



HOW TO IDENTIFY, MONITOR, AND TREAT FATAL EFFECTS OF GESTATIONAL DIABETES IN TANZANIA

Descriptive Literature Review

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ABSTRACT

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This paper purposed to collect, extract, analyze, and synthesize literature on how to identify, monitor, and treat the fatal effects of gestational diabetes on both the mother and the fetus in Tanzania. This thesis was carried out as a descriptive literature review where CINAHL, Andor, and PubMed search engines were used. Search words used were “gestational diabetes AND Tanzania” “gestational diabetes AND fatal* signs* effect* consequence* risk* fetus* and “diabetes AND pregnancy”. The data search was limited to its relevance to the topic, recent 10 years, and language (English, Finnish). The search was also limited to scientific articles (ethics and reliability of the research, refereed and peer-reviewed publications).

The research questions used were:

- What is the incidence of gestational diabetes in Tanzanian?
- What factors contribute to the increasing occurrence of GDM in Tanzania?
- What fetal and maternal health complications are caused by gestational diabetes?
- How to identify, monitor, and control the fatal effects of gestational diabetes in the context of Tanzania?

11 search results were selected, extracted, and analyzed.

The results indicated that in Tanzania, the risk of GDM-related pregnancy complications was high. This was due to the unawareness of the condition in the region, poverty, and lack of diagnosing, treating, and monitoring equipment and facilities. In conclusion, this study revealed that there was a lack of sensitization, and suitable diagnosing criteria for gestational diabetes as indicated by high-risk lifestyles led by pregnant women and increased fatal consequences like stillbirths. This study is therefore relevant, and the results of this study can be used to create an easy-to-read guidebook for maternity nurses, public health nurses, and pregnant women or as an information package for relevant centers in the community as a solution to the identified problem.

Keywords: GDM, Adverse effects, Screening, Tanzania, Monitoring

CONTENT

1	INTRODUCTION.....	5
2	THEORETICAL FRAMEWORK	6
2.1	Statistics on the prevalence of GDM in Tanzania.....	6
2.1.1	Factors contributing to the rise of GDM in Tanzania	6
2.1.2	Lifestyle.....	7
2.1.3	Maternal Body Mass Index (BMI).....	8
2.1.4	Maternal age and family history	8
2.2	Societal, cultural, and healthcare challenges.....	10
2.2.1	Low Socioeconomic Status.....	10
2.2.2	Limitations in WHO Diagnosing Criteria.....	11
2.2.3	Lack of sensitization and awareness	12
2.2.4	Capacity and capability of health facilities.....	13
3	GESTATIONAL DISBETES MELLITUS.....	14
3.1	Definition	14
3.1.1	Etiology.....	14
3.1.2	Diagnosis.....	16
3.1.3	Monitoring and Screening.....	16
4	FETAL FATAL EFFECTS OF GDM	17
4.1	Macrosomia.....	17
4.1.1	Risk Factors.....	17
4.1.2	Diagnosing and Screening.....	17
4.1.3	Treatment and Management.....	18
4.1.4	Mortality and associated risks.....	19
4.1.5	Prognosis.....	19
4.2	Intrauterine growth restriction (IUGR).....	19
4.2.1	Etiology.....	20
4.2.2	Diagnosing and Screening.....	20
4.2.3	Treatment and Management.....	21
4.2.4	Mortality and associated risks.....	22
4.2.5	Prognosis.....	22
4.3	Congenital malformations.....	23
4.3.1	Etiology.....	23
4.3.2	Diagnosing and Screening.....	23
4.3.3	Treatment and Management.....	24
4.3.4	Mortality and associated risks.....	25
4.3.5	Prognosis.....	25

	4
4.4 Stillbirths.....	25
4.4.1 Diagnosis.....	26
4.4.2 Prevention.....	26
4.5 Asphyxia.....	26
4.5.1 Etiology.....	27
4.5.2 Diagnosing and Screening.....	27
4.5.3 Treatment and Management.....	27
4.5.4 Mortality and associated risks.....	28
5 MATERNAL FATAL EFFECTS OF GDM.....	29
5.1 Preeclampsia.....	29
5.1.1 Diagnosis.....	29
5.1.2 Diagnosing, treatment, and monitoring.....	29
5.1.3 Mortality and associated risks.....	30
5.2 Cesarean delivery.....	30
5.2.1 Indications.....	30
5.2.2 Associated Risks.....	31
5.3 Maternal Hemorrhage.....	31
5.3.1 Etiology.....	31
5.3.2 Diagnosing.....	32
5.3.3 Management.....	32
5.3.4 Associated Risks.....	32
6 PURPOSE, OBJECTIVE, AND METHODOLOGY.....	33
6.1 Purpose and goal of study.....	33
6.2 A descriptive literature review.....	33
6.3 Search and selection of material.....	35
7 MATERIAL DESCRIPTION AND ANALYSIS.....	38
7.1 Purpose and goal of study.....	38
7.2 Analysis of Data.....	40
8 ANALYSIS OF RESULTS OF LITERATURE REVIEW.....	43
8.1 Results Analysis.....	43
9 REFLECTION.....	50
7.1 Review of research results and conclusions.....	51
7.2 Ethics and reliability of the literature review.....	53
7.3 Process description and personal growth.....	54
7.2 Usability of the thesis and topics for further research.....	56
5 REFERENCE.....	57

1 INTRODUCTION

Gestational diabetes is a type of diabetes onset in gestation and poses significant threats to both the fetus and the mother. It is a common pregnancy complication affecting approximately 17% of all pregnancies globally (Grunnet, Hjort, Minja, Msemu, Møller, Prasad, Groop, Lusingu, Nielsen, Schmiegelow, Bygbjerg, Christensen 2020). According to Mwanri, Kinabo, Ramaiya, Feskens (2023), Tanzania is no exception as studies highlight a 25% alarming rate of increase in the prevalence of GDM in some populations. Research findings suggest prompt action towards creating awareness, prevention, and management of GDM as it poses a considerable burden on the healthcare system. GDM is associated with fatal fetal and maternal health effects, like pre-eclampsia, macrosomia, stillbirths, and neonatal hypoglycemia. Risk factors for developing GDM include lifestyle, BMI, and family history of diabetes among others (Njete, John, Mlay, Mahande, Msuya 2018). This thesis aimed to contribute to existing knowledge by providing an overview of current knowledge regarding the prevalence, risk factors, and how to identify, monitor, and treat fatal effects of GDM in Tanzania, by examining and synthesizing findings from different studies as referenced in this review.

The motivation and interest in this topic came from a near-death experience of a family member caused by unawareness and negligence of the effects of GDM during pregnancy and an increase in similar cases among friends and acquaintances in Tanzania. The objective was to carry out a descriptive literature review on the prevalence, risk factors, and how to identify, monitor, and control the fatal impacts of gestational diabetes on both the foetus and the mother. In nursing and healthcare studies, literature review is mostly used to promote evidence-based activities and practical nursing work (Aveyard, Helen 2023). The first part of this thesis discusses the incidence, contributing elements, and challenges of GDM in the context of Tanzania. The middle part focuses on different fatal effects of the condition, their definition, causes, treatment or management, risk factors, and prognosis. In the end, the purpose of the study, research method, data search and selection, analysis, discussion of results, personal growth, re-flection, the need for this study, and topics for further research are discussed.

2 THEORETICAL FRAMEWORK

2.1 Statistics on the prevalence of GDM in Tanzania

Different studies consistently report a high prevalence of GDM in Tanzania. Grunnet et al. (2020) estimate that approximately 14.3% of pregnant women are affected by GDM, aligning with other studies that reported rates ranging from 9.3% to 17.5%. Njete et al. (2017) conducted a study in northern Tanzania and found that 17.7% of expectant women had GDM, surpassing the estimated global prevalence of 14%. Additionally, Mwanri et Al. (2023) reported a prevalence rate of eight-point four percent (8.4%) in the urban areas and one percent (1%) in the rural areas as of 2016, showing a significant increase compared to the rates observed in 1991. This highlights the severity of the problem in Tanzania.

Studies reported increased incidences of GDM in Arusha, using simple screening methods and a high occurrence of GDM in northern parts of Tanzania primarily based on blood glucose levels diagnosed using WHO criteria (Msollo, Martin, Mwanri, Petrucka, 2022, Grunnet et Al. 2022). Mwanri et Al. (2023) also reported a significant occurrence of gestational diabetes in both urban and rural of Tanzania. These findings highlight the severity of GDM in Tanzania and emphasize the urgent need for robust screening and intervention programs to address this growing public health issue (Grunnet et Al. 2022).

2.1.1 Factors contributing to the rise of DGM in Tanzania

Several factors contribute to the rising prevalence of GDM in Tanzania. Unhealthy lifestyle choices, including a sedentary lifestyle, poor eating habits, and the use of tobacco, play a major role. Low socioeconomic status, limited awareness of GDM, and cultural practices also contribute to its prevalence (Njete et al. 2017). Contributors included high body-mass-index, particularly obesity. (Grunnet et Al. 2020, Njete et Al. 2017). The age of the mother and diabetes history in the family also increase the chance (Grunnet et Al. 2020). According

to Ramaiya, Swai, Mutabingwa, Mwanri, Kagaruki, (2018) and Njete et Al. (2017), challenges in diagnosing criteria and limited access to healthcare facilities is another compound problem.

2.1.2 Lifestyle

Unhealthy lifestyle choices are recognized as major contributing factors to the development of GDM. Njete et Al (2017) emphasize the association between poor diet and the prevalence of GDM in Tanzania. Unhealthy diet for example, intake of excessive processed foods, fats (saturated), and enhanced sugars contribute to elevated blood glucose levels and insulin resistance. Radenkovic, Miroslav, (2022) further explain how a poor maternal diet increases the risk of the development of highlighting the need for dietary interventions to prevent and manage GDM effectively. Insufficient physical activity during pregnancy is another crucial factor contributing to GDM. Sedentary behavior and lack of regular exercise led to decreased insulin sensitivity and an enhanced chance of developing GDM. Physical activities play an important role in preventing GDM as regular exercise can improve insulin sensitivity and glucose regulation (Grunnet et Al 2020).

Tobacco usage during pregnancy has been associated with fatal health consequences, like increased chances of developing GDM as it can lead to impaired glucose metabolism and insulin resistance. Pregnant women who smoke should receive targeted interventions and support to quit smoking and reduce the risk of GDM (Njete et Al 2017). As evidenced by referenced studies, it can be concluded that unhealthy lifestyle choices contribute to an increased resistance to insulin, and impaired glucose breakdown, which ultimately lead to GDM. Therefore, promoting healthy eating habits, encouraging regular physical activity, and providing smoking cessation support are crucial steps toward reducing the occurrence of gestational diabetes and improving health for both the mother and the fetus.

2.1.3 Maternal body mass index (BMI)

The mother's body BMI (body mass index) is a significant risk factor in the development of GDM. Increased BMI is associated with the body's inability to effectively metabolize insulin leading to high blood glucose levels. Adipose tissue, particularly visceral fat, releases hormones and pro-inflammatory substances that interfere with insulin's action. As BMI increases, the likelihood of developing insulin resistance rises, thereby increasing the risk of GDM (Baz, Riveline, Gautier 2015). Beta cells in the pancreas are responsible for producing insulin. In individuals with higher BMI, beta-cell function may become impaired. The demand for insulin rises during pregnancy to accommodate the growing fetus, and if the beta cells are unable to meet this increased demand, it can lead to elevated blood sugar levels and the development of GDM (Radenkovic, Miroslav 2022)

Additionally, adipose tissue secretes various substances called adipokines, including adiponectin and leptin. In individuals with higher BMI, there is an imbalance in adipokine production, resulting in decreased adiponectin and increased leptin levels. This dysregulation contributes to insulin resistance and chronic low-grade inflammation, further raising risks of GDM (Darling, Liu, Aboud, Urassa, Spiegelman, Fawzi, 2014). Higher BMI is also associated with alterations in hormone levels, such as increased levels of estrogen, progesterone, and human placental lactogen (hPL). These hormonal changes affect insulin sensitivity and blood sugar metabolism, potentially leading to the development of GDM (Baz et Al. 2015). Notably, while a higher BMI increases the likelihood of developing GDM, not all women with elevated BMI will develop the condition. However, maintaining a healthy BMI through proper nutrition, physical activities (regularly), and management of weight can substantially reduce the risk of GDM in pregnant women (Radenkovic, Miroslav 2022).

2.1.4 Maternal age and family history

Advanced maternal age is another factor contributing to acquiring gestational diabetes. Physiological changes in women as they age makes them less sensi-

tive to insulin, leading to insulin resistance thus risking the development of GDM. Older women may have a reduced ability to compensate for insulin resistance, increasing their susceptibility to GDM. Beta cells in the pancreas are responsible for producing insulin. With age, the function of these cells may decline, leading to decreased insulin secretion (Darling et Al. 2014).

This decline in the functions of beta-cells can increase the resistance of insulin and enhance chances of the occurrence of gestational diabetes. Aging also leads to body composition changes, such as decreased muscle mass and increased adiposity, and this can also influence insulin resistance and the development of GDM. Other maternal health factors like increased BMI and the possibility of existing health conditions, for example, hypertension or cardiovascular disease, risk the development of GDM (Perumal, Wang, Darling, Urassa, Wang M, Liu, Pembe, Fawzi 2022).

Research by Grunnet et al (2020) stated that females aged between twenty-five and thirty-four had the highest prevalence of gestational diabetes, while Njete et Al. (2017) reported that women aged thirty-five and above had an enhanced risk of getting GDM. These findings indicate that age contributes to the occurrence of gestational diabetes, and therefore, interventions to reduce incidences of GDM should target older women. Genetic factors influence glucose metabolism and increase the resistance to insulin (Darling et Al. 2014).

A family history of diabetes increases the likelihood of inheriting these genetic traits, thereby enhancing the chance of occurrence of GDM. A type 2 diabetes history in the family indicates a genetic predisposition to the condition. Family members often share similar lifestyles, dietary habits, and environmental exposures. These shared factors can contribute to the development of GDM (Njete et Al 2017). It is therefore essential for healthcare providers to inquire about family history of diabetes during prenatal care in Tanzania.

2.2 Societal, cultural, and healthcare challenges

2.2.1 Low social-economic status

Low socioeconomic status is associated with limited financial resources, which can lead to inadequate access to nutritious foods. This in turn forces the consumption of higher energy-dense diets and non-nutritious foods, which can contribute to obesity and insulin resistance, increasing the risk of GDM (Mukuve, Noorani, Sendagire, Mgonja 2020). Low socioeconomic status is also linked to lower levels of health literacy and limited access to health education. This can result in a lack of awareness about healthy lifestyle choices during pregnancy and a lack of knowledge on the importance of regular physical activity, and GDM prevention strategies. Affected women may experience higher levels of psychosocial stress, including financial strain, limited social support, and living in disadvantaged environments. Chronic stress can lead to dysregulation of hormones, such as cortisol, which can impact glucose absorption and increase the chances of the occurrence of gestational diabetes (Njete et al 2017).

Certain occupations such as physically demanding or sedentary jobs associated with low social economic status, may contribute to a lack of physical activity during pregnancy leading to weight gain and increased insulin resistance (Mwanri et al 2014). Some living conditions with higher exposure to environmental pollutants and toxins can contribute to metabolic dysfunction and increase the risk of GDM in women living in areas affected by low socioeconomic status. Addressing the impact of low socioeconomic status on the development of GDM requires a multifaceted approach. It involves improving access to quality prenatal care and GDM screening for women, implementing health promotion and education programs to enhance knowledge about healthy lifestyles, ensuring access to affordable nutritious foods, and addressing social and environmental determinants of health. (Grunnet et al 2020)

2.2.2 Limitations in WHO Diagnosing Criteria

The limitations in the WHO (World Health Organization) standards for diagnosing GDM impact the diagnosis and management of GDM in Tanzania. These limitations are particularly relevant because the WHO criteria have been widely adopted in many countries including Tanzania. These criteria rely on a single- step method using an oral glucose tolerance test. Studies have however indicated that this approach may have limitations in terms of both sensitivity and specificity in identifying women with GDM. This, therefore, means that some women who have GDM might be missed, while others might be incorrectly classified as having the condition (Grunnet et Al 2020). Another limitation in this criterion is that these criteria were developed based on data primarily from Caucasian populations, which may not accurately reflect the ethnical diversity of populations in Tanzania. These criteria use cut-off values that are both ethnically and genetically biased. The cut-off values are developed for one population without considering the variations in genetic and lifestyle factors among different ethnic groups and their influence on glucose metabolism and the risk of GDM. This can therefore lead to under or overdiagnosis of GDM in Tanzania (Mukuve et Al 2020).

Another downside of these criteria is that they require access to laboratory facilities for performing OGTTs and trained healthcare professionals for interpretation. However, resource constraints in Tanzania, including limited healthcare infrastructure and personnel, poor social economic status, and lack of awareness of the graveness and seriousness of the disease can hinder the widespread adoption and accurate application of the WHO criteria (Njete et Al 2017). This can potentially lead to missed or delayed diagnoses. One example is research conducted in Dodoma Tanzania where for example, 935 eligible women were recruited to participate, 886 completed day one (1) testing, about 250 did not show up for day two (2), and about 616 of the recruited completed day one and two of testing. This shows the logistical downsides of these criteria, thus not being effective in Tanzania and other sub-Saharan countries. According to research, as of 2018, many regions in Tanzania including Dodoma, did not have GDM screening as part of Antenatal screening for pregnant women (Msollo et Al. 2019).

2.2.3 Lack of sensitization and awareness

According to Grunnet et Al (2020), Women who lack awareness about GDM don't recognize vital symptoms of the disease and this may lead to delayed medical care thus late diagnosis and missed opportunities for timely intervention and management. Without proper awareness, women don't know GDM associated dangers like, a diabetes history, obesity, or previous occurrence of GDM. Their limited knowledge can prevent them from taking preventive measures or seeking appropriate screening and care during pregnancy. Insufficient understanding of healthy lifestyle practices leads to women adopting high-risk eating habits and lifestyles during pregnancy. Due to unawareness, women don't recognize the importance of proper nutrition, and other preventative care (Mukuve et Al 2020).

Another factor is the lack of awareness among healthcare providers about the significance of GDM. This results in insufficient screening efforts during prenatal care. If healthcare providers are not knowledgeable about the condition or its risk factors, they may overlook the importance of screening pregnant women for GDM, leading to missed diagnoses and delayed interventions (Ramaiya et Al.2018).

Addressing the lack of awareness and sensitization about GDM in Tanzania requires comprehensive educational campaigns targeting both healthcare providers and the general population. The focus should be on raising awareness about GDM risk factors, signs and symptoms, the importance of prenatal care, healthy lifestyle practices, and available screening and management options (Njete et Al. 2017). Improved education and sensitization empower women to make informed decisions, seek timely medical care, and adopt preventive measures, ultimately reducing the chances of developing GDM and improving maternal and fetal outcomes (Mwanri et Al. 2014).

2.2.4 Capability and capacity of health facilities

The capacity or capability of Tanzanian health facilities in Managing GDM can be assessed through different results from different findings. According to a cross-section study conducted by Mukuve et Al. (2020), the magnitude of GDM screening in the urban settings of Tanzania was very low. This suggests that a significant number of pregnant women go unscreened. This study also highlighted limited resources, limited awareness, and limited non-availability of screening tools in some healthcare facilities as another barrier to significant management of the condition. Lack of consensus on diagnostic thresholds among experts regarding the optimal diagnostic thresholds for GDM is another challenge. Some argue for lower thresholds to capture milder cases and improve pregnancy outcomes, while others emphasize the potential for increased healthcare costs and unnecessary interventions (Grunnet et Al. 2020).

In a review conducted by Ramaiya et Al (2018), findings suggested that Tanzania health facilities have limited capacity in terms of trained personnel, and infrastructure. The Tanzanian healthcare system also lacks standardized protocols and guidelines for diagnosing and managing GDM. Another barrier to the effective management of GDM in Tanzania was the lack of resources including a shortage of essential tools and medications to address the rising prevalence of GDM (Mukuve et Al. 2020). The recommendation for these problems would be to increase the capacity, knowledge, and resources for the management of GDM. This can be done by strengthening healthcare infrastructure, increasing access to resources as well as strengthening training programs for healthcare providers, and community awareness programs. To achieve the above, there is a dire need for policy development (Ramaiya et Al 2018).

3 GESTATIONAL DIABETES MELLITUS

3.1 Definition

Gestational diabetes is a condition defined by impaired glucose resistance whose symptoms appear during pregnancy. This condition is defined by abnormal or high blood glucose levels that can result in fatal health effects for both the mother and the fetus if left untreated. It usually occurs between weeks thirteen (13) to twenty-seven (27) and weeks twenty-eight (28) to forty (40) of pregnancy. Gestational diabetes can also occur in females with no previous history of diabetes. Hormonal changes that occur during pregnancy influence insulin sensitivity and the metabolism of glucose and this can lead to the development of gestational diabetes. Diagnosis of GDM is done by oral glucose tolerance testing. Management involves dietary modifications, physical activity, and in some cases insulin therapy (Baz et Al. 2015).

3.1.1 Etiology

The cause of gestational diabetes mellitus (GDM) is complex and multifactorial. Genetic and environmental factors, insulin resistance, hormonal changes during pregnancy, and age are among the significant elements that influence the occurrence of the development of GDM. Maternal obesity, in particular, strongly influences GDM as it can contribute to reduced insulin sensitivity and impaired glucose tolerance. Insulin resistance, i.e., the decreased sensitivity to insulin, is a key factor in the development of GDM (Mukuve et Al. 2020).

During gestation, the placenta produces hormones that promote insulin resistance, which allows more glucose to be available for the developing fetus. In women with GDM, the pancreas is not able to produce adequate insulin to overcome the resistance, leading to hyperglycemia. Hormonal activities in the placenta and the increase in the fat tissue of the soon-to-be mother increase the mother's insulin resistance (Perumal et Al. 2022). As this state prolongs, produced insulin by the pancreas is not enough to counter high blood glucose lev-

els, thus increasing insulin resistance. Prolonged hyperglycemia and untreated gestational diabetes risk adverse outcomes of pregnancy like macrosomia, brachial plexus damage, and hypoxia during delivery. Hormones such as human placental lactogen (hPL) and progesterone increase during pregnancy promoting insulin resistance (Benhalima, Katrien, Devlieger, Roland, Van Assche, André, 2015).

3.1.2 Diagnosis

GDM diagnosis is done by using either a fasting glucose concentration of ≥ 126 milligrams/deciliter, or a blood glucose concentration (random) of ≥ 200 milligrams/deciliter on two different occasions. The one-step approach involves doing a glucose tolerance test (orally) between weeks twenty-four (24) and twenty-eight (28) of pregnancy. This involves measuring blood sugar levels at specific time intervals after taking a sugary solution. The blood sugar (fasting) recommendation is five point one (5.1) millimoles per liter, ten point zero (10.0) milli- moles per liter after one hour of testing, and eight point five (8.5) millimoles per liter two hours after the test (Baz et Al 2015).

If any one of these limits is met or exceeded, the patient is diagnosed with GDM. The two-step approach involves performing the blood sugar challenge test, and then an oral blood sugar tolerance test, if the results from the glucose challenge are positive. The Glucose challenge test includes taking a sugary solution and measuring blood sugar levels one hour later. If any one of the oral tolerance test limits is met or exceeded, the patient is diagnosed with GDM. A repeat of the oral glucose test challenge is recommended between weeks 32 and 34 of pregnancy in patients diagnosed with GDM (Benhalima et Al. 2015, Baz et Al, 2015, Perumal et Al. 2022).

3.1.3 Monitoring and screening

To predict, monitor, stop effects of GDM (long and short-term), and ensure a healthy pregnancy, maternal screening and monitoring of gestational diabetes is

essential (Darling et Al. 2014). Expectant mothers undergo several blood tests and checks to detect any possible complications that might arise during, before, or after childbirth. These examinations (done in different stages of pregnancy) are recommended for both diabetic and non-diabetic pregnant mothers (Benhalima et Al 2015). Taking blood tests during pregnancy, ultrasound, combined screening, and observation of fetal movement are common ways used in screening. The Symphysis-Fundus (SF) height measuring technique is used to check for fetal and uterine growth. The results are then compared against a reference curve and after the 24th week, it's expected to be proportional to the number of pregnancy weeks. SF measurements exceeding 36 cm may indicate a large fetus, and this requires an ultrasound to get accurate measurements (Baz et Al 2015).

From at least 24 weeks of pregnancy, fetal movements can be felt. At the end of pregnancy, abnormal movement (less than 10 movements per hour) may indicate fetal distress, placental dysfunction, fetal death in utero, abnormal amounts of amniotic fluid, or fetal asphyxia. Guided calculation of fetal movement and this information is available at clinics for expectant mothers. After 32 weeks of pregnancy, motion counting is only done if necessary, according to recommendations (Baz et Al 2015). According to Benhalima et Al (2015), blood glucose self-monitoring and continuous glucose monitoring are effective methods of monitoring blood sugar levels in pregnant women with GDM. Continuous monitoring of blood glucose levels involves using a sensor chip implanted in the skin to continuously check for blood sugar levels. This provides real-time data on blood sugar levels and identifies patterns in blood sugar that may be missed with other traditional methods, allowing for timely adjustments in diet and medication. Self-monitoring of blood sugar is a method of monitoring sugar levels at home using a glucometer. It is also an effective method of monitoring levels of blood sugar in expectant women diagnosed with gestational diabetes. This enables frequent monitoring and timely adjustments and medication if needed (Radenkovic, Miroslav,2022).

4 FETAL FATAL EFFECTS OF GDM

4.1 Macrosomia

Macrosomia is a medical condition defined by a fetus that is larger than normal, weighing more than 4,000g or 4500g about the duration of the pregnancy. The fetus is heavier than the average of the standard population, or the birth weight exceeds 4500 grams (Perumal et Al. 2022). Functions of the placenta affect the growth potential of the fetus. During pregnancy, the diabetic mother's placenta undergoes both structural and functional changes. The pathophysiology of macrosomia is caused by the effect of insulin on adipose tissue associated with maternal obesity, poorly controlled or uncontrolled diabetes, and excessive maternal weight gain during pregnancy (Darling et Al. 2014). Fetal hyperglycemia stimulates insulin production, other insulin-like growth factors, and growth hormones that facilitate fetal growth, and deposition of glycogen and fat. The result is an overweight fetus, thus the term macrosomia (Darling et Al. 2014, Perumal et Al. 2022, Radenkovic, Miroslav, 2022).

4.1.1 Risk factors

Risk factors of macrosomia include a range of maternal, fetal, and environmental factors. Maternal factors include advanced maternal age, pre-pregnancy obesity, and excessive gestational weight. Females who previously had GDM, previous macrosomic delivery, or a history of macrosomia in the family also have higher risks of experiencing the condition. Fetal factors include fetal sex (male), increased fetal abdominal circumference, and gestational age. Environmental factors include lifestyle e.g., smoking by the mother (Darling et Al. 2014).

4.1.2 Diagnosis and screening

To identify, predict risks, and implement a proper treatment and management plan, evaluation and screening of macrosomia is essential. Fetal ultrasounds

are the global standard for the evaluation of fetal growth and identification of macrosomia (Benhalima et Al 2015). To improve the accuracy, the use of customized fetal growth charts in relation to the mother's characteristics such as weight, age, and height is recommended. In addition to the above, maternal influences like their weight before pregnancy, glucose tolerance tests, and gained gestational weight, are also used in the evaluation and screening of macrosomia (Benhalima et Al 2015).

According to a study by Perumal et Al (2022), It's recommended that women who have a high risk for macrosomia based on the above factors should be closely monitored throughout pregnancy. This can be done by regular fetal growth ultrasounds and glucose tolerance tests to assess for gestational diabetes mellitus. Macrosomia is also assessed non-invasively by using biomarkers like maternal serum markers, fetal DNA, and placental growth influencers. (Baz et Al. 2015, Benhalima et Al. 2015, Perumal et Al. 2022).

4.1.3 Treatment and management

The initial step in macrosomia treatment is the identification of the condition as early as possible. Fetal ultrasound, performed around week 32, is commonly used to screen for macrosomia. If suspected or detected, additional ultrasounds may be performed to monitor the fetus's growth (Radenkovic, Miroslav, 2022). In some cases, other diagnostic tests such as a biophysical profile may be done to evaluate fetal health. Upon diagnosis, the optimal management approach depends on a variety of factors, like the gestational age, the severity of the condition, and the mother's medical history (Benhalima et Al 2015).

In some cases, induction of labor may be recommended to prevent complications associated with prolonged pregnancy, while in other cases, cesarean section may be recommended to reduce associated risks like shoulder dystocia, a situation in which the baby is obstructed during delivery by the shoulder getting stuck during delivery. These management options depend on the individual circumstances of each case. In addition to medical management, lifestyle modifications like diet changes are encouraged to moderate the likelihood of complications associated with macrosomia (Baz et Al. 2015).

4.1.4 Mortality and associated risks

Studies show that macrosomia is linked to high rates of mortality for the mother and the neonate. Maternal complications associated with macrosomia are increased risk of respiratory distress, shoulder dystocia, stillbirths, trauma associated with delivery, and newborn hypoglycemia. Additionally, women who have had macrosomic pregnancies before have an elevated risk of developing GDM and hypertension, as well as cardiovascular disease later in life (Perumal et Al. 2022).

4.1.5 Prognosis

According to research, there is significant evidence indicating the linking of hypertension, obesity, and insulin resistance as long-term effects of macrosomia. Males who had macrosomia had an elevated risk of being obese, having impaired glucose tolerance and increased insulin resistance while females of macrosomic background had an increased likelihood of high blood pressure (Benhalima et Al 2015). This condition is also linked with the occurrence of type II diabetes as well as an increased rate of hypertension. The prognosis of macrosomia is triggered by a range of things, including the pre-pregnancy BMI, mother's age, gestational age, and fetal sex. Maternal age above 35 years and pre-pregnancy obesity increases the possibility of macrosomia. Male fetal sex is also a risk factor for the condition (Radenkovic, Miroslav, 2022).

4.2 Intrauterine growth restriction (IUGR)

Intrauterine growth restriction, is a health condition experienced when the fetus, for its gestation age, is smaller than expected. This complication is caused mainly by GDM and poses fatal risks in both the long term and the short term.

other risk factors include smoking, placental insufficiency, and maternal hypertension (Darling et Al. 2014).

4.2.1 Etiology

Although the exact mechanism of how GDM is linked to the IUGR is not well defined, research states that this condition occurs when blood vessels in the placenta are damaged caused by high levels of blood sugar (Radenkovic, Miroslav, 2022). The placenta, apart from just connecting the developing fetus to the mother, plays an important role in transferring nutrients and oxygen from the mother to the fetus. In the presence of gestational diabetes, the high blood sugar levels in the mother's blood can cause damage to the blood vessels in the placenta. This reduces the delivery of both blood nutrients to the fetus, leading to poor fetal development, thus the low birth weight and smaller size (Benhalima et Al 2015).

Additionally, according to Radenkovic, Miroslav (2022), gestational diabetes can also increase the risk of other complications like hypertension, which reduces blood flow to the placenta contributing to the risk of occurrence of IUGR. In the context of gestational diabetes, other factors that can contribute to IUGR include genetic factors and maternal obesity. Women with a history of underweight babies in the family or who were obese before pregnancy are at higher risk of developing IUGR (Benhalima et Al 2015).

4.2.2 Diagnosis and Screening

Diagnosing and screening for Intrauterine Growth Restriction (IUGR) is important because it helps identify, monitor, and predict possible complications that can occur as a result of IUGR. It can help healthcare workers to monitor fetal growth and identify potential complications earlier (Baz et Al 2015, Radenkovic, Miroslav, 2022). Screening involves regular monitoring of fetal growth by using ultrasound and other methods. Since females diagnosed with GDM have an increased risk, frequent monitoring is recommended. The monitoring

frequency and time of screening depend on individual characteristics as well as the severity of GDM. Ultrasound is the most used method of screening as it provides detailed images of the fetus while measuring various significant parameters like femur length, fetal weight, abdominal circumference, and head circumference (Benhalima et Al 2015, Darling et Al. 2014).

These measurements can be used to estimate the normality of the gestation rate concerning its age. Other methods such as fetal monitoring and biophysical profiles can be used to diagnose IUGR in addition to ultrasound. Fetal monitoring involves tracking the fetal movement and heart rate, which can provide information about its well-being. Biophysical profiles include combining fetal monitoring with ultrasound measurements to assess fetal health and detect any signs of distress (Darling et Al. 2014, Perumal et Al. 2022). importantly, fetal monitoring may be challenged by individual growth rates as there is no universally accepted definition of IUGR. GDM on the other hand can complicate the diagnosis of IUGR because of the ability of high blood levels to cause fetal overgrowth in some cases (Radenkovic, Miroslav 2022).

4.2.3 Treatment and management

The treatment of GDM-related Intrauterine Growth Restriction (IUGR) involves a multi-disciplinary approach that aims to optimize fetal growth and reduce complications risk. Treatment includes both medical and non-medical interventions like a lifestyle change. The purpose is to improve, balance, and balance blood sugar levels to promote fetal growth and prevent complications caused by it to the fetus. Blood sugar control involves changes in life for the mother, e.g., Adjustments to the diet, as well as pharmacological intervention like the use of insulin or hypoglycemic medication cases (Benhalima et Al 2015).

Addressing other contributing actors like hypertension and preeclampsia is essential and requires additional medical interventions or other alternatives like early delivery to avoid complications (Radenkovic, Miroslav 2022). Timing of delivery is an important alternative in the treatment of IUGR. Other IUGR treatment options may include fetal monitoring, such as non-stress tests or biophysiological

profiles, to assess fetal well-being, and detect and prevent possible distress to the fetus. Fetal blood transfusion or intrauterine growth restriction surgery might be considered in some cases. It is essential to note that treatment of IUGR is personalized depending on the severity of GDM and the degree of fetal compromise cases (Baz et Al 2015).

4.2.4 Mortality and associated risks

Intrauterine growth restriction can lead to significant morbidity and mortality for the fetus. IUGR complications associated with fetal mortality include hypoxia, acidosis, chronic hyperglycemia, and other metabolic abnormalities that impact fetal development. Placenta insufficiency caused by gestational diabetes is one of the primary mechanisms by which IUGR can lead to fetal death (Benhalima et Al 2015, Perumal et Al. 2022). Placental insufficiency means the placenta is not functioning fully thus affecting oxygen and nutrients supply to the fetus. Insufficiency of the placenta can cause restricted fetal growth leading to various complications such as fetal distress, preterm delivery, and fetal death (Baz et al 2015). Newborn mortality, a situation where an infant dies within the first twenty eight (28) is also associated with IUGR-related complications such as respiratory distress syndrome, sepsis, and intraventricular hemorrhage. In conclusion, IUGR is a serious problem of gestational diabetes that can cause significant mortality for both the mother and the unborn child (Radenkovic, Miroslav 2022).

4.2.5 Prognosis

The GDM-related prognosis of fetal intrauterine growth restriction varies depending on the severity of the condition and the timing of diagnosis and treatment. Early diagnosis and management play a big role in reducing the risk of its adverse effects. If it's not detected or managed promptly, the prognosis can be poor resulting in adverse complications like fetal distress, sepsis, and fetal death among others. Studies link IUGR infants to health complications like

delayed development, cognitive deficits, and other health problems (Radenkovic, Miroslav 2022).

4.3 Congenital malformations

Congenital malformations are other fatal effects of gestational diabetes on the fetus. These are structural abnormalities that can occur in any organ and are present at birth. Some common malformations linked to GDM include heart defects, neural tube defects, and skeletal anomalies (Benhalima et Al 2015).

4.3.1 Etiology

The exact mechanism of how GDM causes congenital malformations is not fully understood. However, research states that hyperglycemia during critical times of fetal growth can interfere with normal organ development (organogenesis) leading to abnormalities (Njete et Al. 2018) Chances of the occurrence of congenital malformations are proportional to the gravity of gestational diabetes and the level of its management. Studies have indicated fetuses from women with inadequately controlled GDM are at a higher risk of congenital malformation than those of women without diabetes (Perumal et Al. 2022).

4.3.2 Diagnosis and Screening

The diagnosis of fetal malformations is usually done non-invasively through prenatal ultrasound examinations. The initial ultrasound examination is usually done at 11-14 weeks of pregnancy and is used to screen for chromosomal abnormalities. The second ultrasound examination is done at 18-22 weeks of gestation and is used to detect fetal anomalies (Darling et Al. 2014). These examinations are advised for all pregnant women, but they are particularly emphasized for women with gestational diabetes, due to their elevated risk for fetal malformations. This scan is used to detect structural abnormalities in the fetus such as brain anomalies, heart defects, and skeletal abnormalities (Perumal et Al. 2022).

Screening is usually done using a combination of maternal serum screening tests and ultrasound examinations. Maternal serum screening tests involve testing the mother's blood to measure the levels of various substances to identify markers of fetal abnormalities. Commonly used tests include the quadruple test, which measures levels of human chorionic gonadotropin, alpha-fetoprotein, unconjugated estriol, and inhibin-A (Baz et Al 2015). The other test is the integrated test, which combines both the quadruple test and first-phase testing markers. If fetal defects are detected, further investigative testing for example, magnetic resonance imaging or amniocentesis may be required to confirm the diagnosis (Benhalima et Al 2015).

4.3.3 Treatment and Management

The treatment and management of congenital malformations in the fetus depends on the type and severity of the malformation. In some cases, early detection allows for intervention and treatment before birth. For example, heart surgery for a fetus with a detected heart defect (Benhalima et Al 2015). In many cases, however, the best action is to monitor the fetus closely and plan for appropriate postnatal management. Ensuring optimal glycemic control in the mother is a key factor in managing malformations. Keen glycemic control is also essential for improving outcomes for infants' afterbirth (Darling et Al 2014).

Other strategies include fetal surveillance, specialized delivery planning, and postnatal care. Fetal surveillance involves ultrasound monitoring, non-stress testing, and other techniques to monitor fetal well-being and detect any changes in fetal status (Darling et Al 2014). Specialized delivery planning includes early delivery, cesarean section, or other measures to manage outcomes for the newborn. Postnatal care might require specialized medical or surgical interventions, depending on the nature and severity of the malformation (Perumal et Al. 2022).

4.3.4 Mortality and associated risks

The mortality rate for fetuses with congenital malformations is higher than those without. Studies show that the higher the severity of GDM the higher risk of malformations. Fetuses of mothers affected by GDM have an elevated risk for intrauterine fetal demise (IUFD) and stillbirth. This risk is mainly caused by the fatal effects of hyperglycemia on the functions of the placenta which may lead to placenta insufficiency and fetal hypoxia (Benhalima et Al 2015).

4.3.5 Prognosis

The prognosis of congenital malformations depends on the type of malformation. Malformations can range from mild to severe and can be associated with long-term complications such as developmental delays and cognitive impairment among others. It is recommended to have an early diagnosis and proper management to improve the prognosis and reduce the risk of long-term complications (Darling et Al 2014).

4.4 Stillbirths

This is defined as death of a fetus at twenty (20) weeks after conception either during or before birth. Stillbirths occur due to a combination of factors including placental insufficiency when the placenta cannot supply the fetus with enough oxygen and nutrients, and increased pressure on the umbilical cord during delivery (Baz et Al 2015). According to research, the incidence of stillbirth is two to three times higher in GDM-related pregnancies compared to those without. Factors that contribute to increased risks of stillbirth include maternal age, maternal BMI, and gestational. Gender also plays a role as male fetuses have increased risks higher risk than female fetuses (Darling et Al.2014)

4.4.1 Diagnosis

The diagnosis of stillbirth is usually confirmed by an ultrasound or other imaging techniques that show no fetal heartbeat or movement. If suspected, further investigations like an autopsy and placental examination are usually done to determine the cause (Benhalima et Al 2015).

4.4.2 Prevention

Prevention of stillbirth in women with GDM is important. Adequate glycemic control, especially in the third phase of pregnancy, is crucial to reduce the chances of stillbirths. The American Diabetes Association proposes a 5.3 mmol/liter (fasting) blood sugar target and a one (1) hour postprandial blood sugar target of 7.8 mmol/liter in women diagnosed with GDM. IADPSG (international association of diabetes and pregnancy study groups) advises even tighter glycemic targets of 5.0 millimoles per liter (fasting glucose) and 7.2 millimoles per liter (1-hour postprandial glucose). Keen observation of the health and growth of the fetus is also essential (Darling et Al.2014). Mothers with GDM should have regular ultrasound scans to detect fetal growth restriction or other abnormalities that may increase the risk of stillbirth. Non-stress tests or biophysical profiles may also be used to assess fetal well-being (Darling et Al. 2014, Benhalima et Al. 2015, Baz et Al. 2015).

4.5 Asphyxia

Asphyxia is a fetal distress associated with the lack of gas exchange or blood flow from or to the fetus either before during or after birth. This leads to a chronic oxygen deficiency thus risking death. This situation can lead to profound systemic and neurological problems (Perumal et Al. 2022).

4.5.1 Etiology

Hyperglycemia caused by uncontrolled GDM leads to changes in placental blood flow, leading to placental insufficiency, reduced oxygen supply to the fetus, and eventually asphyxia (Radenkovic, Miroslav, 2022). Additionally, maternal hyperglycemia can cause metabolic acidosis in the fetus, which can lead to decreased oxygen-carrying capacity of fetal blood. Macrosomia may lead to compression of the umbilical cord during delivery, reducing blood flow to the fetus and this can lead to asphyxia. Fetal factors that contribute to asphyxia in gestational diabetes include abnormalities in fetal growth and development, such as intrauterine growth restriction, and congenital malformations, which can cause reduced oxygen supply to the fetus (Perumal et Al. 2022).

4.5.2 Diagnosis and Screening

Asphyxia in gestational diabetes can be diagnosed through a combination of clinical signs and symptoms, fetal monitoring, and laboratory tests. Clinical signs and symptoms of asphyxia may include decreased fetal movements, meconium marking of the amniotic fluid, and abnormal patterns of fetal heart rate. Electronic (fetal) monitoring is used in fetal monitoring to record the heart rate of the fetus and uterine contractions. Non-stress tests and biophysical profiles may also be used to assess fetal well-being (Benhalima et Al 2015). Laboratory tests are also used to evaluate fetal oxygenation and acid-base balance. These tests may include fetal scalp blood sampling or cord blood gas analysis. Normally, the acid-base balance is checked by measuring the PH of blood sample from the scalp of the fetus. Other diagnostic tests for assessing blood flow in the fetal vessels may include ultrasound, doppler studies, and amniotic fluid volume. (Baz et Al, 2015).

4.5.3 Treatment and management

The initial step in the treatment of asphyxia in gestational diabetes is to identify and manage any underlying medical conditions that may be contributing to the

problem, such as hypertension or placental insufficiency. In cases of fetal distress, immediate delivery is recommended to avoid further complications. This can be done through induction of labor, cesarean section, or other methods, depending on the individual circumstances of the patient (Radenkovic, Miroslav 2022).

Upon delivery, careful monitoring and supportive care are needed to ensure optimal outcomes. Neonatal intensive care may be necessary for babies who are born with signs of asphyxia, including low Apgar scores, respiratory distress, and low blood sugar levels. Treatment may involve oxygen therapy, mechanical ventilation, and other supportive measures to stabilize the baby's condition and promote healthy development. Continuous monitoring including regular check-ups with a pediatrician, and developmental assessments are recommended (Baz et Al, 2015).

4.5.4 Mortality and associated risks

The mortality and associated risks of asphyxia in infants of mothers with GDM are significant. Studies have shown that infants of diabetic mothers have a higher chance for neonatal and perinatal mortality plus long-term neurodevelopmental impairment compared to infants born to non-diabetic mothers (Radenkovic, Miroslav 2022).

5 MATERNAL FATAL EFFECTS OF GDM

5.1 Preeclampsia

Preeclampsia is a disorder experienced after twenty (20) weeks of pregnancy defined by proteinuria and hypertension. It affects multiple organs, including the brain, liver, kidneys, and cardiovascular system. Preeclampsia can also cause placental dysfunction and fetal growth restriction, which can lead to fatal neonatal outcomes (Benhalima et Al 2015).

5.1.1 Etiology

Preeclampsia is allegedly caused by abnormalities in the placenta, maternal immune response, and vascular dysfunction. Preeclampsia can range from mild to severe, and if left untreated, it can progress to eclampsia, which is characterized by seizures, coma, and even death (Baz et Al, 2015).

5.1.2 Diagnosis, treatment, and monitoring

Preeclampsia diagnosis is done by measuring blood pressure and proteinuria in pregnant women after 20 weeks of pregnancy. Close monitoring and looking out for its signs and symptoms for example; elevated blood pressure, headaches, proteinuria, swelling, visual disturbances, and abdominal pain is recommended for women with GDM. For treatment, the only cure for pre-eclampsia is delivery of the baby and placenta. However, if preeclampsia develops before 37 weeks of gestation, the risks of premature delivery must be weighed against the risks of continuing the pregnancy. Continuous monitoring and medication to regulate underlying medical conditions e.g., insulin for blood sugar regulation and blood pressure control medication may be required in some cases (Darling et Al.2014).

5.1.3 Mortality and associated risks

Preeclampsia is a serious complication of pregnancy that affects 2-8% of pregnant women worldwide. It is the major cause of fetal and maternal mortality and morbidity. GDM-related pre-eclampsia is associated with both long-term and short-term risks such as increased risks of fetal growth restriction, preterm delivery, cesarean section, placental abruption, and stillbirth (Benhalima et Al 2015).

5.2 Cesarean delivery

Cesarean delivery is a surgical way of delivering a baby by cutting open the mother's uterus through the abdomen. This is the most common delivery method for women with gestational diabetes due to the high risk of complications during labor and delivery (Baz et Al, 2015).

5.1.4 Indications

The main indication for C-section in GDM is fetal macrosomia, which is associated with elevated risks of shoulder dystocia and childbirth trauma during vaginal delivery. Other indications include poor glycemic control despite medical management, fetal distress, and other obstetric complications, such as placental abruption and uterine rupture (Darling et Al.2014). The timing of cesarean delivery in gestational diabetes is not very clear as some studies suggest that elective cesarean delivery at weeks thirty-eight or thirty-nine (38-39) of gestation may reduce the chances of complications caused by fetal macrosomia and birth trauma. However, other studies suggest that performing a C-section at this time might increase the chances of the occurrence of respiratory distress syndrome and other complications for the neonate. Timing for a C-section should, therefore, be individualized based on the clinical situation and gestational age of the fetus. The decision for a C-section highly depends on individual circumstances (Benhalima et Al 2015).

5.1.5 Associated risks

Cesarean delivery is generally associated with higher rates of maternal morbidity, for example, longer hospital stays, increased risk of infection, and surgical complications, such as bleeding and injury to surrounding organs. However, it may reduce other risks like fetal macrosomia and birth trauma in women with GDM. Additional risks include increased risks for neonatal respiratory distress syndrome in infants. Recent studies associate cesarean delivery and increased risk of childhood obesity and type two (2) diabetes in the descendants of mothers diagnosed with gestational diabetes diagnosis. Careful consideration should therefore be given to the risks and benefits of cesarean delivery in GDM, and consider alternative delivery methods, like induction of labor or vaginal delivery with instrumental support (Radenkovic, Miroslav, 2022).

5.3 Maternal Hemorrhage

Maternal hemorrhage is a rare but significant cause of maternal mortality worldwide that can occur during pregnancy, childbirth, or the postpartum period for mothers with GDM. It is defined as excessive bleeding from the uterus during or after delivery (Benhalima et Al 2015).

5.1.6 Etiology

The etiology of maternal hemorrhage is multifactorial and can be attributed to various factors, including abnormal placental development and function, uterine atony, trauma during delivery, coagulopathy, and the presence of other comorbidities. GDM increases the risks of placental insufficiency, leading to abnormal placental development and function, and this can cause excessive bleeding during delivery. Additionally, high levels of insulin resistance associated with GDM can cause uterine atony, leading to hemorrhage (Darling et Al.2014).

5.1.7 Diagnosis

The diagnosis of maternal hemorrhage in GDM is made based on clinical presentation, like excessive vaginal bleeding, uterine atony, and signs of shock such as hypotension, tachycardia, and altered mental status. To rule out other underlying conditions, laboratory tests are performed to evaluate the coagulation status (Baz et Al, 2015).

5.1.8 Management

Management of maternal hemorrhage in GDM involves quick recognition and immediate intervention. Initial management includes the administration of uterotonic agents to promote uterine contraction and control bleeding. If bleeding continues, surgical interventions such as manual removal of the placenta, uterine artery ligation, or hysterectomy can be done (Benhalima et Al 2015).

5.1.9 Associated risks

The mortality and associated risks of maternal hemorrhage in GDM are significant. According to research, women diagnosed with gestational diabetes have an increased risk of maternal hemorrhage unlike those without. Additionally, maternal hemorrhage in GDM is associated with increased rates of postpartum hemorrhage, cesarean delivery, and newborn mortality (Radenkovic, Miroslav, 2022).

6 PURPOSE, OBJECTIVE AND METHODOLOGY

6.1 Purpose and goal of study

This study purposed to examine and review literature material on how to identify, monitor, and treat the fatal consequences of gestational diabetes for both the fetus and the mother in Tanzania. The goal of the literature review was to collect, analyze, and synthesize existing information on the topic from existing literature from the years 2013 to 2023. A descriptive literature review was used to provide a general overview of available information on the topic and illustrate the current picture of GDM in Tanzania, identifying gaps, and suggesting areas for future research. The research questions used were:

- What is the incidence of gestational diabetes in Tanzanian?
- What factors contribute to the increasing occurrence of GDM in Tanzania?
- What fetal and maternal health complications are caused by gestational diabetes?
- How to identify, monitor, and control the fatal effects of gestational diabetes in the context of Tanzania?

The synthesized results aimed to evaluate the current state of GDM in Tanzania, and suggest effective strategies for identifying, monitoring, and treating fatal effects of gestational diabetes. This would also provide healthcare professionals, policymakers, and other stakeholders with evidence-based recommendations on best practices for identifying, monitoring, and treating fatal effects of gestational diabetes to manage and prevent its impacts on maternal and fetal health in Tanzania.

6.2 Descriptive literature review

According to Aveyhard, Hellen (2023), a descriptive literature review is a scientific research method that provides a comprehensive summary and analysis of existing research studies and publications on a specific topic or research

question(s). It aims to provide an overview of the research conducted on a particular subject, summarizing the findings of different studies, and providing a synthesis of the information presented in them. A descriptive literature review does not involve conducting original research but rather synthesizing and analyzing the existing research on the chosen topic. Since a descriptive literature review offers a clear and coherent picture of the current state of knowledge on a particular subject, it is particularly useful in healthcare research. As noted by Meades, Peter (2015), descriptive literature reviews can be used for a variety of purposes in healthcare, such as exploring the prevalence and incidence of a specific condition, evaluating the effectiveness of different interventions or treatments, or identifying the risk factors associated with a particular disease or condition (Oakland 2015 p.30)

To achieve its goals and objectives, a descriptive literature review follows specific stages. The first stage was topic Selection. This involves choosing a well- defined and specific research topic or question (s) to focus the literature review. The topic and questions should be of interest and relevance to the field of study. The second stage was the literature search. In this stage, a thorough literature search is conducted using academic databases, journals, books, and other reliable sources. As for this thesis, Andor, PubMed, CINAHL, books, and other reliable sources were used. Keywords and specific search terms related to the topic were used to identify relevant material for this paper (Meades, Peter 2015)

The third stage was the use of inclusion and exclusion Criteria. Searched material was sorted according to its relevance to the topic, the publication year, study design, internationality, geographical specificity as well and language. Using the inclusion and exclusion criteria ensured that the literature selected was appropriate for the review. In the fourth stage, data was extracted according to its relevance, its ability to meet the study objectives, key findings, methodologies used, and conclusions. The ethics and reliability of the research were also evaluated in this stage. The fifth stage involved the analysis of extracted data. This was done through the identification of common themes, similarities, differences, and trends in the selected material (Oakland 2015)

Material synthesis then followed as information from various studies was used to write a synthesized thesis paper as provided above. Finally, the implications of the findings were discussed, pointing out their contribution to the topic. Limitations and gaps were identified and areas for future research were suggested. In conclusion, key findings and overall state of knowledge were summarized. All references were cited in the thesis according to TAMK's referencing style. (Aveyhard, Hellen 2023). In the descriptive literature review, the analyzed material is not to be referenced, summarized, cited, or reported. The goal is to compare the material and draw new conclusions based on it. (Kangasniemi, Ahonen, Utriainen, Jääskeläinen, Pietilä, Liikanen, 2013)

6.3 Search and selection of material

This is a crucial step in a descriptive literature review. This step requires the implementation of a search strategy that involves conducting a comprehensive search for relevant academic material and selecting appropriate studies that answer the research questions or objectives of the literature review. The goal is to identify and select relevant, reliable, high-quality, and credible material that gives a comprehensive overview of existing information and knowledge on the subject. The quality of the literature selected directly impacts the credibility and validity of the literature review (Kangasniemi et Al. 2013). The knowledge acquired during the structured data search course in class guided this search for information.

Keywords and phrases were generated according to their relevance and their reflection on the main topic. Some of the keywords used were GDM, adverse effects, risk factors, diagnosis, and monitoring. The data search process involves the adaptation of different data search techniques since every database has its unique features and indexing system. The search was tailored differently in each database. There were specific subject terms and formats for satisfactory results. Hyphenation was used for phrase searching and when combining words that form compound terms (Aveyhard, Hellen 2023). In PUBMED Medical Subject Headings (MeSH terms) were primarily used to index articles. For example, "Gestational Diabetes Mellitus in Tanzania" was used as a MeSH term

to categorize articles related to GDM in Tanzania. Punctuation marks such as quotations, and Boolean operators (AND, OR, NOT) were also used especially in the combined method of data search to search for complex queries and to optimize search results (Oakland 2015).

CINAHL being a nursing and healthcare-specific database, subject headings were used to index articles for example, "Gestational diabetes ". Use of punctuation marks, Boolean operators as well as using hyphens and parenthesis depending on the simplicity or complexity of the search. ANDOR database allowed multiple tries with the search including combining different strategies, using synonyms, parentheses, and combining search terms (Kangasniemi et Al. 3013). The data search had specific strategies for different databases. Keywords were generated, then data search strategies were tailored as per the database. The main strategy was to use a variety of punctuation marks, hyphens, subject words, Boolean operators, and different data search techniques, and modify them to suit each database (Oakland 2015).

Figure 1. Search phrases and results from different databases

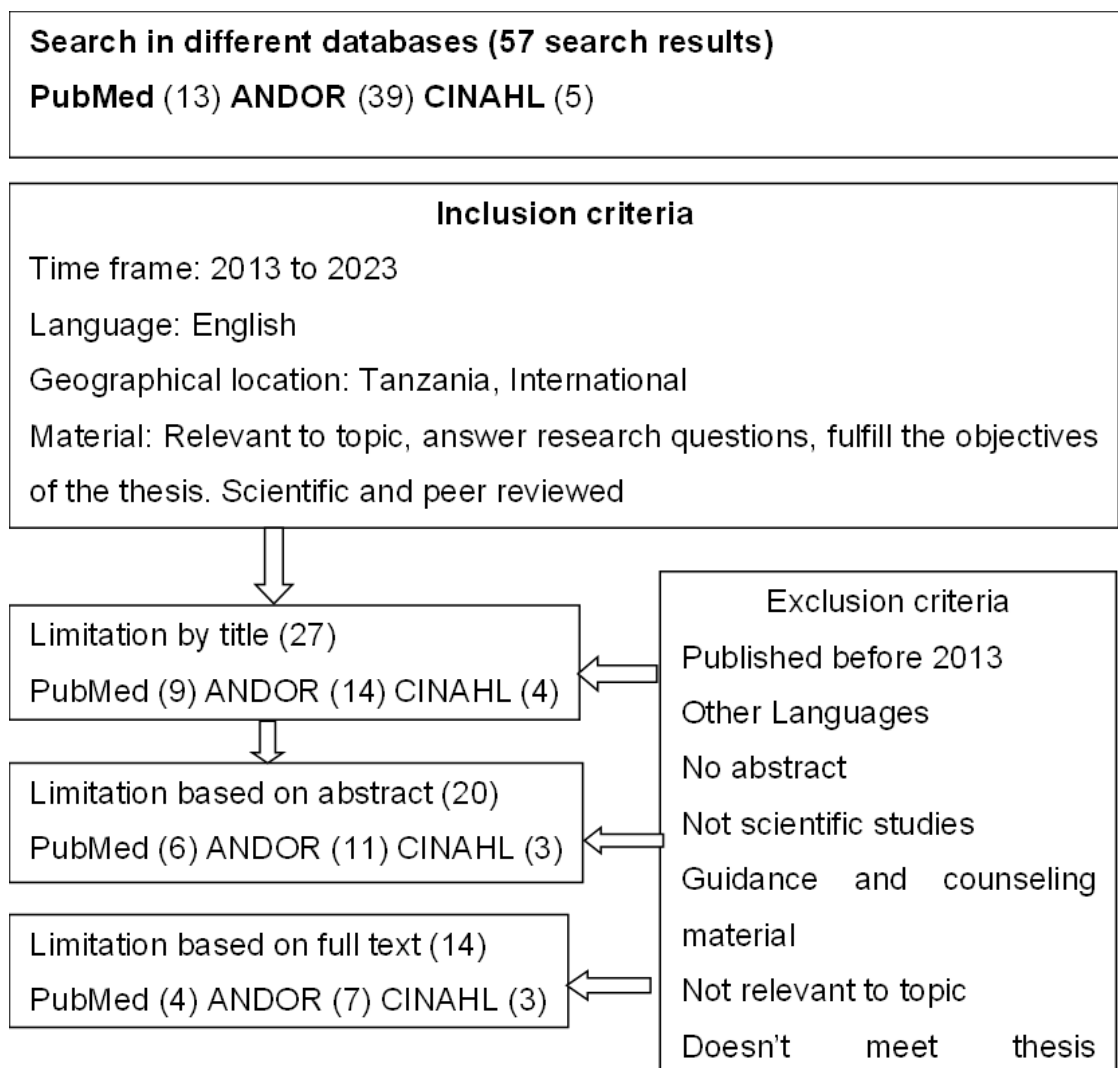
Database	Search Query	Total Results
PUBMED	(Gestational diabetes OR GDM OR diabetes in pregnancy) AND Tanzania AND (Prevalence or commonness) AND (Fatal effects OR complications OR adverse outcomes OR maternal mortality OR neonatal mortality) AND (Identification OR diagnosis OR screening)	13
CINAHL	(Gestational diabetes OR GDM OR diabetes-in-pregnancy) AND Tanzania AND (Fatal effects OR complications OR adverse outcomes OR maternal mortality OR neonatal mortality) AND (Identification OR diagnosis OR screening OR monitoring OR management OR treatment OR prevention OR intervention OR strategies)	5
ANDOR	"Gestational diabetes mellitus" AND Tanzania	39

For material selection, results were assessed according to relevance and quality. The search was limited to publication dates between the year 2013 to year 2023. The search language was limited to English and the geographical region was limited to Tanzania and international studies. Only scientific articles were

selected for this thesis. For the inclusion criteria, the content of studies had to be relevant to the topic, answer research questions as well, and meet the goals and objectives of the thesis (Kangasniemi et Al. 3013).

The exclusion criteria included materials whose publication date was older than the set period of 10 years, materials that were not in the context of Tanzania as well as materials that focused only on the perspective of the mother, and materials that missed the clinical aspect of gestational diabetes. Materials were then narrowed down first according to the title, then selected according to the abstract, and finally according to the entire text (Aveyhard, Hellen 2023). The process is shown in Figure 2.0.

Figure 2. Results elimination process



Key results are described in the next chapter.

7 MATERIAL DESCRIPTION AND ANALYSIS

This literature review was based on different studies including both national and international. There were 11 selected studies from Tanzania, France, Serbia, and Belgium. Collected data included qualitative studies, quantitative studies, and review articles. The studies were analyzed using a descriptive literature review methodology.

7.1 Purpose and goal of study

The main results are described below.

Table 1. Description of main results.

Title	Authors	Description
1.	Grunnet, Line, Msemo, Abdul, Lykke, Rashmi, Leif, Lusingu, Nielsen, Bruun, Christentze, Christian, Lund	The research explores the occurrence of GDM in both rural and urban Tanzania and its risk factors giving insight on its increased prevalence in urban areas, indicating potential challenges in healthcare management.
2.	Mwanri, Kinabo, Ramaiya, Feskens	This study estimates the occurrence of GDM and associated risks in rural and urban Tanzania suggesting a higher prevalence in urban areas, suggesting potential health challenges in this setting.
3.	Msollo, Simon, David, Wendelin, Pammla	The study investigates the epidemiology of hyperglycemia and its association with body fat among pregnant females in Arusha, Tanzania. It aims to examine the prevalence and effects of hyperglycemia during pregnancy.

4.	Njete, John, Mlay, Msuya Mahande,	This research addresses challenges faced during the screening for GDM in antenatal care highlights the importance of its early detection and management to improve maternal and fetal outcomes region and provides recommendations for enhancing screening practices.
5.	Mukuve, Noorani, Mgonja Sendagire,	This research evaluates the extent of assessing for gestational diabetes during antenatal care in an urban setting in Tanzania. It gives evidence of suboptimal screening rates. The research gives insight into the importance of improving GDM screening practices to enhance maternal and fetal health outcomes.
6.	Ramaiya, Swai, Mwanri, Mutabingwa,	The research gives insight into healthcare facilities' readiness to address GDM, suggesting potential challenges and opportunities for improvement in GDM diagnosis and management.
7.	Radenkovic, Miroslav,	The book talks about new developments in GDM, etiology, screening, management, outcomes, and how to control them.
8.	Baz, Jean-Pierre, Jean- François	This study focuses on the endocrinology of GDM in pregnancy specifically its definition, etiology, pathophysiology, and risk factors, from a clinical perspective,
9.	Perumal, Wang, Wang M, Darling, Urassa, Liu, Pem- be, Fawzi	The study defines gestational weight gain adequacy based on the percentage of total observed weight gain during pregnancy against the recommended values according to body mass index-specific guidelines concerning GDM and its fatal effects including low weight at birth, stillbirth, perinatal death, and preterm birth.

10.	Darling, Liu, Aboud, Urassa, Spiegelman, Fawzi	The study assesses the impact of maternal hyperglycemia on pregnancy outcomes, including potential risks for both the mother and the fetus.
11.	Katrien, Devlieger, Van Assche,	The article discusses the diagnosis and management of gestational diabetes from a medical expert's perspective. It covers various aspects of GDM, including screening methods, diagnostic criteria, and management strategies.

7.2 Analysis of data

The process of analyzing data systematically and objectively in a literature review is called content analysis. It has a structured approach that guides the transformation of large volumes of diverse literature into structured and meaningful content. This helps researchers to extract meaningful insights from different sources. Qualitative literature analysis can be approached either (often) by using deductive or inductive analysis methods (Kangasniemi et Al. 2013). A deductive analysis is guided by a specific theoretical framework, concept, or hypothesis. The researcher starts with a clear research question and then performs a literature search that supports or contradicts it. The aim is to find relevant literature and explore how concepts have been studied, supported, or challenged by previous research (Oakland 2015). An inductive literature review on the other hand is characterized by a more exploratory approach. The researcher does not start with a specific hypothesis but begins with a broader research topic or question and reviews a wide range of literature to identify patterns, themes, and emerging concepts from the data itself instead (Kangasniemi et Al. 2013).

In this thesis, a deductive literature review analysis was used. The process proceeded as follows: Topic decision, selection of units of analysis (research questions), code development, familiarization with material, coding process, data

analysis, and synthesis, interpretation of findings, and abstraction and assessment of reliability (Aveyhard, Hellen 2023). The selection of a theoretical framework involves choosing a well-defined hypothesis or theory. In this case, GDM-related fatalities in Tanzania. This was a guide to finding literature material on the frequency, risk factors, identification of fatal effects, and contributors, of GDM in Tanzania. In unit selection, the research was narrowed down with specific research questions. The research then focused on research studies, reviewed articles, and clinical reports. Based on the research topic, a set of codes were created for example, GDM prevalence: Code: GP, description: literature discussing the prevalence and severity of GDM in Tanzania (Kangasniemi et Al. 2013).

Table 1. Theoretical framework, unit selection, and Code development

Theoretical Framework	Hypothesis	Unit Selection	Codes
Health Belief Model	Hypothesis: Women's perception of the severity of GDM and the benefit of seeking medical care influences their likelihood of seeking early intervention, thereby reducing fatal outcomes.	Research studies	PS1: Perception of GDM severity and risk
		Research Studies	AC2: Access to healthcare facilities
Social Determinants of Health	Hypothesis: Socio-economic factors and limited access to quality healthcare services contribute to the fatal effects of GDM in marginalized communities in Tanzania.	Research Studies	HC1: Healthcare system deficiencies
Structural	Hypothesis: Structural factors	Research	PP1: Poverty

Theoretical Framework	Hypothesis	Unit Selection	Codes
Violence Theory	such as poverty and gender inequality contribute to the higher incidence of GDM and its fatal effects among vulnerable populations in Tanzania.	Studies	and fatal outcomes

The other step was familiarization with material which involved reading and understanding collected data. This step helped in understanding the content, context, and ideologies found in the material. This was then followed by the coding process which involved the application of predefined codes to units of analysis (research questions). Each unit was read carefully to determine codes that best aligned with the content. The coded data was then analyzed to identify patterns, trends, and relationships. Care was taken in identifying how data aligned with predefined codes, considering how different codes interacted, co-occurred, or diverged with each other (Aveyhard, Hellen 2023). Findings were then interpreted, and insights were gathered from the analyzed data discussed in this literature review (Oakland 2015).

8 ANALYSIS OF RESULTS OF LITERATURE REVIEW

In this chapter, contents of results of literature review are analyzed. Topics of interest were derived from units of analysis formed during the deductive literature review process that included gestational diabetes, severity, and prevalence of GDM in Tanzania, contributors and risk factors, screening, and fatal effects and management.

8.1 Results analysis

Study (1) by Grunnet et Al. (2020) stated that the occurrence of GDM in Tanzania had risen from 0% (1991) up to 19.5% (2016). In their cross-section study, 538 expecting women were assessed using the oral blood sugar tolerance test between weeks 32-34 of pregnancy. The diagnosis was done according to the WHO 2013 guidelines. The report indicated that 39% out of the 392 women screened had GDM, 94.1% (majority) being diagnosed based solely on the OGTT. Statistics collected from the above studies therefore suggest an alarming rise in the occurrence of GDM in Tanzania as indicated by the results stated above.

Study (2) investigated the prevalence of gestational diabetes in parts of Tanzania (Morogoro and Dar es Salaam) between years 2011 and 2012. Using 1999 WHO diagnosing criteria, the study was carried out on 910 women, 301 from rural areas and 609 in urban areas. This study recorded a mean average of 5.9%. 1.0% in rural areas and 8.4% in urban areas. According to them, this was much higher than it was in 1993, and a much higher increase compared to the reported 0% in studies done in rural and urban areas in the 1990s. According to Mwanri et Al. (2013) observed patterns that risked GDM included previous still-birth history and a family history of diabetes. They also emphasized that sedentary lifestyles, family history, and gestational weight increased the risk of acquiring GDM.

Study (3) by Msollo et Al. (2019) examined the prevalence of hyperglycemia onset during gestation, its relation to body fat percentage, and other determi-

nants contributing to its occurrence. According to them, hyperglycemia is caused by either already existing diabetes or insulin resistance. This cross-section study examined 468 women of twenty-eight (28) and beyond gestation weeks and an average of twenty-eight (28) years in the Arusha district in Tanzania. The results of this study recorded a sixteen point two percent (16.2%) had hyperglycemia in pregnancy (HIP) of which, thirteen percent (13%) had GDM, and three-point two percent (3.2%) had diabetes in pregnancy. This study targeted other relevant forms of diabetes since according to them, many cases go unnoticed because of different thresholds set by different diagnosing criteria. In their view, this approach is important and helps in creating appropriate interventions.

This study also emphasized the ability of diabetes in pregnancy to increase the risk of complications due to the intensity of hyperglycemia and the uncertainty as to whether its occurrence happened before or during gestation. Health education, and pre- and during pregnancy testing were among the suggested interventions for this problem. The study also identified gaps in the monitoring and screening process and suggested continuous blood sugar screening and control before, during, and during pregnancy. This, according to them, would prevent diabetes in continuing pregnancies. The research also recorded that the occurrence of hyperglycemia in pregnancy (HIP) was higher in cases where body fat percentage was high, BMI was high, a type 2 diabetes history was present in the family, unhealthy lifestyles as well as a previous macrosomia.

In study (4), Njete et Al. (2017) carried out a cross-sectional in the Moshi region in Tanzania between 2015 to 2016 among pregnant women (24–28 weeks of pregnancy) to find out the occurrence of gestational diabetes. Results from this study indicated that among 333 screened females, The average prevalence was 19.5%. In this case, the risk factors included pre-pregnancy obesity, age ≥ 35 years, and a history of abortion. According to this study, GDM prevalence was high. Out of 5 pregnant women, one had glucose intolerance as per the 2013 WHO criteria. This according to the authors was much higher compared to the previously recorded results of eight point four (8.4%) predominance among expecting females in Dar es Salaam, Tanzania.

Study (5) by Mukuve et Al. (2020) discussed the comprehensive overview of GDM diagnosis, healthcare infrastructure, cultural influences, and long-term effects in the context of Tanzania, offering valuable perceptions into the complexities of managing GDM within the healthcare system in Tanzania. According to this study, the inclusion of GDM screening in antenatal care would allow early detection followed by convenient management and treatment to prevent adverse effects on both the mother and the fetus. This research stated that despite present global and local guidelines supporting GDM testing during antenatal care, Tanzania suffers from inadequacy and lack of resources to implement it. This study suggested that Tanzania experiences a limitation in resources including shortages in diagnostic equipment, trained healthcare personnel, and infrastructure. The study also highlighted that healthcare facilities in Tanzania lack sufficient trained personnel and advocated for the introduction of educational and training programs to promote adequate diagnosis and treatment.

This research suggested possible investment in healthcare infrastructure, especially the construction of healthcare facilities in rural and underserved areas. This, according to them, could improve accessibility to GDM screening and management services. According to the authors, basic and more advanced tests like glucose tolerance tests were not readily available. Another challenge according to them was the proximity of healthcare facilities to pregnant women as they need to travel long distances to reach the care, especially in rural areas. The study also explored different screening methods to fill the gap in undiagnosed cases. They also provided insight into the practical implications of each method in the Tanzanian healthcare system. Another discussed factor was cultural influences and interventions. The authors of this research emphasized the significance of culturally sensitive interventions in improving awareness and adherence to treatment among pregnant women. Long-term impacts of GDM and potential risks associated with undetected or poorly managed GDM, and adverse outcomes were discussed suggesting important measures for prevention.

Study (6) overall, highlighted the urgent need for comprehensive enhancements in the scope and ability of Tanzanian healthcare facilities toward effective management and diagnosis of gestational diabetes. This research supported the

hypothesis of study (5) underscoring the importance of investing in improved screening and management strategies, reinforcing healthcare infrastructure, and delivering targeted training programs to relevant personnel. The study investigated associated challenges experienced by the healthcare system in Tanzania. According to them, limited screening strategies and inadequate resources, including diagnostic tools and trained personnel, contributed to the inadequacies in GDM screening, leading to ignored or delayed diagnoses. It also stated that insufficient management procedures and policies for GDM hindered effective management, leading to suboptimal outcomes for pregnant women affected by GDM. This study also addressed the shortage of resources and barriers to accessing necessary care for expecting females with GDM. According to them, the absence of necessary medications, tools, and well-equipped healthcare facilities hindered the provision of timely and effective management for GDM.

Study (7), the book "Gestational Diabetes Mellitus: New Developments" by Radenkovic edited by Miroslav (2022) defines gestational diabetes as an insulin resistance onset during pregnancy. The study explores important insights into GDM, its new developments, definition, etiology, clinical aspects, and the importance of its management and treatment. This study also suggests that GDM is typically diagnosed through fasting glucose and oral blood sugar tolerance tests following specific diagnostic criteria. Radenkovic, Miroslav (2022) highlighted that the etiology of GDM is multifactorial, citing genetic predisposition including a family history of diabetes and changes in metabolism as key players in risking the acquisition of GDM. This study additionally states that hormonal changes during gestation such as the influence of placental hormones like placental lactogen, and progesterone, contribute to insulin resistance. The hormonal imbalance reduces the effectiveness of insulin, resulting in high blood glucose levels.

Radenkovic, Miroslav (2022) also stated that metabolic changes, especially the metabolism of lipids and glucose, can impact insulin resistance and glucose intolerance during pregnancy. According to them, factors that can influence such changes include sedentary lifestyle, maternal obesity as well and dietary habits. This study in conclusion discussed complications caused by gestational

diabetes and emphasized the importance of monitoring and treating GDM effectively to avoid such adverse effects. This book mentioned that insulin therapy, dietary modification as well and timely intervention played an important role in preventing long-term health effects.

Study (8), research by Baz et Al. (2016) investigated the endocrinology of pregnancy focusing on GDM, its clinical aspect, definition, and etiology. The study gives a comprehensive overview of GDM. All studies had a similar definition and etiology for gestational diabetes. Baz et Al. (2016) however use the word glucose intolerance and are more specific on the significant health concerns that GDM poses to both the mother and the fetus. This study characterized GDM by elevated blood sugar levels, occurring during the second or third trimester, but also possible to occur at any stage of pregnancy. Genetics, hormonal changes, and environmental changes were mentioned in this study as risk factors for the development of GDM.

Baz et Al. (2016) cited that a history of diabetes in the family, especially among close relatives, heightened the risk of GDM. According to them, inherited predisposition may involve insulin resistance, impaired pancreatic function, insulin, and alterations in glucose metabolism. They also stated that hormonal changes during pregnancy contribute to insulin resistance by reducing the action of insulin in target tissues. The screening and diagnosis criteria, clinical aspects as well as complications both neonatal and maternal in this study were similar to that of the study (7). Both studies emphasized the importance of early intervention and management, the importance of antenatal care programs as well and healthcare policy adjustment to favor the fight against GDM especially in resource-constrained areas.

Study (9) by Perumal et. Al. (2022) estimated the relationship between weight gained during gestational and fatal neonatal consequences. According to them, weight gained during pregnancy is the weight gained above the recommended weight based on index-specific guidelines. In their cross-section study, 8, 428 pregnant women with a gestation age of between twelve (12) and twenty- eight (28) weeks were selected from different health facilities in Dar es Salaam and studied over a specific period. The set eligibility criteria were, (i) Gestational age

of between 12 and 27 weeks, (ii) testing negative for HIV, (iii) 18 years old and above, and (iv) After delivery, live in Dar es Salaam for 1 year (at least). Data collected was, detailed obstetric and medical information (history), clinical examinations, follow-up visits, and sociodemographic information.

In this study, an average of 25% of females had serious inadequate gestational weight gain, 31% had adequate, 26% had inadequate, and 18% had excessive gestational weight gain. Assessed neonatal outcomes included perinatal death, stillbirths, low birthweight, preterm birth, macrosomia among others. The prevalence of perinatal death was 6.1%, stillbirths 3.5%, macrosomia 2.5%, and pre-term birth 17%. The high prevalence of adverse neonatal effects recorded in this study was about gestation weight gain. The authors noted that fetal growth and outcome were proportional to gestational weight gain. This was influenced by the availability and ability of the mother to supply nutrients to the fetus during gestation. Inadequate gestational weight gain was in this study linked to low birth weight as well as an increased risk of fetal growth restriction. Excessive gestational weight gain on the other hand was linked to macrosomia, stillbirths, cesarean section delivery, childhood obesity, and other adverse effects. In conclusion, gestational weight gain and increased BMI are significant risks for GDM-related complications of pregnancy. It was therefore suggested that controlling maternal gestational weight gain was vital in ensuring safe and healthy pregnancy outcomes.

Study (10) provided valuable insights into the consequences of maternal hyperglycemia on pregnancy in Tanzania. This study emphasized the need for improved screening, management, and adherence to preventative measures to enhance maternal and fetal health. Key aspects discussed included risk assessment for adverse perinatal consequences associated with maternal hyperglycemia and fatal pregnancy outcomes. This included the investigation of the possible occurrence of stillbirths, macrosomia, preterm birth, and neonatal complications associated with maternal hyperglycemia. The authors also discussed the impact of hyperglycemia on maternal health examining possible risks of preeclampsia, cesarean section, and other maternal complications associated with elevated glucose levels in gestation. This article also discussed

the prevalence of GDM comparing its current state to previous years and specific challenges faced by pregnant women in Tanzania.

This study aimed to create awareness and advocate for intervention, especially change in healthcare practices and policies in Tanzania. The identification of maternal hyperglycemia as a predictor of fatal pregnancy outcomes emphasized the importance of implementing effective screening and management strategies for gestational diabetes. The study also suggested the need for improved antenatal care and designed interventions to address the specific risks associated with it. This study also discussed the potential of preventive interventions like dietary interventions, advocating for lifestyle modifications, and targeted healthcare programs in managing and mitigating the prevalence of maternal hyperglycemia and its adverse effects on pregnancy outcomes.

Study (11) discussed best practices and the latest research developments in the screening and management of GDM, providing valuable guidance for healthcare professionals. This study covered a range of important aspects related to the screening, diagnosis, and treatment of GDM, including screening protocols and guidelines, diagnostic criteria and thresholds, management strategies and Interventions, pregnancy outcomes and complications, and long-term health implications. The study explained recommended approaches for identifying high-risk pregnant women and discussed various screening tests and their comparative efficacy in detecting GDM, suggesting the most reliable and practical screening methods. The authors explored the diagnostic criteria and thresholds set by international bodies and their applicability in different clinical settings, emphasizing the importance of accurate and standardized diagnostic parameters.

This study also discussed recommended management strategies and interventions for women diagnosed with GDM. These were dietary interventions, pharmacological treatments, changes in lifestyle, physical activities, and close monitoring protocols. Discussed also was the impact of effective timely and targeted screening and management of GDM on pregnancy outcomes and complications. Potential risks associated with uncontrolled GDM during pregnancy and different types of long-term effects were also explained in this study.

9 REFLECTIONS

This thesis purposed to collect, review, extract, analyze, and synthesize literature on how to identify, monitor, and treat the fatal effects of gestational diabetes on both the mother and the fetus in Tanzania. The method used in this thesis was a descriptive literature review. Research questions used were: What is the occurrence of gestational diabetes in Tanzanian, what factors contribute to the increased occurrence of GDM in Tanzania, fatal effects of gestational diabetes to the expecting mother and the fetus, and how do identify, and monitor, and control fatal effects of gestational diabetes in the context of Tanzania. In this chapter, we examine research results, reflect on the ethics and reliability of this work, personal and professional growth, usability, and topics for further research.

9.1 Review of research results and conclusions

This chapter discusses the comparison between the theoretical background and literature review results obtained from the data search.

Grunnet et al. (Study 1) and Mwanri et al. (Study 2) painted a clear picture of the incidence of gestational diabetes in Tanzania which is the problem statement of this thesis. Studies (1) and (2) emphasize the high occurrence of GDM, particularly in urban areas, indicating an alarming rise. On the other hand, studies (4, 5, 6, 9, and 10) gave insights into the overall current situation of challenges related to the screening of gestational diabetes in expectant females in Tanzania. The disparity observed between prevalence and effective screening strategies suggests a critical gap in the healthcare system. All studies acknowledged the complex interplay between maternal and fetal adverse effects. For example, Darling et al. (Study 10) stated that maternal hyperglycemia that characterizes GDM directly affects fetal development.

Darling et al. (Study 10) stated that macrosomia is caused by the effect of insulin on adipose tissue linking it with maternal obesity, poorly controlled or uncon-

trolled diabetes, and excessive maternal weight gain during pregnancy. This study explained that fetal hyperglycemia stimulates insulin production, other insulin-like growth factors, and growth hormones that facilitate fetal growth, and deposition of glycogen and fat resulting in macrosomic babies. Ramaiya et al. (Study 6) that high maternal blood sugar levels lead to increased fetal insulin production, contributing to fetal macrosomia. The research by Radenkovic (Study 7) and Baz et al. (Study 8) provides a broader understanding of the clinical aspects of GDM. According to them, severe GDM is linked to possibilities of having a large baby because uncontrolled high sugar values predispose the fetus to macrosomia. These studies agreed that macrosomic babies may experience birth injuries during delivery, affecting maternal well-being.

Perumal et al. (Study 9) highlighted the linkage between the adequacy of weight gained during pregnancy and adverse neonatal health outcomes, emphasizing the significance of appropriate weight management during pregnancy. She stated that women with GDM have higher chances of getting preeclampsia, a dangerous condition defined by high blood pressure that can cause damage to vital organs, asphyxia, i.e., fetal distress associated with the lack of gas exchange or blood flow from or to the fetus either before during or after birth, an increased likelihood of cesarean section deliveries, and exacerbation of pre-existing Conditions like hypertension or obesity. Baz et al. (Study 8) provided a broader understanding of the evolving developments including higher chances of getting type 2 diabetes later on. This study also explained the link between stillbirths and GDM associating it with factors including placental insufficiency, that can result from uncontrolled levels of hyperglycemia.

Msollo et al. (Study 3) provided evidence of the impact of body fat on the occurrence of hyperglycemia during gestation, adding an important dimension to the understanding of GDM risk factors. This research stated that elevated blood sugar levels during crucial periods of fetal growth can interfere with normal organ development (organogenesis) leading to abnormalities (congenital malformations). Njete et al. (Study 4) further explained the risk of congenital malformations as directly proportional to the gravity of gestational diabetes and the degree of blood sugar control. Radenkovic (Study 7) Baz et al. (Study 8), and Benhalima et al. (Study 11) agreed with the idea that the exact mechanism of

how GDM is linked to the IUGR is believed to be related to the damage of blood vessels in the placenta caused by high levels of blood. It can therefore be concluded that GDM is highly prevalent in Tanzania evidenced by multiple cases of adverse outcomes related to it as evidenced by several studies in this thesis.

Studies 5 (Mukuve et Al.) and study 6 (Ramaiya et Al.) reveal the limitations in the scope and ability of healthcare centers to deal with GDM, underscoring the impact of resource constraints on addressing this critical health issue. Grunnet et al. (Study 1) explained that a lack of awareness of GDM and its adverse effects leads to delayed diagnosis and management risking death and other fatal effects. Ramaiya et al. (Study 6) further explained related risks such as lifestyle, obesity, and a history of diabetes in the family, and also emphasized the importance of early intervention like tailored screening and care. Grunnet et al. (Study 1) explained the discrepancies in diagnosing criteria giving insights into how limitations in the World Health Organization (WHO) diagnosing criteria impact Tanzania. Mukuve et al. (Study 5) emphasized the role of socioeconomic status and cultural practices that impact the prevalence of GDM and its fatal effects.

Njete et al. (Study 4) among other risks further explored the main challenge of GDM, unhealthy lifestyles, and sedentary behavior. The above studies agreed on the ideology of the association with poor diet and lack of exercise as a link to gestational weight gain that risks glucose intolerance thus risking the occurrence of GDM in pregnant women perpetuating a cycle of health risks. This underscores the importance of post-pregnancy monitoring and lifestyle modifications. While the studies generally support the notion of the significant prevalence of GDM in Tanzania, there is no consensus regarding effective testing and management strategies. Finally, the study by Benhalima et al. (Study 11) provides valuable insights into the screening and management of GDM, suggesting potential strategies for improving the current healthcare practices in Tanzania.

It can therefore be concluded that the prevalence of GDM in Tanzania is high, proper intervention is lacking, and the adverse effects are on the rise. Health effects associated with GDM cause fatal complications for the fetus, mother, and newborn. According to the results indicated in the obtained research mate-

rial, these health effects are related to birth injuries and complications, the size of the child being born, and physiological functions. Adverse outcomes are sometimes interlinked for example, macrosomia increases the chances of shoulder dystocia in the unborn child. High levels of maternal hyperglycemia directly affect the health and growth of a fetus for example, a fetus of a diabetic mother can also suffer from severe breathing difficulties. According to the results, poor maternal blood sugar control increases the risk of health problems for both the fetus and the newborn. It is for this reason that maternal screening, awareness and education, monitoring, and personalized intervention are highly recommended during the entire gestation period and after birth.

Results from the research also suggested that effective treatment and management of GDM effectively prevent fatal effects and health complications for the mother, the fetus, and the newborn. The fatal effects of GDM on both the mother and the fetus were considered from the perspective of public health and costs, cultural influences, as well as healthcare policies. A cesarean section, for example, is a high-cost procedure, a hypoglycemic newborn requires intensive care, among other related costs. It is therefore better to think of preventative measures like creating awareness and advocating for health. From a humanitarian perspective, GDM increases the burden on pregnant mothers and parents, affecting the overall well-being of the whole family. The theoretical background of this thesis explains the prevalence, fatal effects, and challenges experienced in screening and management of GDM in Tanzania as well as how to monitor, treat, and prevent these adverse effects.

9.2 Ethics and reliability of the literature review

This thesis process was handled ethically. Work from other researchers was referenced and handled with respect without copying their work exactly. I also strived to present their thoughts in a simple, clear, and understandable way to avoid distorting their information. I started by familiarizing myself with literature reviews and how to identify good research material. According to Oakland (2015), the researcher needs to consider research principles and ethics when conducting research. Key principles include avoiding plagiarism and carefully

explaining research methods used in the report. Results should be reported honestly in the writer's own words. Apart from knowing the principles and ethics of research, research also requires good scientific practice. Research ethics are considered for example when forming research questions, and when choosing the focus of research i.e., choosing the point of view on how the topic is discussed. In terms of data selection, ethics is considered, for example, correctly reporting your findings (Kangasniemi et Al. 2013).

The studies included in this demonstrated a commitment to ethical research practices. For example, studies (9, 3, 1,4) showed ethical considerations in their studies involving pregnant women and their fetuses with appropriate measures to ensure informed consent of their participants. To ensure reliability, the reviewed literature was scientific studies searched from reliable academic databases, and their references were checked to ensure their credibility as well. Used studies also employed ethical methodologies in data collection and analysis. Research studies were also selected from different countries for comparison. In my opinion, reliability improved by recording the literature review and data search process as demonstrated in this thesis. The content of studies used was carefully and accurately paraphrased according to my understanding of the text and carefully referenced. It is however essential to acknowledge potential biases, especially in the selection of studies.

9.3 Process description and personal growth

This thesis process began when a close relative almost lost her life and that of the unborn child due to GDM. The whole experience got me interested in her pregnancy journey and often asked myself why wasn't this noticed earlier in the healthcare center.? After seeking information and monitoring her lifestyle, I started to identify patterns and gaps of lack of information and incentives about GDM and its effects. This is when I developed a deep interest in researching GDM and being a part of the solution advocating for awareness. This could only be possible if I equipped myself with enough information and knowledge about the condition. Having experienced a fatal effect of GDM, it was easy for me to

narrow down the topic and find out what more harm this can cause to the mother and the fetus, thus the topic of my thesis.

The idea was to create a piece of simple information that can be easily used to design an easy-to-read guidebook for relevant individuals. The literature review process was suggested to me by my supervising teacher. It was a good process to search, sort, and analyze material according to its relevance. The process started by searching for material in different databases as explained in the methodology process, reading, analyzing, and selecting the references that best supported the idea. The search was aided by the studies I received in school. There were challenges in choosing studies as most of them had three to four similar writers either supporting or opposing their narrative about the topic. The most time-consuming part was analyzing and describing the results. Doing the thesis alone had both pros and cons. The pros were the ability to solely define the picture of how I want the story to flow, and the cons included time-consuming, and being able to only depend on my angle of analyzing and style of writing.

I was interested in the topic, motivated and the topic had a personal interest as well. This process required me to be committed, motivated, and flexible to make changes as well as be organized and stay on schedule. My positive attitude towards this helped me achieve my goal. Although the process was long and demanding, I found it to be appropriate as I gained a lot of knowledge in the process. Conducting this review has been a valuable process. I gained skills and knowledge in a systematic approach, and being organized, and sharpened my skills in literature analysis, information search from different databases, and information synthesis. Another outstanding skill learned during the process is the ability to critically assess the quality and relevance of acquired information, synthesize it, and create a coherent narrative about it.

Through this process, I learned the overall picture of GDM and gained a deeper understanding of the challenges, outcomes, and complexities of identifying, diagnosing, managing, and mitigating GDM prevalence in Tanzania. Multiple studies highlighted the importance of a multidisciplinary of involving healthcare providers, policymakers, researchers, and the population itself to improve both

maternal and fetal outcomes. Professionally, this review process enhanced my research skills, particularly in evaluating the credibility and validity of academic sources. This review has also enhanced my research skills, particularly in evaluating the reliability and validity of academic sources and understanding the significance of ethical considerations in research.

9.4 Usability of the thesis and topics for further research

This literature review contributed to my professional growth as I gained clinical knowledge that I can use in my future career. In my opinion, nurses need to be able to do proper evaluations and identify risk groups to be able to give preventative measures to adversely affect them. The findings used in this literature review give insights into the practical implications of GDM in Tanzania and its overall state. This information is useful for healthcare professionals, pregnant mothers, the healthcare system, policymakers, and researchers in Tanzania. The information emphasizes the importance of early detection as a measure to prevent adverse outcomes, continue monitoring to monitor, creating awareness and sensitization, as a way of minimizing the fatal outcomes to both the mother and the fetus.

This informative material can be used and simplified into an easy-to-use guidebook for healthcare workers, and health facilities, as well as an information booklet for pregnant mothers. For topics for further research, I suggest exploring strategies for interventions to improve screening and managing GDM in limited resource settings in the context of Tanzania. Another interesting topic will be investigating culturally sensitive interventions in managing and preventing adverse effects of GDM in Tanzania. Research on these topics would be meaningful and helpful in search of identifying and mitigating contributing factors on a grassroots basis.

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