MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.8.160.164

Comparative Analysis of Hypertension Prevalence among Type 1 and Type 2 Diabetes Patients: A Cross-Sectional Study

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ABSTRACT
Diabetes, categorized into Type 1 and 2, has varying complications. This study explores its relationship with hypertension prevalence. To explore the relationship between diabetes type and hypertension prevalence among 100 diabetes patients (50 with type 1 diabetes and 50 with type 2 diabetes). The study also investigated blood pressure levels and the control of hypertension within these patient groups. Demographic data, hypertension prevalence, and blood pressure measurements were collected for both type 1 and 2 diabetes patients. Statistical analyses were performed to determine significant differences between the groups. Demographic characteristics: Type 1 diabetes patients were notably younger, with an average age of 34.2 years, compared to Type 2 diabetes patients, whose average age was 58.5 years. Gender distribution was balanced, with 52% male and 48% female participants in each group. Hypertension Prevalence: A substantial difference in hypertension prevalence was observed between the two groups. Among type 1 diabetes patients, 56% had hypertension, while among type 2 diabetes patients, 84% were hypertensive. The difference was statistically significant ($p<0.001$), indicating a higher likelihood of hypertension in type 2 diabetes patients. Blood Pressure Levels: Type 2 diabetes patients exhibited significantly higher mean systolic blood pressure (148.9 mmHg) and diastolic blood pressure (84.7 mmHg) compared to Type 1 diabetes patients. Both systolic and diastolic blood pressure levels were significantly elevated in type 2 diabetes patients ($p<0.001$). Control of hypertension: In type 1 diabetes patients with hypertension, 50% had their blood pressure under control (BP <140/90 mmHg). Among type 2 diabetes patients with hypertension, 42% achieved blood pressure control, a difference that was not statistically significant. This study highlights a higher prevalence of hypertension and elevated blood pressure levels in type 2 diabetes patients compared to Type 1 diabetes patients. Although, hypertension control rates were suboptimal in both groups, the findings emphasize the importance of effective hypertension management strategies, particularly for type 2 diabetes patients. Further research with larger cohorts and longitudinal designs is warranted to

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Key Words
Diabetes type 1, diabetes type 2, hypertension, blood pressure, prevalence

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Received: 31 May 2023
Accepted: 27 July 2023
Published: 31 July 2023

Citation: S.V. Keshavanath, B.A. Sai Kishore and Kanukurthi Deepika, 2023. Comparative Analysis of Hypertension Prevalence among Type 1 and Type 2 Diabetes Patients: A Cross-Sectional Study. Res. J. Med. Sci., 17: 160-164, doi: 10.59218/makrjms.2023.8.160.164

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels, poses a significant global health challenge[1]. It is classified into different types, with Type 1 and 2 diabetes being the most prevalent forms[2]. Beyond the immediate concerns related to glucose control, diabetes is associated with a range of complications that can affect various organ systems. One of the commonly observed comorbidities in diabetes is hypertension, a condition characterized by elevated blood pressure levels[3]. This comorbidity not only complicates the management of diabetes but also increases the risk of cardiovascular events and other complications[4]. This study undertakes a comparative analysis to explore the prevalence of hypertension among type 1 and 2 diabetes patients, shedding light on potential differences that could influence clinical care and public health strategies.

Diabetes types and their distinctions: Diabetes mellitus encompasses a group of disorders characterized by elevated blood glucose levels resulting from defects in insulin production, action, or both[5]. Type 1 diabetes, often diagnosed in childhood or adolescence, is characterized by autoimmune destruction of the insulin-producing beta cells in the pancreas, leading to absolute insulin deficiency[6]. In contrast, Type 2 diabetes typically develops in adulthood and involves insulin resistance and relative insulin deficiency, often associated with lifestyle and genetic factors[7]. These fundamental distinctions in pathophysiology have implications for the management and complications associated with each diabetes type.

Hypertension as a common comorbidity: Hypertension, or high blood pressure, is a widespread health concern globally. It is a major risk factor for cardiovascular diseases, including heart attacks, strokes and kidney diseases[8]. Importantly, hypertension frequently coexists with diabetes, exacerbating the risk of cardiovascular complications and worsening the prognosis for affected individuals[9]. The presence of hypertension in diabetes patients is associated with an increased risk of microvascular and macrovascular complications, including nephropathy, retinopathy, and cardiovascular events[10]. Therefore, understanding the prevalence of hypertension in different diabetes types is essential for tailored patient care and the development of effective preventive strategies.

Rationale for comparative analysis: While the association between diabetes and hypertension is well-established, there is a paucity of research that specifically compares the prevalence of hypertension between type 1 and 2 diabetes patients within a single study cohort. Such a comparative analysis can provide insights into potential differences in the risk and burden of hypertension across these diabetes types, considering variations in age of onset, genetic factors, and metabolic profiles. Understanding these differences is crucial for healthcare providers to offer personalized care and interventions based on diabetes type.

Aim and objectives: The primary aim of this cross-sectional study is to compare the prevalence of hypertension among Type 1 and Type 2 diabetes patients within a sample of 100 participants. To achieve this aim, the study will pursue the following specific objectives:

- To assess and compare the demographic characteristics, including age and gender distribution, of Type 1 and 2 diabetes patients in the study cohort
- To determine and compare the prevalence of hypertension in Type 1 and 2 diabetes patients within the same cohort
- To examine and compare blood pressure levels, both systolic and diastolic, between Type 1 and 2 diabetes patients
- To evaluate the control of hypertension among Type 1 and 2 diabetes patients with hypertension, assessing the proportion of patients achieving recommended blood pressure targets

MATERIALS AND METHODS

Study design: This research adopts a cross-sectional observational study design to investigate and compare the prevalence of hypertension among two distinct groups of diabetes patients: those with Type 1 diabetes and those with Type 2 diabetes. Data collection for this study took place from January 2022 to December 2022.

Study setting: The study was conducted at Government Medical College, Mahabubnagar, situated in Telangana, India. Data collection occurred within the premises of this medical institution, including its affiliated healthcare facilities.

Sampling population: The study's sampling population comprised adult diabetes patients aged 18 years and above, who had been medically diagnosed with either Type 1 or 2 diabetes.

Sample size calculation: To ensure statistical power and significance, the study selected a sample size of 100 participants. This sample size was evenly divided into two groups: 50 individuals with Type 1 diabetes

and 50 with Type 2 diabetes. The determination of the sample size was based on estimations of the prevalence of diabetes and hypertension within the local population.

Recruitment of participants: Participants were recruited based on specific inclusion and exclusion criteria to ensure the study's relevance and validity.

Inclusion criteria:

- Participants had to be adults aged 18 years and older
- Participants were required to possess a confirmed diagnosis of either Type 1 or 2 diabetes
- Willingness to participate in the study was mandatory

Exclusion criteria:

- Individuals with secondary hypertension were excluded from the study
- Pregnant women were not included
- Participants with severe comorbidities or cognitive impairments were also excluded

Data collection: Data was collected using a combination of methods, including a review of medical records and structured interviews.

Data collection tools: Relevant information was gathered through the review of medical records, which included details such as diabetes type, age, and comorbid conditions for each participant.

Structured interviews were conducted with participants to collect additional data, including information about their gender and medication history.

Measurements: The study employed specific measurements and criteria for hypertension assessment:

Blood pressure measurements: Systolic and diastolic blood pressure measurements were obtained using a calibrated sphygmomanometer. These measurements followed standardized procedures to ensure accuracy and consistency.

Hypertension definition: Hypertension was defined as systolic blood pressure (SBP) $\geq$140 mmHg and/or diastolic blood pressure (DBP) $\geq$90 mmHg on two separate occasions or the current use of antihypertensive medication.

Data analysis: The collected data underwent rigorous statistical analysis to fulfill the study's objectives. The following statistical methods were employed:

Statistical analysis: Descriptive statistics were utilized to summarize demographic characteristics, hypertension prevalence and blood pressure levels within the Type 1 and 2 diabetes patient groups.

The chi-square test was used for comparing categorical variables, while t-tests were employed for comparing continuous variables. A significance level of $p<0.05$ was applied to determine statistically significant differences.

Ethical considerations: The study adhered to ethical principles and standards to safeguard the rights and well-being of participants.

Ethical approval: Ethical clearance for the study was obtained from the Institutional Ethics Committee at Government Medical College, Mahabubnagar, Telangana, India ensuring compliance with ethical guidelines and principles.

Informed consent: Informed consent was sought from all prospective study participants before data collection. This process ensured that participants voluntarily agreed to participate in the study and their information remained confidential.

RESULTS

Demographic characteristics of type 1 and 2 diabetes patients: The average age of Type 1 diabetes patients was 34.2 years (SD = 7.8), indicating that the Type 1 diabetes group consisted of relatively younger individuals. In contrast, the average age of Type 2 diabetes patients was 58.5 years (SD = 10.2), indicating that the Type 2 diabetes group included older individuals.

The gender distribution was similar in both groups, with 52% male and 48% female participants in each group. This gender balance suggests that gender was not a confounding factor in the analysis (Table 1).

Hypertension prevalence among type 1 and 2 diabetes patients: Among Type 1 diabetes patients, 28 out of 50 (56%) had hypertension. This means that more than half of the Type 1 diabetes patients in the sample also had high blood pressure.

Among Type 2 diabetes patients, 42 out of 50 (84%) had hypertension. In the Type 2 diabetes group, a significantly higher proportion had hypertension compared to the Type 1 diabetes group.

The difference in hypertension prevalence between the two groups was statistically significant ($p<0.001$). This indicates that Type 2 diabetes patients were more likely to have hypertension compared to Type 1 diabetes patients within this sample (Table 2).

Table 1: Demographic characteristics of type 1 and 2 diabetes patients

Characteristic	Type 1 diabetes (n = 50)	Type 2 diabetes (n = 50)
Average age (years)	34.2 (SD = 7.8)	58.5 (SD = 10.2)
Gender distribution (male/female)	26 (52%)/24 (48%)	26 (52%)/24 (48%)

Table 2: Hypertension prevalence among type 1 and 2 diabetes patients

Hypertension prevalence	Type 1 diabetes (n = 50)	Type 2 diabetes (n = 50)
Number with hypertension	28 (56%)	42 (84%)
Statistical significance (p)	p<0.001	p<0.001

Table 3: Blood pressure levels (systolic and diastolic) in type 1 and 2 diabetes patients

Blood pressure levels (mmHg)	Type 1 diabetes (n = 50)	Type 2 diabetes (n = 50)
Mean SBP	130.5 (SD = 12.3)	148.9 (SD = 15.7)
Mean DBP	78.4 (SD = 8.5)	84.7 (SD = 9.8)
Statistical significance (p)	p<0.001	p<0.001

Table 4: Control of hypertension among type 1 and type 2 diabetes patients with hypertension

Control of Hypertension	Type 1 diabetes with hypertension (n = 28)	Type 2 diabetes with hypertension (n = 42)
Number with BP <140/90 mmHg	14 (50%)	18 (42%)

Blood pressure levels (systolic and diastolic) in type 1 and type 2 diabetes patients: The mean systolic blood pressure (SBP) among Type 1 diabetes patients was 130.5 mmHg (SD = 12.3). This indicates the average SBP for Type 1 diabetes patients.

The mean SBP among Type 2 diabetes patients was 148.9 mmHg (SD = 15.7). Type 2 diabetes patients had significantly higher average SBP levels compared to Type 1 diabetes patients.

The mean diastolic blood pressure (DBP) among Type 1 diabetes patients was 78.4 mmHg (SD = 8.5), while the mean DBP among Type 2 diabetes patients was 84.7 mmHg (SD = 9.8). Both SBP and DBP were significantly higher in Type 2 diabetes patients compared to Type 1 diabetes patients ($p<0.001$). These findings indicate that Type 2 diabetes patients tended to have higher blood pressure levels, both systolic and diastolic, on average (Table 3).

Control of Hypertension among Type 1 and 2 Diabetes Patients with Hypertension: Among Type 1 diabetes patients with hypertension, 14 out of 28 (50%) had their blood pressure under control (BP <140/90 mmHg). This suggests that half of the Type 1 diabetes patients with hypertension had their blood pressure adequately managed.

Among Type 2 diabetes patients with hypertension, 18 out of 42 (42%) had their blood pressure under control. In the Type 2 diabetes group, a slightly lower percentage had their blood pressure under control compared to Type 1 diabetes patients, but the difference was not statistically significant (Table 4).

DISCUSSIONS

The findings of our cross-sectional observational study, which compared the prevalence of hypertension among Type 1 and 2 diabetes patients at Government Medical College, Mahabubnagar, Telangana, India, during January 2022 to December 2022, align with and expand upon existing research. In this discussion, we contextualize our results by referencing key studies in the field.

Hypertension prevalence: Our study identified a substantial difference in hypertension prevalence between Type 1 and 2 diabetes patients. Type 2 diabetes patients exhibited a significantly higher prevalence of hypertension (84%) than Type 1 diabetes patients (56%). These findings resonate with Colosia *et al*.[7] systematic literature review and Berraho *et al*.[11] cross-sectional study in Morocco both of which reported a higher prevalence of hypertension in Type 2 diabetes patients. This consistency across studies underscores the robust association between Type 2 diabetes and hypertension, which can be attributed to factors like insulin resistance and obesity.

Blood pressure levels: Our study further delved into blood pressure levels, revealing that Type 2 diabetes patients had significantly higher mean systolic and diastolic blood pressure values compared to their Type 1 counterparts. This aligns with the observations made by Cryer *et al*.[8], who in their comparative review of guidelines, emphasized the higher cardiovascular risk associated with hypertension in Type 2 diabetes patients. Additionally, Gress *et al*.[10] Atherosclerosis Risk in Communities Study indicated a link between hypertension and the development of Type 2 diabetes, suggesting a bidirectional relationship between these conditions.

Control of hypertension: Our study explored the control of hypertension within both Type 1 and 2 diabetes groups. Interestingly, while a slightly higher percentage of Type 1 diabetes patients achieved blood pressure control (50%) compared to Type 2 diabetes patients (42%), this difference was not statistically significant. This finding echoes the results of Conen *et al*.[12] study within the Women's Health Study cohort, highlighting the challenges in achieving blood pressure control among Type 2 diabetes patients[13]. This underscores the importance of tailored and multifaceted hypertension management approaches for this population.

Clinical implications: The implications of our study align with the broader literature[14,15]. Given the higher prevalence and more pronounced impact of hypertension in Type 2 diabetes, healthcare providers must prioritize proactive blood pressure monitoring and management in this population. Regular blood pressure assessments should be integrated into routine diabetes care to mitigate the heightened cardiovascular risk associated with Type 2 diabetes.

LIMITATIONS OF STUDY

Our study shares limitations with the existing body of research in this area. Its cross-sectional design precludes the establishment of causal relationships between diabetes type and hypertension. Future longitudinal studies could provide further insights into the temporal aspects of this association. Additionally, the relatively small sample size and the focus on a specific geographic region may limit the generalizability of our findings, emphasizing the need for larger and more diverse cohorts in future research.

CONCLUSION

Our study reaffirms the well-documented association between Type 2 diabetes and hypertension while highlighting the complexity of hypertension management within diabetes populations. These findings underscore the necessity for personalized and targeted interventions to effectively address the co-occurrence of these chronic conditions and reduce the associated cardiovascular risk. Future research should continue to explore these associations in diverse populations and consider the long-term implications for cardiovascular health in diabetes patients.

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