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Clinics in Mother and Child Health

Review Article

Gestational diabetes mellitus: unique challenges in sub-Saharan Africa

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ABSTRACT

Gestational diabetes is defined as any degree of glucose intolerance first detected in pregnancy. The exact prevalence is difficult to determine in sub-Saharan Africa because the various studies on gestational diabetes mellitus did not use the same criteria. The sub-Saharan Africa has some peculiar challenges with addressing the burden of gestational diabetes in the region. This review aims to highlight some of these unique challenges.

There are no universal criteria for the screening and diagnosis of gestational diabetes mellitus which is a challenge for health care providers and researchers in the region. The mainstay of treatment of gestational diabetes mellitus is lifestyle modification. There are insufficient trained dieticians and health educators to undertake this task in the region. Provision of health care for this category of patients is suboptimal in the region. Cost of health care and medications are mostly unaffordable thereby mitigating against optimal care of gestational diabetes mellitus in sub-Saharan Africa.

The short term and long term complications of gestational diabetes mellitus to the mother and child are additional burden to the health care delivery systems in the region considering that the prevalence of gestational diabetes mellitus is rising in the region.

Keywords: Gestational diabetes mellitus; Sub-Saharan Africa; Challenges

BACKGROUND

Diabetes mellitus is a metabolic disease characterized by disorder of carbohydrates, lipids and proteins. The central theme in diabetes mellitus is exposure of various tissues, including the foetus, to chronic hyperglycaemia. The hyperglycemia is due to deficiency in insulin secretion and/or action. Gestational diabetes mellitus (GDM) is a type of diabetes and it is defined as any degree of glucose intolerance that is first diagnosed in pregnancy [1]. It has adverse effects on maternal and child health if not well managed.

There are documented challenges with the epidemiology, diagnosis and management of GDM in sub-Saharan Africa. There is also paucity of expertise to manage this delicate aspect of Diabetology. This review aims to highlight these challenges so that evidenced-based solutions that can be domesticated in the sub-region are proffered.

EPIDEMIOLOGY

Determining the exact prevalence of GDM is challenging in sub-Saharan Africa because there are no specific criteria applicable to the region. So, different studies adopt various criteria mostly applied for the Caucasians in the developed world. A systematic review of the various studies carried out in different countries of sub-Saharan Africa estimated the prevalence of GDM in sub-Saharan Africa to be 14.9%.[2] A major limitation for this study was that different diagnostic criteria were used for the studies recruited into the systematic analysis. There is a need for a uniform diagnostic criteria for the diagnosis of GDM in sub-Saharan Africa before the studies can be compared with one another. A recent metaanalysis that recruited studies which used the International Association of Diabetes in Pregnancy Study Groups (IADPSG) criteria found a prevalence of 13.6% among pregnant women in sub-Saharan Africa. The roles of problems peculiar to low and middle income countries such as malnutrition and infection on the incidence of GDM have not been extensively explored.

The data on the risk factors specific for Africans for GDM is scanty. However, there are risk factors for GDM which have been documented in other regions. A systematic review of these classical

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Received: August 08, 2020**; Accepted:** August 24, 2020**; Published:** August 31, 2020

Citation: Azeez TA, Abo-Briggs TW (2020) Gestational diabetes mellitus: unique challenges in sub-Saharan Africa. Clinics Mother Child Health. 17:358.

risk factors found obesity, older maternal age and family history of type 2 diabetes to be associated with GDM in sub-Saharan Africa.[3] The relevance of exploring these factors is that some of these factors have been associated with type 2 diabetes mellitus. For example, childhood undernutrition has been associated with type 2 diabetes in sub-Saharan Africa.[4] Also, chronic infectious diseases prevalent in sub-Saharan Africa, such as human immunodeficiency virus (HIV) infection and tuberculosis, have been linked with type 2 diabetes via the mechanisms of inflammation and activation of the immune system [5]

A meta-analysis of various studies on GDM conducted in many countries of sub-Saharan Africa found that the prevalence of GDM has been rising over the years. This rising prevalence is a major challenge in sub-Saharan Africa where optimal obstetric care is lacking [2]. This rise in GDM prevalence in sub-Saharan Africa is hypothesized to be as a result of adoption of western lifestyles. Consumption of processed food, sedentary lifestyle, urbanization and rising prevalence of obesity are some of the factors associated with rising GDM prevalence [6]. Moreover, due to the improvement in girl child education and women empowerment, the age by which women are getting pregnant is being delayed and older maternal age is a documented risk for GDM [7].

PATHOPHYSIOLOGY

Pregnancy is a state characterized by high insulin resistance. Insulin resistance refers to the reduced physiologic response of tissues to the same amount of insulin. [8] Molecularly, insulin resistance is a problem of insulin signaling. There is reduced translocation and incorporation of glucose transporters (GLUT) into the cell membrane thereby impairing the transportation of glucose into the cells leading to accumulation of glucose in the blood.[8] In pregnant women with GDM, the rate of transporting glucose into the cells, under the influence of insulin, is reduced by half compared to pregnant women without GDM.[9] Many of the classical risk factors for GDM exert their influence by affecting the processes of insulin signaling.[8] A study reported that there are differences in the expression of genes mediating insulin signaling between women of African ancestry compared to Caucasian women.[10]

Physiologically, the pancreas β cells produce enough insulin to drive insulin-mediated glucose uptake into the cells and overcome insulin resistance. β cells dysfunction is said to occur when they ca no longer produce adequate insulin to drive insulin-mediated glucose uptake. β cells dysfunction has been reported to be one of the underlying pathophysiologic mechanisms causing gestational diabetes mellitus.[8] Moreover, insulin resistance worsens β cells dysfunction and β cells dysfunction perpetuates insulin resistance thereby creating a vicious cycle which ultimately leads to hyperglycaemia.[8] A study has reported that there is a reduced capacity for insulin secretion among Africans and this is partly responsible for the higher risk of diabetes among them.[11]

Pregnancy is associated with increased elaboration of hormones that promote insulin resistance. [8] These hormones include human chorionic somatomammotropin, oestrogen, progesterone and cortisol. These hormones exert their diabetogenic effects by regulating metabolic rate, energy balance and appetite. They promote adipogenesis and enhance insulin resistance. A study has reported a higher level of progesterone among pregnant women of African ancestry compared with Caucasians.[12]

Apart from the roles of the classical diabetogenic hormones of pregnancy, there are other hormones that play roles in the development of GDM. Leptin is a hormone secreted by the adipose tissue. Its physiologic role is to induce satiety by activating appetite suppressing molecules such as pro opiomelanocortin (POMC) and inhibiting appetite stimulators such as Agouti-related peptide. GDM is associated with leptin resistance.[13] Adiponectin has also been documented to play a role in the development of GDM.[14]

DIAGNOSIS

A major challenge for health practitioners in sub-Saharan Africa managing GDM is determine the appropriate criteria to use in diagnosing the disease. There is no international consensus on the criteria for diagnosing GDM. This also makes it difficult to compare studies since different criteria are being adopted by different authors. The various criteria documented in the literature include O'Sullivan criteria, Carpenter and Coustan criteria, 1999 World Health Organization (WHO) criteria and 2004 American Diabetes Association (ADA) criteria. [8] In the last decade, criteria that were published include 2010 IADPSG criteria, 2013 WHO criteria, 2015 National Institute for Health and Care Excellence (NICE) and 2016 ADA criteria.[8]

Apart from being confusing none of the criteria was specific for Africans. In most published articles on GDM in the developed world, IADPSG criteria were recommended.[15] In contrast, a systematic review of articles on GDM in various African countries reported the WHO criteria as the most adopted criteria to define GDM.[16] The challenge in this is that findings in GDM in sub-Saharan Africa may not be comparable with findings in other places because of the difference in the criteria used. Even in the Hyperglycaemia and Adverse Pregnancy Outcome (HAPO) study which is the basis of the IADPSG criteria, there was no African cohort and the findings may not be necessarily applicable to Africans.[17]

TREATMENT

The primary treatment modality for GDM is lifestyle modification.[18] The overall aim of treating GDM is to control the blood glucose of the affected women to the range of other pregnant women without GDM. Medical nutrition therapy plays a central role in the treatment of GDM. In sub-Saharan Africa, there is dearth of trained dieticians, especially in the rural areas, which makes it difficult for the patients to initiate and adhere to a meal plan. In addition, the exact quantity of calories in the various local food is not known and this may make calorie prescription awkward and inaccurate.

There is a need to improve physical activity so as to enhance insulin sensitivity. In a typical rural health centre in sub-Saharan Africa, there are very little or no diabetes educators to educate the women with GDM on the need and the type of physical activity that is safe and effective to be embarked upon.

Frequent and multiple glucose monitoring is essential for the management of GDM.[18] this will require self-monitoring of blood glucose at home using a glucometer. Many households in the rural sub-Saharan Africa may find the glucometer and more importantly the recurrent purchase of strips unaffordable. So, they either check the blood glucose inadequately or they may not check it at all. Inadequate glucose monitoring makes optimal glycaemic

control in GDM challenging to the attending health personnel.

In terms of pharmacotherapy, most of the oral glucose lowering agents are contraindicated in pregnancy. Metformin and glyburide may be used but many guidelines do not recommend them as fist line options in the treatment of GDM.[19] There are no guidelines specifically designed for the population of sub-Saharan Africa and this may be confusing for the heath personnel. Rather, insulin is considered the first line in many of the available guidelines.[19] Insulin is relatively expensive to this particular population. In the rural areas, due to unavailable or erratic power supply, maintaining a cold chain for the insulin vials may be challenging thereby undermining the potency of the drug. In some, rural areas, insulin may be unavailable at all and the cost of transportation to the cities is another financial burden to the patient. All these challenges that are peculiar to low resource settings such as sub-Saharan Africa make optimal management of patients with GDM a herculean task.

OUTCOMES

GDM has deleterious effects on the mother and the child hence the need to optimize management.[8] The mother is exposed to a number of short term and long term complications. Mental health disorders such as antenatal depression and psychological stress are among the documented short term potential complication of GDM.[20] in a sub-Saharan Africa setting, this is peculiar because there is a background stress for the mother to be transported to the nearest health facility.

There is also the risk of obstetric complications such as preeclampsia and eclampsia, preterm delivery, instrumental or surgical deliveries. [2] These potential complications increase the risk of maternal mortality. Considering that sub-Saharan Africa already has one of the highest maternal mortality rate in the world, it therefore becomes additional health burden for these poor resource settings.

In the long term, diagnosis of GDM increases the risk of GDM in subsequent pregnancies by as high as 60%.[8] Also, the long term risk of developing type 2 diabetes in the long term is increased, as high as 2% per year. [8] In sub-Saharan Africa, the risk of developing type 2 diabetes is already considered high and the prevalence is increasing therefore the additional risk of GDM will be an enormous burden to the region where health care is generally considered suboptimal.

The child can also develop potential complication of GDM. Foetal macrosomia with its attendant complication are the most common documented complication of GDM to the child. [8] Macrosomia increases the risk of shoulder dystocia and surgical delivery. [22] There is increased risk of perinatal death, neonatal hypoglycaemia which can cause permanent brain injury, neonatal jaundice and birth asphyxia.[23] The sub-Saharan Africa region already has one of the highest number of neonatal mortality and this further worsens the burden.[24]

In the long term, a child born to a woman with GDM has the increased risk of developing obesity, type 2 diabetes and cardiovascular disease in adulthood.[8] These are diseases whose prevalence in sub-Saharan Africa are rising at a rate higher that most parts of the world due to the epidemiological transition. Therefore adding the long term complications of GDM to this burden will be a great challenge for the region in the nearest future. [8] The female child of a woman with GDM is likely to develop GDM herself in adulthood.[25] Considering that the prevalence of GDM is said to be rising in sub-Saharan Africa, this may create an intergenerational vicious cycle which would be a strain to the barely optimal health care being rendered in the region.

CONCLUSION

Gestational diabetes is any degree of glucose intolerance first detected in pregnancy. Its prevalence with the attendant complications is rising in sub-Saharan Africa. This has created some unique set of challenges for the region which this article has highlighted.

There is lack of uniformity in the diagnostic criteria and none of the well-known criteria was designed specifically for sub-Saharan Africa, considering its peculiarities. This has made compilation of data about the disease difficult in the region. The treatment is also fraught with the challenges of inadequacy of personnel and medications in the region. The short term and long term complications of GDM for both the child and the mother are additional burden to the poor resource setting of sub-Saharan Africa.

REFERENCES

1. Muche AA, Olayemi OO, Gete YK. Prevalence and determinants of gestational diabetes mellitus in Africa based on the updated international diagnostic criteria: a systematic review and meta-analysis. Archives of Public Health. 2019; 77: 36
2. Mwanri AW, Kinabo J, Ramaiya K, Feskens EJ. Gestational diabetes mellitus in sub-Saharan Africa: systematic review and metaregression on prevalence and risk factors. Tropical Med Int Health. 2015;20(8):983-1002.
3. Nyirenda MJ. Non-communicable diseases in sub-Saharan Africa: understanding the drivers of the epidemic to inform intervention strategies. Int Health. 2016;8(3):157-158.
4. Norris SA, Daar A, Balasubramanian D, Byass P, Kimani-Murage E, Macnab A, et al. Understanding and acting on the developmental origins of health and disease in Africa would improve health across generations. Glob Health Action. 2017;10(1):1334985.
5. Glennie SJ, Nyirenda M, Williams NA, Heyderman RS. Do multiple concurrent infections in African children cause irreversible immunological damage? Immunology. 2012;135(2):125-132.
6. Steyn NP, McHiza ZJ. Obesity and the nutrition transition in Sub‐Saharan Africa. Ann N Y Acad Sci. 2014: 1311: 88-101.
7. Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. Diabetes Care. 2007: 30(Suppl 2): S141–S146.
8. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. Pathophysiology of gestational diabetes mellitus. Int J Mol Sci. 2018;19(11): 3342.
9. Catalano PM. Trying to understand gestational diabetes. Diabet Med. 2014; 31(3):273-281.
10. Smith LM, Yao-Borengasser A, Starks T, Tripputi M, Kern PA, Rasouli N. Insulin Resistance in African-American and Caucasian Women: Differences in Lipotoxicity, Adipokines, and Gene Expression in Adipose Tissue and Muscle. J Clin Endocrinol Metab. 2020; 95(9):4441-4448
11. Kodama K, Tojjar D, Yamada S, Toda K, Patel CJ, Butte AJ. Ethnic Differences in the Relationship between Insulin Sensitivity and Insulin

Response-A systematic review and meta-analysis. Diabetes care. 2013; 36(6): 1789-1796

12. Potischnan N, Troisi R, Thadani R, Hoover RN, Dodd K, Davis WW, et al. Pregnancy Hormone Concentrations Across Ethnic Groups: Implications for Later Cancer Risk. Cancer Epidemiol Biomarkers Prev. 2005;10:5-8.

13. Farr OM, Gavrieli A, Mantzoros CS. Leptin applications in 2015: What have we learned about leptin and obesity? Curr. Opin. Endocrinol. Diabetes Obes. 2015;22:353-359

14. Bouchard L, Hivert MF, Guay SP, St-Pierre J, Perron P, Brisson D. Placental adiponectin gene DNA methylation levels are associated with mothers' blood glucose concentration. Diabetes. 2012; 61(5):1272-1280.

15. Chiefari E, Arcidiacono B, Foti D, Brunetti A. Gestational diabetes mellitus: an updated overview. J Endocrinol Invest. 2017;40(9):899-909

16. Macaulay S, Dunger DB, Norris SA. Gestational diabetes in Africa: A systematic review. PloS One. 2014;9(6):e97871.

17. Coustan DR, Lowe LP, Metzger BE, Dyer AR. The HAPO Study: Paving The Way For New Diagnostic Criteria For GDM. Am J Obstet Gynaecol. 2010; 202(6): 654

18. Delamou A, Belaid L, De Brouwere V. Detection and Management of Diabetes during Pregnancy in Low Resource Settings: Insights into Past and Present Clinical Practices. J Diabetes Res. 2016; 32(17): 98.

19. Kelley KW, Carroll DG, Meyer A. A review of current treatment strategies for gestational diabetes mellitus. Drugs context. 2015; 4: 212282

20. Byrn M, Penckofer S. The relationship between gestational diabetes and antenatal depression. J Obstet Gynecol Neonatal Nurs. 2015; 44(2):246-255

21. Gunawardena N, Bishwajit G, Yaya S. Facility-based maternal death in West Africa: a systematic review. Frontiers in public health. 2018: 0048.

22. Gascho CL, Leandro DM, Ribeiro E Silva T, Silva JC. Predictors of cesarean delivery in pregnant women with gestational diabetes mellitus. Rev Bras Ginecol Obstet. 2017; 39(2):60-65.

23. Langer O, Yogev Y, Most O, Xenakis EM. Gestational diabetes: the consequences of not treating. Am J Obstet Gynecol. 2005; 192(4):989-997.

24. Akombi BJ, Renzaho AM. Perinatal Mortality in Sub-Saharan Africa: A Meta-Analysis of Demographic and Health Surveys. Ann Glob Health. 2019; 85(1):106.

25. Lee SC, Pu YB, Chow CC, Yeung VT, Ko GT et al. Diabetes in Hong Kong Chinese: evidence for familial clustering and parental effects. Diabetes Care. 2000; 23(9):1365-1368.