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Predictors of glycemic control in type-2 diabetes mellitus: Evidence from a multicenter study in Ghana

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ABSTRACT

Background: The burden of uncontrolled type-2 diabetes (T2DM) sub-Saharan Africa is high, with an increased risk of developing microvascular and macrovascular complications. We sought to identify predictors of poor diabetes control among Ghanaians with T2DM.

Methods: A cross-sectional study involving 1226 participants with T2DM enrolled at five health facilities in Ghana (2 tertiary, 2 district and 1 rural hospital). Data on demographics, medical history, lifestyle factors, anti-diabetic medications, and treatment adherence were collected. Additional questionnaires on sources of diabetes treatment medications and challenges with accessing these medications were also administered. Glycated hemoglobin was measured and a cut-off value of ≥7.0% used to define poor control. Predictors of diabetes control were assessed using a multivariate logistic regression model.

Key results: The mean ± SD age of study participants was 57 ± 12.1 years, with a female preponderance (77.5%). The mean HbA1C among all study participants was 8.9 ± 4.9% of which 70% had HBA1C >7%. Duration of diabetes diagnosis (aOR = 1.04; 95% CI 1.02–1.06), the absence of the Ghana National Health Insurance Scheme (aOR = 1.41; 95% CI 1.09–1.82) and the number of diabetes medicines (aOR = 1.73; 95% CI 1.45–2.07) were adversely associated with poor glycemic control while male gender (aOR = 0.66; 95% CI 0.49–0.88), increasing age (aOR of 0.97; 95% CI of 0.96–0.98) and dual diagnosis of diabetes and hypertension (aOR = 0.69; 95% CI 0.50–0.95) had positive associations with good glycemic control.

Conclusion: 7 out of 10 patients with T2DM in Ghana are poorly controlled. Multidisciplinary interventions that improve patient education, quality of care, access to antidiabetics including insulin, are all needed to avert deaths related to diabetes complications associated with uncontrolled T2DM in Ghana.

1. Introduction

The exponential rise in the burden of diabetes in low- and middle-income countries (LMIC), due to population growth, aging, urbanization, unhealthy diet, increasing physical inactivity, and obesity, is alarming.[1] The World Health Organization (WHO) estimates there were 422 million people living with diabetes in 2014, compared to 108 million in 1980, which represents a rise in the

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prevalence of 80.8%.[2] Diabetes prevalence in the WHO Africa region has increased by 129·0%, thus demonstrating that LMICs have particularly experienced a more rapid rise in the prevalence of diabetes, compared to high-income countries.[2–4] The International Diabetes Federation has estimated that the prevalence of diabetes in sub-Saharan Africa is likely to more than double by 2035.[3] The prevalence of diabetes in Ghana has been estimated to be 6.6% in Greater Accra, compared with 0.2% in 1964.[5]

Diabetes is associated with complications, including micro- and macrovascular complications. An estimated 1.9% of the global disability adjusted life years are attributed to diabetes, doubling since 1990.[5] Several observational studies have demonstrated substantial reduction in the risk of microvascular and macrovascular complications, myocardial infarction, stroke and all-cause mortality with improved control of diabetes.[6–10] Lifestyle modification through targeted behavior change including weight loss and physical activity can reduce glycemic index, blood pressure and lipid levels.[11] This requires engagement with the patient on lifestyle modifications and behavior change. Additional control measure such as proper blood pressure control and lipid reduction to reduce cardiovascular risk and other complications are also required. It is well known that there is an increased risk of cardiovascular mortality and morbidity that is associated with microvascular complications of type 2 diabetes. Clinical management should therefore focus on the prevention of both microvascular and macrovascular complications through integrated control of modifiable risk factors.

Many patients with diabetes require a pharmaceutical intervention in order to achieve glycemic control. This remains challenging in LMIC, as it is estimated that 50—90% of the population are required to purchase medicines out of pocket, resulting in high out of pocket expenditure.[12,13] In 2000 it was estimated that direct and indirect economic costs of diabetes in the WHO's Africa region was $8836 per person per year.[14] Additional studies conducted in India, Mexico, Pakistan and Sudan demonstrated that the purchase of medicines represents 32%—62% of total expenditure on diabetes care.[15–20] In Ghana, for those who require insulin for glycemic control, out of pocket expenditure in rural areas were reported to be as high as 60% of the monthly income of those on the minimum daily wage.[21] In 2015, The Lancet Diabetes and Endocrinology Commission estimated that the overall cost of diabetes in sub-Saharan Africa was US$19·45 billion or 1·2% of cumulative gross domestic product (GDP), with $10·81 billion (55·6%) arising from direct costs, which included expenditure on diabetes treatment (purchase of medicines), hospital stays, and treatment of complications.[22]

WHO reports limited availability of essential medicines for the treatment of diabetes in Sub-Saharan Africa. In fact, in a WHO Service Availability and Readiness (SARA) survey, it was found that metformin, glibenclamide, and insulin were consistently not available in all sub-Saharan African countries in 2010.[23] In 2015, of the countries in the WHO African region, 51% had availability of metformin, while 40% had availability of insulin in the public sector.[23] There are few studies which examine the burden of diabetes in Sub-Saharan Africa. There is little documentation of glycemic control, or individual and systems level factors which affect diabetes control. Key elements in diabetes control, requires multiple factors including access to good clinical care, health care providers who can effectively manage diabetes, adequate diagnostic capacity and access to affordable treatment.

The Ghana Access and Affordability Program (GAAP) evaluated the effect of differential pricing of and availability of innovator medicines coupled with health systems and diabetes control in five Ghanaian health facilities. The principal objective of the study was to test approaches to improve access to innovator medicines for underserved populations by improving their availability and affordability. This report is to present a comprehensive analysis of predictors of glycemic control among Ghanaian patients with diabetes, receiving clinical care at five health facilities in an 18 month prospective study.

2. Methods

2.1. Study design

Study design: This GAAP pilot study report is a cross-sectional analysis of baseline data of a prospective cohort study of hypertensive and type 2 diabetes patients. The study was approved by the Committee of Human Research Publication and Ethics of the Kwame Nkrumah University of Science and Technology as well as the Ghana Health Service Ethical Review Committee.

Study sites: The GAAP Pilot study was conducted at 5 hypertension and diabetes specialty and general clinics in urban, peri-urban and rural locations in Ghana. These sites were selected based on the ecological zones of northern savannah, central forest, mixed zone and the coastal belt. These sites were previously described.[23] Briefly, the study sites included:

- The Agogo Presbyterian Hospital (APH): a secondary level hospital
- The Atua Government Hospital (AGH): a secondary level hospital
- The Komfo Anokye Teaching Hospital (KATH): a tertiary level hospital
- The Kings Medical center (KMC): a primary level hospital
- The Tamale Teaching Hospital (TTH): a tertiary level hospital

Study population and settings: Study participants included 1226 patients with type-2 diabetes who were enrolled from 5 study sites distributed across the ecological zones of Ghana. Participants were newly or previously diagnosed type II diabetes patients presenting to one of the participating major referral or district hospitals for medical care. Participants were eligible if they were 18 years or older with known diagnosis of type II diabetes presenting for routine care at either a general polyclinic (AGH, KMC, TTH) or a dedicated diabetes/hypertension clinic (KATH, APH). Participants were excluded if they had hypertensive urgency/emergency or glycemic complications such as hypoglycemia or a hyperglycemic emergency at initial contact for enrollment. During the 6-month enrollment period of the study, each consecutive participant meeting the eligibility criteria was invited for enrollment by research assistants after explaining the objectives of study and obtaining informed consent.

Study participant evaluations and interviews: Trained Research Assistants interviewed study participants and collected demographic and household information such as age, gender, educational attainment, employment status, number of dependents on monthly income and health expenditures. Study participants were also interviewed on their lifestyle behaviors such as alcohol use, cigarette smoking and physical activity. Vital signs, including blood pressure and pulse rates were measured using an automated blood pressure monitor (Omron HEM-907XL) using a standardized study protocol by study nurses. Weight, height and waist circumference were measured by Study nurses.[24] Alcohol intake, smoking status and physical activity were also reported by participants.[24] Self-reported adherence was assessed using a question derived from the Morisky Green and Levine (MGL) adherence scale. Responses of one item of the MGL were coded analogous to the English version.[25,26] The MGL score were classified as follows: adherent (1) and non-adherent (0).