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Genetic and Demographic Determinants of Diabetes: A Cross-Sectional Analysis of Family History, Gender Differences, and Disease Characteristics in Ghana

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ABSTRACT

Background: The prevalence of diabetes mellitus in Ghana presents an emerging public health issue, being fueled by lifestyle, genetic and demographic factors.
Objective: This study aimed to determine the relationship between family history and the type of diabetes and assess the differences in diabetes onset and duration between genders.
Methods: A cross-sectional survey was conducted with a sample of 1,000 Ghanaians with diabetes selected from various healthcare institutions in Ghana. Participants were chosen using stratified random sampling. Demographic information, type of diabetes, family history, age of onset, and duration of diabetes were gathered using a structured questionnaire. The association between family history and diabetes type was examined through chi-square tests. Age and duration of diabetes between individuals with and without a family history were compared using independent samples t-tests. Demographic characteristics were described using summary measures.
Results: The study revealed that 58% of the participants have a family history of diabetes. Chi-square analysis revealed a considerable interrelation between family history and Type 2 diabetes ($\chi^2 = 112.3$, $p < 0.001$). Participants with a family history were diagnosed at a younger age with diabetes (M = 54.2 years vs. 57.8 years, $p < 0.001$) and had a longer duration of the condition (M = 6.8 years vs. 5.5 years, $p < 0.001$). More females than males reported having a family history of diabetes (62.4% vs. 52.6%). The rest (61%) were urban residents.
Conclusion: In Ghana, family history is closely related to having Type 2 diabetes, as well as preceding the diagnosis and extending the duration of the disease. The gaps in reporting highlight the need for women-sensitive diabetes care programs. To bridge these gaps, targeted public health interventions, such as community-based screening and educational campaigns, should be implemented to raise awareness and promote early diagnosis, especially among high-risk families.

Keywords: Diabetes mellitus, Type 2 diabetes, family history, genetic risk, gender differences, disease onset

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INTRODUCTION

Several research studies [1-4] have indicated that diabetes mellitus is becoming a public health concern in Ghana and across Africa, consistent with the global increase in the prevalence, morbidity, and mortality rates associated with diabetes. The disorder is classified into two major subclasses: Type 1 Diabetes, which is an autoimmune disease marking an insulin deficiency, and Type 2 Diabetes, which is a metabolic disorder mainly due to a blend of insulin resistance alongside other lifestyle factors [5, 6]. There is significant evidence suggesting diabetes is a highly heritable disorder, particularly Type 2 diabetes, which poses a greater risk to individuals with a family history of diabetes [7, 8].

Ghana faces underlying challenges with diabetes due to escalating susceptibility and rapid epidemiological transitions driven by urbanization, dietary changes, and sedentary lifestyles. Globally, the prevalence of diabetes among adults has nearly doubled, rising from 7% in 1990 to 14% in 2022, with more than 800 million people currently affected [9]. In Ghana, recent reports estimate that approximately 7.5% of adults live with type 2 diabetes, amounting to over 2.4 million individuals, with a significant portion remaining undiagnosed [10, 11]. While these risk factors are well-documented, there appears to be a gap in the literature concerning the role of family history in the risk of developing diabetes among Ghanaians. Moreover, it remains unclear whether this association is modified by gender or disease phenotype, such as age at onset and duration. Understanding these relationships is crucial for designing tailored, evidence-based prevention and intervention strategies.

This study aimed to examine the association between family history and type of diabetes among individuals living with diabetes in Ghana while also exploring gender differences in the prevalence and awareness of the disease. The findings are expected to enhance understanding of genetic susceptibility and support targeted public health policies in Ghana and similar contexts.

METHODOLOGY

Study Design and Setting

This study employed a cross-sectional survey design, which is effective for examining relationships between variables at a single point in time [12]. The research was conducted in Ghana across various diabetes clinics and public hospitals to ensure a diverse representation of individuals living with diabetes. Data were collected from Holy Child Hospital, St. Martin de Porres Hospital, Father Allan Rooney Memorial Hospital, Ave Maria Clinic, Jubilee Catholic Hospital, and several community diabetic clinics in Ghana. These sites were purposefully selected to capture a broad demographic and geographic distribution of the diabetic population within the country.

Sample Size and Sampling Technique

A total of 1,000 participants were selected using stratified random sampling to ensure adequate representation across gender and urban/rural residence. Eligibility criteria included:

- Participants had to be aged 18 years or older.
- Participants had to have a confirmed diagnosis of diabetes (Type 1 or Type 2).
- Participants had to be able to provide informed consent.
- Participants were asked about their family history of diabetes to assess potential genetic predisposition.

Data Collection

A closed-ended questionnaire was used to gather the demographic details of the participants: age, gender, place of residence, self-reported or medically confirmed diabetes status, family history of diabetes and characteristics of the disease (age of onset and duration of diabetes). Data collection was done by face-to-face interviews supplemented by medical record reviews.

Statistical Analysis

A chi-square test of independence was conducted to examine the relationship between family history of diabetes and type of diabetes, as this test is appropriate for assessing associations between categorical variables [13]. Additionally, an independent two-sample t-test was used to analyze differences in age and the duration of diabetes with respect to family history of diabetes. This test helps determine whether significant differences exist between two independent groups [13]. Descriptive statistics, including frequencies, means, and standard

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deviations, were used to summarize the demographic and clinical characteristics of the sample.

Ethical considerations

The study was fully compliant with the Declaration of Helsinki [14]. Prior to data collection, ethical approval was obtained. Participants were required to provide informed consent, which guaranteed confidentiality and anonymity, a fundamental right of participants [15]. No identifying details were collected from participants, who could voluntarily withdraw from the study at any point, without facing any consequences, thereby ensuring alignment with ethical research standards.

RESULTS

Table 1: Demographic and Clinical Characteristics of Participants

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	460	46.0%
	Female	540	54.0%
Type of Diabetes	Type 1	180	18.0%
	Type 2	820	82.0%
Family History of Diabetes	Yes	580	58.0%
	No	420	42.0%
Place of Residence	Urban	610	61.0%
	Rural	390	39.0%

Among the 1,000 participants, a slightly higher proportion were female (54%). A vast majority (82%) were diagnosed with Type 2 diabetes, aligning with global trends in adult populations. Notably, 58% of the sample reported a family history of diabetes, reinforcing its potential genetic linkage. Urban residents made up 61% of the sample, which may reflect both lifestyle-related risk and better access to diagnostic services in urban areas.

Table 2: Association Between Family History and Type of Diabetes (Chi-Square Test)

Family History	Type 1 Diabetes (n)	Type 2 Diabetes (n)	Total (n)
Yes	45	535	580
No	135	285	420
Total	180	820	1000

- Chi-square value (χ^2) = 112.3
- p-value = < 0.001

A statistically significant association was observed between family history of diabetes and diabetes type (χ^2 = 112.3, p < 0.001). Among those with a family history, 92.2% had Type 2 diabetes, while a higher proportion of Type 1 cases were found among those without a family history (32.1%). This supports existing evidence that Type 2 diabetes has stronger familial clustering and genetic predisposition.

Table 3: Differences in Age and Duration of Diabetes by Family History (Independent Samples t-Test)

Variable	Family History	Mean (M)	Standard Deviation (SD)	t-value	p-value
Age (years)	Yes	54.2	11.5	-4.32	< 0.001
	No	57.8	12.1		
Duration of Diabetes	Yes	6.8 years	4.0	3.57	< 0.001
	No	5.5 years	3.6		

Participants with a family history of diabetes were significantly younger on average than those without (M = 54.2 vs. 57.8 years, p < 0.001). This suggests earlier onset in genetically predisposed individuals. Additionally, the duration of diabetes was significantly longer in those with a family history (M = 6.8 vs. 5.5 years, p < 0.001), likely reflecting earlier diagnosis due to heightened awareness or earlier symptom recognition within families.

Table 4: Gender Differences in Diabetes Characteristics

Gender	Mean Age (years)	Mean Duration (years)	% with Family History
Male	56.5	5.8	52.6%
Female	55.4	6.2	62.4%

While there were no significant differences in mean age or diabetes duration by gender, a higher

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proportion of females reported a family history of diabetes (62.4%) compared to males (52.6%). This may suggest greater health awareness or stronger familial risk tracking among women, which aligns with prior research highlighting gendered differences in health perception and reporting.

DISCUSSION

This research focused on the effects of family history, gender, and other demographic factors on the type of diabetes and its pattern among people in Ghana. The results confirm the hypothesis that diabetes, and especially Type 2 diabetes, is influenced by genetic predisposition in the form of family history.

The link between family history and diabetes type had some level of statistical significance, as those with a family history were found to have a higher likelihood of being diagnosed with Type 2 diabetes. This corroborates past research asserting the high heritability of Type 2 diabetes among blood relatives – at least one of the parents will have undiagnosed Type 2 diabetes [2]. This phenomenon of familial clustering might be explained by shared genetic factors as well as environmental factors such as diet, lifestyle, and health behavior within the family.

Remarkably, people with a family history of diabetes not only had a greater risk of developing Type 2 diabetes but also did so at a younger age and had a longer disease duration. These results echo existing international studies that suggest genetic predisposition may lead to an earlier onset of diabetes because there is likely an impaired threshold for recognition of symptoms needing medical care within families that are informed about the condition [16-18].

Analyses by gender showed that females were comparatively more likely to have a family history of diabetes than males. This may be illustrative of differences regarding the threshold of actual disease within the family even though genetic risk is not sex specific. Women tend to be primary carers actively involved in managing the health of the family, which could account for this finding [19-23]. The proportion of women with diabetes in this sample may be indicative of relatively greater diagnostic health-seeking behavior or more proactive health behaviors among women.

In addition, the fact that 61% of people with diabetes live in urban areas marks another stage in the epidemiological transition within Ghana: urbanization coupled with increased consumption of unhealthy foods, decrease in physical activities, and heightened stress, all potent risk factors for Type 2 diabetes [2]. These effects may be compounded by inherited susceptibility to the condition, thereby hastening the onset of the disease.

There is an urgent need to incorporate family history assessments into routine diabetes screening, particularly at the primary healthcare level. National diabetes prevention and education programs should prioritize individuals with known familial risk by offering targeted interventions, including structured lifestyle modification plans and continuous monitoring. Gender-responsive strategies must also be developed, recognizing women's central role in household health to maximize outreach and effectiveness.

However, this study is not without limitations. The cross-sectional design restricts the ability to establish causality between family history and diabetes type. Self-reported family history data may also be subject to recall bias, particularly in cases where relatives were undiagnosed or unaware of their condition. Additionally, the study sample may not fully capture the rural population or regional variations across Ghana, which could influence generalizability.

Despite these limitations, the study contributes valuable insights into the role of heredity in diabetes and highlights the need for genetically informed, culturally sensitive public health strategies to combat the growing burden of diabetes.

CONCLUSION

This research illustrates that familial history is a marked predictor for Type 2 diabetes in Ghana, related to earlier age of onset and longer duration of disease. It also describes the urban-rural gap and other gender differences in possession of disease knowledge versus prevalence of disease. Such insight demands attention to culturally appropriate public health frameworks that integrate foundational-level genomic risk evaluations, particularly in family medicine.

Considering the increasing prevalence of diabetes in Ghana and the rest of sub-Saharan Africa, early identification of individuals with genetic predisposition can enhance the prevention and management efforts. The region will benefit from

enhanced integration of family history into diabetes screening protocols, increased public education, and development of more health promotion programs that factor in gender disparities.

Conflict of interest

The authors declare that no conflict of interest.

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