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Association Between Diabetes Type and Family History of Diabetes: A Cross-Sectional Analysis of Gender Differences and Genetic Influences

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Abstract

Introduction: *Diabetes mellitus (DM) is one of the fastest-growing chronic metabolic disorders in the world, with high impact and burden in low- and middle-income countries. Although genetic predisposition is a central determinant of diabetes risk, particularly for Type 2 diabetes (T2D), the contribution of familial aggregation varies across populations. In many parts of the world where diabetes is rising very fast, understanding the relationship between diabetes type and family history can guide appropriate prevention and interventions.* ***Methods:*** *A total of 1,500 cases of diabetes were included in this cross-sectional study, recruited from hospitals and diabetes care centers in Northern India. Participants of different age groups, male and female genders, and socio-economic backgrounds were effectively acquired from stratified random sampling. Structured questionnaire was used for collection of data which included demographic data, duration of diabetes and family history of diabetes. Type 633-80 test and 1254-80 model 167-203 family history was analyzed using a Chi-square test of independence to assess the association between diabetes.* ***Results:*** *Among the study participants, 44.9% confirmed family history of diabetes in their family while 55.1% were without a family history of diabetes. Type 2 diabetes was more common (45.1%) than Type 1 diabetes (42.2%), with differences between sexes. Statistical analysis using the Chi-square test revealed that family history was significantly associated with diabetes type ($\chi^2 = 92.824$, $df = 2$, $p < 0.001$), where those with a family history was more often classified as having a Type 1 or Type 2 diabetes than those without. Also, 12.7% were not sure what type of diabetes they had, and this uncertainty was more common among females.* ***Take-Home:*** *The data demonstrates a significant genetic component to diabetes risk, underscoring the importance of early screening and preventive efforts in those with a family history of diabetes.* ***Conclusion:*** *Gender differences in diabetes knowledge and diagnostic reflection and pursuit of diagnosis identify the need for gender sensitive health education strategies. Such data can help to inform future genetically informed diabetes prevention programs; future studies should, therefore, consider an interaction between genetic and environmental risk factors.*

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INTRODUCTION

Diabetes is on the ascendency globally. Data from [1] reveals that the number of people living with diabetes rose from 200 million in 1990 to 830 million in 2022. The prevalence of diabetes has been rising more rapidly, especially in low- and middle-income countries as compared to high-income countries. Diabetes mellitus (DM) is a chronic metabolic condition defined by the

presence of persistent hyperglycemia, secondary to defects in insulin secretion, insulin action, or both [2]. Diabetes is mainly divided into T1D and T2D. Type 1 diabetes (T1D) is an autoimmune disease characterized by the destruction of pancreatic beta cells and subsequent insulin deficiency, whereas type 2 diabetes (T2D) involves the development of insulin resistance and relative insulin deficiency [3]. Sorvillo, whose research focused on the genetic basis of diabetes, said the ongoing global rise in diabetes is a key challenge of the 21st century and understanding risk factors, including genetics, is an important part of the solution. Those with a family history of diabetes also have a statistically increased risk of developing the disease [4].

Genetic predisposition to T2D has been extensively researched. Studies have consistently shown a high heritable contribution to the development of T2D [5]. For example, people with a first-degree relative who have been diagnosed with diabetes are at significantly higher risk of developing this disease themselves [6]. Nonetheless, the strength of this association varies according to the type of diabetes and needs further investigation into various populations and ethnic groups.

The growing prevalence of diabetes in India is often linked directly to a mix of genetics and lifestyle issues. There is an alarming rise of diabetes, especially in the northern parts of India as recent studies have shown [7]. Nonetheless, little research has been conducted on the relationship between diabetes type and family history among diagnosed individuals in this area. So, our study would be to evaluate the prevalence of types of diabetes in a cohort of 1500 diagnosed diabetics in North India and to examining the correlation between family history and type of diabetes mellitus. “Future studies will shed more light on the genetic basis of diabetes risk and how risk may differ based on genetic ancestry, which will help tailor the prevention, treatment and screening strategies for certain populations at risk.”

METHODOLOGY

Study Design and Participants

This study used a cross-sectional, quantitative design, which is often used to explore relationships between variables at one point in time [8]. We aimed to investigate the association of diabetes type with family history within the population of diagnosed diabetics. The study initially involved the recruitment of 1,500 diabetics from hospitals and diabetes care centers in North India. A stratified random sampling was employed to ensure that the sample represented a range of age groups, genders, and socioeconomic backgrounds, which enhances the generalizability of the findings to the broader population [9].

Data Collection Instrument

Data collection for this study was done through a structured questionnaire [10]. notes that structured questionnaires are a popular choice for collecting data from participants in a cross-sectional study because it helps provide standardized data across all participants. The questionnaire was composed of three sections:

- *Section A:* Demographic information (age, gender, socioeconomic status, education level).
- *Section B:* Clinical information (diagnosed type of diabetes, length of diagnosis, co-morbidities).
- *Section C:* Family History of Diabetes (diabetes in first-degree and second-degree relatives).

The questionnaire consisted of multiple-choice and Likert-scale items. To ensure content validity of the tool, the instrument was reviewed by endocrinologist and diabetes researchers, which is beneficial for ensuring whether the tool measures the constructs it is intended to measure [11]. Furthermore, the questionnaire was pilot tested to assess its clarity and reliability among 40 diabetic persons based on standard procedures for validating survey instruments [12]. The internal consistency was determined to be high as demonstrated with a Cronbach’s alpha of 0.88 [13].

Ethical Considerations

This study adhered to the principles of the declaration of Helsinki [14]. Ethical approval for this study was provided by the IRB of affiliated institutions and the research followed internationally accepted ethical principles. All participants were required to provide informed consent, ensuring the confidentiality and anonymity of participants, which is considered a basic right of participants [15]. No identifiable information from participants was collected, and subjects maintained the ability to exit the study at any time without penalty, consistent with the best ethical practices of research.

Data Collection Procedure

The data were collected over a six-week period via online and paper-based surveys, a method shown to increase accessibility and response rates [16]. The involvement of healthcare professionals in the distribution of questionnaires has been shown to improve participation in health-related surveys [17] and so were involved in the current study. Trained data collectors also clarified when it was needed and ensured that each participant filled in the forms independently (reducing response set and increasing data quality) [18].

Data Analysis

Data were analyzed using IBM SPSS Statistics (Version 27). Descriptive statistics, including frequencies, percentages, and means, were employed to summarize demographic characteristics and diabetes prevalence (Field, 2013). A Chi-square test of independence was used to examine the association between diabetes type and family history. The Chi-square test is commonly used to assess relationships between categorical variables in cross-sectional research [19]. Statistical significance was set at $p < 0.05$.

RESULTS

The age distribution of respondents reveals a diverse representation across different age groups. The largest proportion of respondents falls within the 46–55 age category, comprising 28.5% (n = 428) of the total sample. This is followed by the 36–45 age group, accounting for 20.1% (n = 301), and the 56 and above category, representing 21.6% (n = 324). Younger respondents are comparatively fewer, with 26–35-year-olds making up 16.9% (n = 254) and those aged 18–25 comprising the smallest proportion at 12.9% (n = 193). The cumulative distribution indicates that nearly half (49.9%) of the respondents are aged 45 or below, while a significant 50.1% are 46 and above. These findings suggest that the study captures a well-balanced age range, with a relatively higher representation of middle-aged and older adults (Table 1).

Table 1. Age distribution of respondents.

		Frequency	Percent	Cumulative Percent
Valid	18–25	193	12.9	12.9
	26–35	254	16.9	29.8
	36–45	301	20.1	49.9
	46–55	428	28.5	78.4
	56 and above	324	21.6	100.0
	Total	1500	100.0	

In terms of gender distribution, females constitute the largest proportion of respondents at 45.5% (n = 682), followed closely by males, who make up 39.9% (n = 599). A notable 14.6% (n = 219) of respondents identify as “other,” reflecting a significant representation of gender diversity. The cumulative percentages indicate that 85.4% of the respondents identify as either male or female, while the remaining portion belongs to the “other” category. This gender distribution suggests inclusivity in the study, ensuring that diverse gender identities are represented (Table 2).

Table 2. Gender distribution of respondents.

Valid	Frequency	Percent	Cumulative Percent
Male	599	39.9	39.9
Female	682	45.5	85.4
Other	219	14.6	100.0
Total	1500	100.0	

Regarding the place of residence, the sample is relatively balanced between urban and rural respondents. A slightly larger proportion, 52.8% (n = 792), reside in urban areas, whereas 47.2% (n = 708) are from rural areas. This near-equal representation ensures that perspectives from both rural and urban dwellers are adequately captured. The findings suggest that the study does not disproportionately favor one geographic setting, allowing for a comprehensive understanding of potential regional differences in responses (Table 3).

Table 3. Place of residence.

Valid	Frequency	Percent	Cumulative Percent
Rural	708	47.2	47.2
Urban	792	52.8	100.0
Total	1500	100.0	

The distribution of diabetes type among respondents based on gender highlights key patterns in diabetes prevalence and awareness. Among males, Type 2 diabetes is the most prevalent, affecting 48.2% (n = 289) of the respondents, followed closely by Type 1 diabetes at 40.9% (n = 245). A smaller proportion, 10.9% (n = 65), reported being unsure about their diabetes type. The cumulative percentage shows that nearly 90% of male respondents are aware of their diabetes type, while a small but notable group remains uncertain.

Among females, Type 2 diabetes is also slightly more common, accounting for 41.3% (n = 282), compared to Type 1 diabetes at 40.5% (n = 276). However, the proportion of females unsure about their diabetes type (18.2%, n = 124) is notably higher than that of males. This suggests a greater degree of uncertainty or potential gaps in diagnosis or awareness among female respondents.

In the “other” gender category, Type 1 diabetes is the most prevalent, affecting 51.1% (n = 112) of respondents, while Type 2 diabetes is slightly less common at 48.4% (n = 106). Only 0.5% (n = 1) of respondents in this category reported being unsure about their diabetes type. This indicates a higher level of certainty about diabetes classification among this group compared to males and females (Table 4).

The crosstabulation analysis of family history of diabetes provides insights into potential hereditary influences and awareness levels among respondents. Out of the total 1,500 respondents, 44.9% (n = 448) reported having Type 1 or Type 2 diabetes without uncertainty regarding their diagnosis. Among these, 213 individuals have Type 1 diabetes, while 235 have Type 2 diabetes. Notably, none in this category reported uncertainty about their diabetes type, indicating a higher level of awareness and possibly a stronger link to a confirmed family history of diabetes.

On the other hand, a larger proportion of respondents (70.1%, n = 1,052) reported having diabetes with some level of uncertainty. Within this group, 420 individuals identified as having Type 1 diabetes, and 442 as having Type 2 diabetes. However, 190 individuals in this category were unsure of their diabetes type, suggesting that a significant number of people with a family history of diabetes may lack proper awareness or confirmation of their diagnosis.

Table 4. Gender variations in diabetes type.

What Type of Diabetes Do You Have?						
Gender			***Frequency***	***Percent***	***Valid Percent***	***Cumulative Percent***
Male	Valid	Type 1	245	40.9	40.9	40.9
		Type 2	289	48.2	48.2	89.1
		Not Sure	65	10.9	10.9	100.0
		Total	599	100.0	100.0	
Female	Valid	Type 1	276	40.5	40.5	40.5
		Type 2	282	41.3	41.3	81.8
		Not Sure	124	18.2	18.2	100.0
		Total	682	100.0	100.0	
Other	Valid	Type 1	112	51.1	51.1	51.1
		Type 2	106	48.4	48.4	99.5
		Not Sure	1	.5	.5	100.0
		Total	219	100.0	100.0	

Overall, the total distribution of respondents shows that Type 2 diabetes is slightly more prevalent (n = 677) than Type 1 diabetes (n = 633). Additionally, a notable 190 respondents remain uncertain about their diabetes type. These findings underscore the potential hereditary link to diabetes while also highlighting gaps in diabetes awareness and diagnosis. The presence of uncertainty among a substantial number of respondents suggests a need for targeted education and screening programs, particularly for those with a known family history of diabetes (Table 5).

Table 5. Family history of diabetes.

Do You Have a Family History of Diabetes? * What Type of Diabetes Do You Have? Crosstabulation					
Count					
		What Type of Diabetes Do You Have?			**Total**
		Type 1	***Type 2***	***Not Sure***	
Do you have a family history of diabetes?	Yes	213	235	0	448
	No	420	442	190	1052
Total		633	677	190	1500

A Chi-Square analysis was performed to examine the association between family history of diabetes and the type of diabetes a respondent has. The results indicate a statistically significant relationship, as evidenced by the Pearson Chi-Square value of 92.824 (df = 2, p = .000). The likelihood ratio test further supports this association with a value of 146.416 (p = .000), while the linear-by-linear association test (44.878, p = .000) suggests a significant trend in the relationship.

Since the p-values for all the tests are below the conventional threshold of .05, the null hypothesis – stating that there is no association between family history and diabetes type – is rejected. This confirms that individuals with a family history of diabetes are significantly more likely to be diagnosed with either Type 1 or Type 2 diabetes, reinforcing the hereditary component of the disease.

Additionally, the validity of the Chi-square test is confirmed by the fact that no expected cell count is less than 5, with the minimum expected count being 56.75. This ensures that the observed association is not due to chance. When interpreted alongside the crosstabulation results, these findings highlight the importance of genetic predisposition in diabetes while also underscoring the need for increased awareness and early screening for individuals with a known family history of the condition (Table 6).

Table 6. Chi-square analysis of the association between family history and diabetes type.

Chi-Square Tests			
	Value	**df**	**Asymp. Sig. (2-Sided)**
Pearson Chi-Square	92.824[a]	2	.000
Likelihood Ratio	146.416	2	.000
Linear-by-Linear Association	44.878	1	.000
N of Valid Cases	1500		

Note: a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 56.75.

DISCUSSION

Demographic Characteristics of Respondents

The demographic analysis highlights key patterns in age, gender, place of residence, and diabetes among respondents. The majority belong to the 46–55 age group (28.5%) and 56+ category (21.6%), indicating a higher representation of middle-aged and older adults. Gender distribution shows that females (45.5%) slightly outnumber males (39.9%), while 14.6% identify as "other," ensuring gender diversity. A near-equal urban (52.8%) and rural (47.2%) representation allow for a balanced analysis of geographic differences.

Diabetes type distribution varies across genders. Type 2 diabetes is the most prevalent among males (48.2%) and females (41.3%), whereas Type 1 diabetes is slightly higher among those identifying as "other" (51.1%). Notably, 18.2% of females are unsure of their diabetes type, compared to 10.9% of males and only 0.5% in the "other" category, suggesting potential gaps in awareness or diagnosis. Overall, the study captures a diverse and inclusive sample, with findings emphasizing age-related diabetes trends, gender disparities in awareness, and a well-balanced urban-rural distribution, providing a strong foundation for further analysis of diabetes management and healthcare access.

ASSOCIATION BETWEEN DIABETES TYPE AND FAMILY HISTORY OF DIABETES

With clear variations between gender groups, the results of this study underline the important correlation between diabetes type and family history of diabetes. The Chi-square study validates this link by showing a statistically significant association ($\varphi^2 = 92.824$, df = 2, p =.000), therefore, indicating that those with a family history of diabetes are more likely to acquire either Type 1 or Type 2 diabetes. This is consistent with earlier studies stressing the hereditary character of diabetes, in which illness starts is much influenced by genetic sensitivity [20]. Across all respondents, the crosstabulation results show that Type 2 diabetes (n = 677) is rather more common than Type 1 diabetes (n = 633). Still, a sizable fraction of respondents (n = 190) was unsure about their type of diabetes; this ambiguity is more noticeable among individuals with a family history of diabetes. This implies that even if genetic predisposition affects diabetes risk, awareness and diagnosis remain lacking, especially in populations with a family history of the condition. Studies have indicated that environmental and lifestyle factors including food, physical activity, and stress can change the risk of diabetes [5, 21] even in cases of a significant hereditary relationship. Additionally, noted were variations in diabetes awareness and frequency based on gender. With just 10.9% of men indicating doubt on their diabetes type, Type 2 diabetes was more common (48.2%) than Type 1 diabetes (40.9%). By comparison, among women Type 2 diabetes was marginally more common (41.3%) than Type 1 diabetes (40.5%), but a larger proportion (18.2%) were unclear of their diagnosis. Previous research has shown that women are often identified later than men due to variations in symptom presentation and healthcare-seeking behavior, so this pattern suggests possible discrepancies in diabetes education and screening [22]. Since the lack of expected cell counts below 5 (minimum expected count = 56.75) strengthens the validity of the statistical results, the Chi-square analysis supports even more the robustness of these results. Furthermore, pointing to a consistent trend connecting family history with diabetes type are the significant likelihood ratio (146.416, p =.000) and linear-by-linear relationship (44.878, p =.000). Previous studies have shown that people with first-degree relatives who have diabetes are more likely to acquire the disorder, especially in relation to obesity and metabolic risk factors [23].

Public health consequences of these results are important. The great correlation between diabetes type and family history emphasizes the need for early genetic screening and focused preventive programs. Those with a known family history of diabetes should be urged to follow better lifestyles, have regular screening, and get customized health education to lower modifiable risk factors. Furthermore, the noted gender variations imply that initiatives for diabetes prevention and awareness should be created using gender-sensitive strategies to guarantee efficient communication and early diagnosis.

CONCLUSIONS

Finally, this research emphasizes the need for better awareness and preventive actions as it confirms the hereditary influence on diabetes type. Although gaps in diagnosis and gender-based variations must be addressed, the strong correlation between family history and diabetes type indicates that genetic predisposition is quite important. Future studies should investigate how environmental and genetic elements combine to create more all-encompassing diabetes preventive plans.

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