nigeria	Multi-hospital cohort study	253	31.4±4.6	NR	NR	20.6%	Increasing maternal age Higher body mass index (BMI) Family history of diabetes mellitus Previous history of foetal macrosomia
Bruno *et al*, 2023	2018-2019	Nigeria	Hospital based crossectional study	281	29.2 ± 4.8 years	NR	47	16.7%	Increasing maternal age and early pregnancy High BMI
Lendoye *et al*., 2022	2014-2015	Gabon	Hospital Cross-sectional	245	27.2 ± 6.0	15-43	NR	4.5	High age combined high parity
Mghanga *et al*., 2020	2017	Tanzania	hospital–based cross-sectional	612	24±6.9	15 – 48	26	4.3	Advanced maternal age History of macrosomia History of still births Alcohol consumption First hand relative who is diabetic History of spontaneous abortions History of preterm delivery
Mdoe *et al*., 2021	2018	Tanzania	hospital–based cross-sectional	600	26 (±5.8)	NR	160	27.5	Age above 35 years History of pre-eclamspia Low physical activity Family history diabetes Alcohol use
Boadu *et al*., 2022	2021	Ghana	hospital-based cross-sectional study	200	NR	NR	17	8.5	Oral use contraceptives History of pre-eclampsia

Larebo & Ermolo, 2021	2019-2020	Ethiopia	Cohort study	420	29.57	NR	NR	26.2	Primary education Adequate dietary diversity
Egbe *et al.*, 2018	2016-2017	Cameroon	Cross-sectional study	200	27.8 (SD 5.7)	16-42	7	3.5	Advanced maternal age ≥30 years High BMI ≥30 kg/m2 History of unexplained stillbirth History of macrosomia
Nigatu et al., 2022	2017	Ethiopia	Institution based cross sectional study	390	NR	NR	66	16.9	Age above 30 years BMI of above 25 years
Meharry *et al.*, 2019	2017	Rwanda	Hospital based cross sectional study	281	27	16-44	9	3.2	NR
Kiiza *et al.*, 2019	2018-2019	Ethiopia	Cross-sectional study	1027	27.22 (SD ± 5.24)	NR	9	NR	Overweight / obese Previous history of GDM Family history of diabetes, Low physical activity Inadequate dietary diversity Antenatal depression
Grunnet *et al.*, 2020	2014-2016	Tanzania	NR	392	NR	NR	NR	39	NR
Muche *et al.*, 2019	2018-2019	Ethiopia	cross-sectional study	1027	27.22 (SD ± 5.24)	NR	131	12.8	Obesity Adequate dietary diversity Previous history of GDM Family history of diabetes
Nakabuye *et al.*, 2017	2013-2014	Uganda	prospective cohort study	251	29.25 SD+/-4.95	NR	NR	31.9	Multiparty High BMI Family history of DM
Nombo *et al.*, 2018	2018	Tanzania	Hospital based cross sectional study	609	NR	NR	NR	NR	Smoking and Alcohol consumption Pre-existing hypertension High parity Previous caesarean section Advanced age Previous stillbirth History of type 2 diabetes
Woticha *et al.*, 2019	2017-2018	Ethiopia	Hospital based cross sectional study	518	25.7 (4.4)	NR	NR	4.2	Previous still birth Family history of type 2 DM

Chola *et al.*, 2017	2012	South Africa	Community based cross sectional study	4261	33 (9.1)	15 - 49	144	3	NR
Macaulay *et al.*, 2018	2015	South Africa	Cross sectional study	1906	NR	NR	NR	9.1	Higher household socioeconomic status Family history of diabetes An age of ≥35 years, BMI ≥ 30 kg/m^2 Family history of diabetes
(Maidwell-Smith et al., 2020)	2014-2015	Gambia	Cross sectional study	1392	NR	18-45	199	16.1	Obese Advanced maternal age Hypertension
Dłuski *et al.*, 2022	2017	Ethiopia	NR	NR	15.9-67.8	NR	NR	NR	NR
Njete atel, 2017	2015-2016	Tanzania	Cross sectional study	433	27.9±5.9	NR	65	19.5	Alcohol, and smoking history History macrosomic baby, obesity
Quansah *et al.*, 2018	2018	Ghana	NR	195	NR	NR	NR	3.6	NR
Tsuhasuma *et al.*, 2024	2023	Congo	Hospital based Crossectional study	203	NR	NR	NR	17.2	Preterm birth
Aftab *et al.*, 2021	2020	Ethiopia	NR	139	28±4.4	18-39	NR	18	NR
Sekotileko *etal*, 2023	2023	Uganda	Population based cross study	10950	18	2022	NR	NR	NR
Byakwaga *et al.*, 2021	2020	Uganda	Hospital based cross sectional	403	26.6	NR	NR	NR	Family history of GDM Previous history of GDM Obesity Advanced maternal age
Zalwango *et al.*, 2021	2018-2019	Uganda	Hospital based cross sectional study	NR	NR	18-40	NR	NR	NR
Pastakia *et al.*, 2017	NR	Kenya	Prospective cohort study	616	NR	NR	NR	2.9%	NR
Mapira *et al.*, 2017	NR	Rwanda	Hospital based crossectional	288	NR	NR	NR	8.3%	Advanced maternal age Previous gestational DM Family history of GDM

Ottaro *et al*,., 2023	2021-2022	Kenya	Prospective Cohort	210	NR	NR	NR	NR	Family history of GDM Obesity
Bengtson *et al*., 2023	NR	South Africa	Prospective Cohort study	397	NR	NR	NR	8.1	Family history of GDM Obesity PLWHA
Olabuji *et al*., 2022	2017-2020	Nigeria	Hospital based cross sectional study	8915	29.60 ± 5.64	NR	NR	12.5%	Family history GDM Family history Hypertension
Adeoye *et al*., 2023	NR	Nigeria	Prospective cross sectional study	1745	29.8 ± 5.3	NR	NR	NR	Sugar sweetened beverages Low physical activities Sedentary behavior Alcohol and tobacco consumption
Munang *et al*., 2017	2012-2013	Cameroon	Hospital based crossectional	978	26 ± 5	NR	NR	32.1%	NR
Msollo *et al*., 2022	2018	Ghana	Cross sectional study	468	NR	NR	NR	NR	Family history of GDM History of macrosomic baby
Macaulay, 2018	2012	South Africa	Prospective cohort study	1906	NR	NR	NR	9.1%	NR
Eltoony, *et al*, 2021	2016-2017	Egypt	Prospective cohort study	1000	NR	NR	NR	17.5	History of still birth Obesity Macrosomia
Bune etal 2024	2023	Ethiopia	Unmatched case control	255/378	NR	NR	NR	NR	History of SB, Widowed marital status, Multipari and previous CS
Yaping etal, 2022	2018	Developing countries	Case control	293/293	NR	NR	NR	15.69%	History of DM, Hypertension, married, Advanc age and Pre eclampsia
Taye etal, 2022	2020	Ethiopia	Case control	80/240	NR	NR	NR	NR	Still birth, advanced age, family history DM hypertension, previous CS, Macrosomic baby
Alshafe etal, 2020	2017	Sudan	Nested case control	NR	NR	NR	NR	NR	History of low level of 25-hydroxyvitamin D
Feleke etal, 2018	NR	Ethiopia	Unmatched case control	567/1690	NR	NR	NR	NR	History of IUFD, still birth, abortion, macrosom baby, DM/hypertension, abortion and obesity
Bawah etal, 2019	NR	Ghana	Retrospective case control	NR	NR	NR	NR	NR	Still birth, advanced age, history of DM hypertension, CS, Macrosomic baby and Obesity

DISCUSSION

The prevalence of GDM is on exponential upward trend as time advances. This is in congruence with a previous study done in the US between 2006- 2017 which revealed that the prevalence of GDM continuously increased and nearly doubled, from 2006 to 2016[59,60,61,62]. The increase appeared more marked among the populations with overweight people, insufficient activity, and family incomes below the poverty threshold. A similar revealed that GDM prevalence increased significantly from 2019-2023. Between 2019 and 2023, the overall prevalence of GDM per 100 live births (95% confidence interval) was 6.9% [63, 48, 64, 65, 66]. Further, a study done by Yueyi demonstrated that the risk of GDM increases linearly with successive age-groups[67, 68, 69]. For each one-year increase in maternal age from 18 years, GDM risk for the overall population, increased by over 6%[68]. The risk factors of GDM are obesity, physical inactivity, advanced maternal age, multiparous, and family history of type 2 diabetes mellitus. In their review of diet and lifestyle factors influencing the development of GDM, Zhang and Ning note several studies that demonstrate a positive correlation between exercise before and/or during pregnancy and reduced GDM risk [69].

STUDY LIMITATIONS

This review had several limitations. Limited availability of studies from SSA, many may not have been indexed in major databases increasing the risk of publication bias. Heterogeneity across Countries, populations and study designs made the synthesis difficulty. Contextual differences across SSA settings may limit the generalizability of the findings.

CONCLUSION

The prevalence of GDM is on exponential upward trend as time advances, this was due to more stringent diagnostic procedures, increase in advance maternal age, universal screening strategy and change of lifestyle.

The common risk factors revealed are modifiable and thus can be controlled; therefore, the researcher recommends intervention of the risk factors in order to reduce the prevalence. However, evidence of this kind is missing in most of the SSA Countries; this may mean that current practices and guidelines are not informed by the most current evidence. Therefore, more prevalence studies on GDM are recommended especially in countries where this evidence is missing.

RECOMMENDATION

There is need to ensure that every pregnant woman is screened for diabetes mellitus. This will facilitate early diagnosis and prompt treatment.

Most of the risk factors for gestational diabetes mellitus are modifiable e.g. Dietary factors, obesity and sedentary lifestyle. Women of reproductive age should be encouraged to adopt healthy feeding habits, exercise before conception and during pregnancy, and maintain the recommended weight. They should also be taught how to recognize early cardinal signs of diabetes mellitus in order to avoid complications. Additionally, those with a family history /risk factors of GDM should be encouraged to go for screening during the preconception period.

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Author 2 CM; Extracted articles using the search strategy and independent Critical analysis and synthesis of the identified studies
Author 3 JM; Resolved discrepancies between the reviewers and drafted manuscript
Author 4 DM; critically revised the manuscript and authenticated the whole review document
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CONFLICT OF INTEREST STATEMENT

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