JSTMU Journal of Shifa Tameer-e-Millat University

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ORIGINAL ARTICLE

Exploring the demographic variables, disease burden, and pharmacotherapy in diabetes type II and related co-morbidities: Insights for tailored healthcare strategies

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Author`s Contribution

[1] Designing research tools, analysis
[2] Data collection
[3] Manuscript preparation
[4] Reviewing and Proof Reading
[5] Data collection

Article Info.

Conflict of interest: Nil
Funding Sources: Nil

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Article information

Submission date: 16-09-2024
Acceptance date: 04-12-2024
Publication date: 31-12-2024

Cite this article as *Qureshi A, Shah I, Ain QU, Haider S, Saqib A. exploring the demographic variables, disease burden, and pharmacotherapy in diabetes type II and related co-morbidities: Insights for tailored healthcare strategies. JSTMU. 2024;7(2):175-183.*

A B S T R A C T

Introduction: Type 2 diabetes mellitus is a prevalent metabolic disorder with significant implications for public health, particularly in developing countries. Its management involves a combination of pharmacotherapy and lifestyle modifications. This study aims to explore demographic factors, disease burden, and pharmacotherapy patterns providing insights into current practices and areas for improvement in healthcare delivery.

Methodology: This study investigates the prescribing patterns and indicators of diabetes management in outpatients in Islamabad and Rawalpindi. The study collected recent prescriptions and brief verbal past histories from patients with type 2 diabetes mellitus. Age, gender, HbA1c, blood pressure, blood sugar level, and present complaints of prescribing indicators were analyzed, including the average number of drugs/prescriptions, percentage of drugs prescribed by generic name, percentage of prescriptions with antibiotics or injections, percentage of drugs from Essential Medicine Lists, and average drug cost per prescription.

Results: 64% of females and 36% of males have Diabetes mellitus type 2, positive correlation between blood sugar level, blood pressure, and cholesterol level. The outcome of prescription analysis shows a significant association p=.043 p≤0.05 of blood sugar level for diabetes mellitus 2, Prescription shows pharmacological treatment up to some extent according to the WHO-defined protocols. Furthermore, 35% usage of metformin shows that metformin is prescribed relatively less than second-generation sulfonylurea (preferably gliclazide) metformin.

Conclusion: Preferably, gliclazide is prescribed to patients with inadequately controlled glycemia on metformin when metformin alone fails to control glycemia. These findings provide insights into current practices and highlight areas for potential improvement in diabetes management according to the WHO protocols.

Keywords: *Diabetes mellitus; Healthcare disparities; OHD (Oral hypoglycemic drugs); Therapeutic interventions; Treatment outcomes*

Introduction

Type 2 diabetes is a state that occurs because of a problem in the way the body regulates and uses sugar as a fuel. That sugar is known as glucose. This long-term complaint results in too much sugar mixing in the blood. Ultimately, high blood sugar levels can lead to illnesses of the circulatory, nervous, and immune systems. Diabetes mellitus type 2 mainly creates two problems. The pancreas does not produce enough insulin a hormone that regulates the crusade of sugar into the cells. In addition, cells respond poorly to insulin and take in less sugar. Diabetes

mellitus type 2 used to be identified as adult-onset diabetes, but both type 1 and type 2 diabetes can begin during childhood and adulthood. Type 2 is more common in older adults. However, the increase in the number of children with obesity has led to more cases of type 2 diabetes in younger people.[3]

There is no whole cure for type 2 diabetes. Losing weight, eating well, and exercising can help manage the disease. If diet and exercise are not enough to control blood sugar, diabetes medications or insulin therapy might recommended according to WHO protocol. The regular history of type 2 diabetes is one of advanced beta cell failure that leads to the need to build up a medical regimen over time. This generally means starting with one treatment and adding others as needed to meet glycemic goals. Some treatments can maintain glycemic control for longer than others, and thus have a more promising effect on the natural history of diabetes, likely by successfully altering and improving the fundamental abnormal physiology.[3]

Diabetes mellitus Type 2 is a prevalent chronic condition with significant implications for patient health and healthcare systems globally. Effective diabetes management requires appropriate prescribing practices to optimize patient outcomes while minimizing costs and adverse effects. Understanding prescribing patterns and indicators is crucial for assessing the quality of diabetes care and identifying areas for improvement.[4] It is very important to manage diabetes without insulin until medicines are unable to maintain glucose levels. Ideally, the initial management of NIDDM should be based on dietary therapy combined with increased physical activity, if possible. However, pharmacologic therapy (oral hypoglycemic drugs or insulin) may be considered in the presence of marked hyperglycemia.[5] Therapy targets should be determined and fully discussed with the person with diabetes at the initial phase of management. In addition to achieving an optimal body weight, Table 1 represents targets that may be considered.[6] Oral hypoglycemic drugs (OHD) given only after a schedule of dietary treatment combined with exercise has failed to achieve the therapy targets set.

Table 1: WHO-given range to identify diabetes

Value	Optimal	Acceptable	Poor
Symptoms	**Plasma glucose level in mg/dl (mmol/L)**		
Fasting	80-120 (4.5-6.7)	<160 (9)	>160 (9)
Postprandial	90-145 (5-8)	<180 (10)	>180 (10)
Glycated Hb level (% of upper limit)	<110	<140	>140
Total cholesterol level in mg/dl (mmol/L)	<200 (5.2)	<250 (6.5)	>250 (6.5)
Triglyceride level in mg/dl (mmol/L)	<150 (1.7)	<200 (2.2)	>200 (2.2)
Blood pressure (mm Hg)	<135/85	<140/90	>160/90

There are two key groups of OHD: sulphonylureas (SUs) and biguanides (BGs). SU acts by stimulating insulin release from the beta cells and by helping its action through extra pancreatic mechanisms. BG exerts its action by decreasing gluconeogenesis and by increasing the peripheral utilization of glucose. Several SU arrangements are marketed in countries of the Eastern Mediterranean Region.[7] Selection of a specific SU preparation will depend on factors such as availability, cost, and the physician's experience. However, this group of drugs may be represented by glibenclamide or tolbutamide. SUs can cause hypoglycemia and their use therefore should be closely monitored in the elderly and those with nephropathy.

Tolbutamide is a short-acting SU and may be selected in patients with renal impairment. Glibenclamide may be given in an initial dose of 1.25-2.5 mg, which can be increased up to a maximum daily dose of 15 mg. For tolbutamide, the initial daily dose is 0.5g, which can be increased, if necessary, to 1.5 g in divided doses. Metformin is the only BG preparation now marketed in most Eastern Mediterranean Region countries.[8] Metformin is primarily used in the obese not responding to dietary therapy. The starting dose is 500-850 mg with or after food, once daily, which can increased to 500 mg tds or 850 mg bd.[9] Because of the risk of lactic acidosis, it is contraindicated in:

- Patients with compromised renal function
- People above the age of 70 years

- Patients with heart failure, hepatic impairment, or predisposition to lactic acidosis.

For the same reason, treatment with metformin should discontinued during surgery, severe infections, and illnesses. In parallel, therapeutic modalities ranging from conventional pharmaceuticals to cutting-edge biologics, gene therapies, and digital health interventions are revolutionizing patient care. However, the efficacy, safety, accessibility, and cost-effectiveness of these treatments vary across different demographic groups, necessitating a nuanced understanding of patient profiles to optimize therapeutic decision-making and maximize clinical benefits. In the realm of modern healthcare, the quest for precision and personalized approaches to patient care has never been more pronounced. Central to this pursuit is the intricate interplay between patient demographics, disease dynamics, therapeutic interventions, and clinical outcomes.[10] This study embarks on a journey to dissect and elucidate these multifaceted relationships, aiming to unravel the intricate tapestry of healthcare delivery in the context of diverse patient populations

In the twin cities of Islamabad and Rawalpindi, outpatients constitute a significant proportion of individuals seeking diabetes management. However, limited research focuses on prescribing practices and indicators in this population. This study aims to fill this gap by examining prescriptions and patient histories to evaluate various prescribing indicators related to diabetes management according to the WHO protocol given in the Figure 1 methodology section.

In people with NIDDM (not insulin-dependent diabetes mellitus) indicated in the following situations:

- when diet and oral hypoglycemic drugs fail to control hyperglycemia and achieve therapy targets;
- diabetes during pregnancy when diet alone is inadequate;
- when oral hypoglycemic drugs are contraindicated;
- During stressful conditions such as infection and surgery.[11]

Further guidelines on insulin treatment are included in the section on the management of IDDM. Treatment with insulin is one aspect of management in which adequate education of the patient cannot be overstated. Close support between the patient and his family and members of the health care team is important. Insulin therapy aims at:

- Attaining good metabolic control by imitating physiological insulin secretion as much as possible;
- Minimizing the risk of hypoglycemia.

The factors supporting to initiation of Glycemic Targets (Adapted from the American Diabetes Association) favoring lower glucose targets include low risks of adversarial effects of drugs, newly diagnosed, long life expectancy, no vascular complications, and other comorbidities and vice versa.

Moreover, the landscape of disease prevalence, incidence, and morbidity is in constant flux, shaped by a myriad of factors including genetic predispositions, environmental exposures, lifestyle choices, and social determinants of health. Chronic diseases, infectious outbreaks, and emerging health threats underscore the importance of proactive surveillance, early detection, and targeted interventions to mitigate risks and improve health outcomes on a population scale.[12] Ultimately, the insights gleaned from this study can inform evidence-based clinical practice, public health policies, and research agendas, paving the way for a more equitable, efficient, and patient-centered healthcare system that empowers individuals, improves health outcomes, and enhances population well-being.[13]

Demographic factors such as age, gender, ethnicity, socioeconomic status, and geographic location exert profound influences on health outcomes and healthcare utilization patterns.[14,15] Understanding these demographic nuances is not merely an academic exercise but a prerequisite for designing equitable healthcare policies, interventions, and resource allocations that cater to the diverse needs of individuals and communities. It is very important to control glucose levels to secure human life.[14]

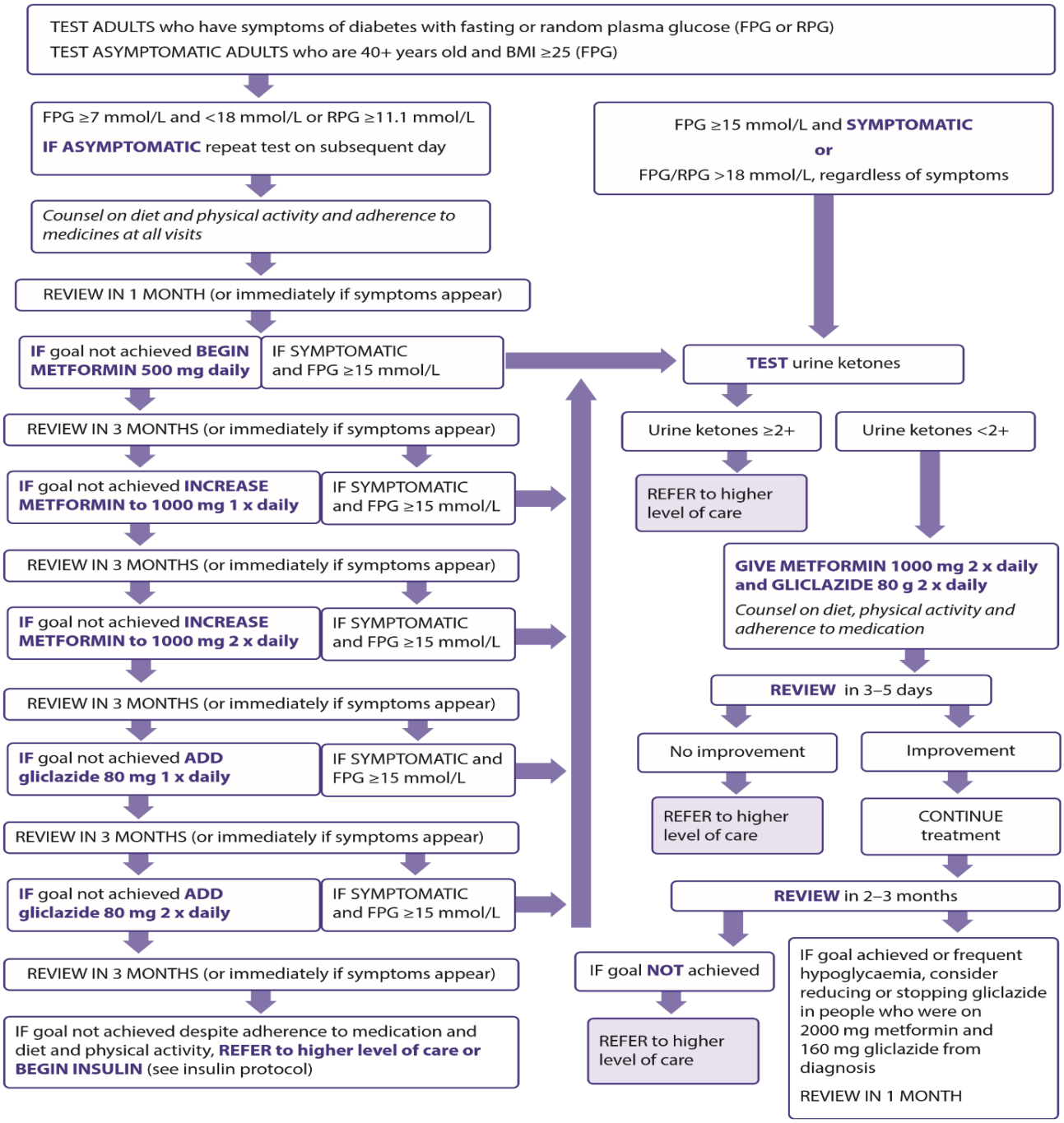

Figure 1: Protocol for control of blood glucose in type 2 diabetes, derived from WHO-PEN 2013

Methodology

This qualitative research was conducted in the outpatient departments of healthcare facilities in Islamabad and Rawalpindi. The study was performed to evaluate prescribing practices and patient histories in depth. This study aims to provide the patterns and rationales behind prescription choices to identify whether WHO core indicators are followed or not for treatment and patient management strategies. Recent prescriptions and brief verbal past histories were collected from patients diagnosed with type 2 diabetes mellitus in different clinical setups in twin cities. Ethical approval was taken from the Institutional Human Committee of the Margalla Institute of Health Sciences, Rawalpindi, Pakistan and Informed consent from Patients also has been taken.

The eligibility criteria include patients above 20 years of age, diagnosed with type 2 diabetes mellitus confirmed by a physician, and patients who reported Hba1c, fasting blood sugar level, and blood pressure. Individuals with physical or intellectual disabilities hindering participation, and have side effects with different DM medications were not included in this study. The prescriptions with missing information like gender, age, and Hba1c were also excluded. The information from the patients who were not provided consent for participation was not part of the current data collection. The following prescribing indicators were analyzed:

1. Demographic aspects like age, gender, and Location.
2. Laboratory findings Highlighted by WHO shared in Table 1, for management of DM 2, such as Blood Pressure, Pulse, and Cholesterol level. Association and correlation among those variables and criteria Range.
3. Prescription patterns with antibiotics prescribed.
4. Percentage of prescriptions with injections prescribed.

Results

We began by examining the demographic information of the patients, focusing on their ages. The mean age of the patients was found to be approximately 52.3 years, with a median age of 50 years. The average age for females was 46.7 and for males was 55.3. The age range spanned from 32 to 80 years, with a standard deviation of approximately 9.8 years, indicating the variability of ages within the patient population. This indicates that the patient population is relatively evenly distributed across different age groups, with no significant skewness towards older or younger individuals. The standard deviation suggests that there is some variability in the age distribution of the patients, with some individuals being relatively younger or older compared to the average age. Table 2 given below shows the demographic of patients. Most patients belong to twin cities. 17 patients out of 56 were from Islamabad and 37 from Rawalpindi 1 from Kahuta and 1 from Kalar Sayedan.

Table 3 shows laboratory findings which reveal that average blood pressure was 160/100 mmHg which predicts most patients with diabetes mellitus 2 have hypertension as well. According to WHO protocol blood pressure greater than 160/100 mmHg is considered a value of risk. One of the Limitations of the FGP (Fasting glucose plasma) record was not present but (the BSR) blood sugar record shows 256 mg/dl on average, which is higher than the normal range. Beta HbA1c minimum 7.4% and maximum 13.2% and on average 11.4% the range for diabetes mellitus is considered at risk greater than 7%. The average Cholesterol level was 240 mg/dl, which was higher and predicted risk. Laboratory findings predict hypertension and diabetes mellitus are interrelated. Although, the temperature of the body is not directly related to Diabetes some patients who participated in the research had fever data showing 100 °F on average. The pulse rate was 93 bpm on average and the minimum was 71 bpm and the maximum was 108 bpm.

The correlation between blood sugar level and cholesterol was .61 positive value of correlation shows that blood sugar level and Cholesterol level positively related to each other increase in one brings an increase in the other and its P≤0.05 shows a statistically significant result of the study. However, the p-value (>0.05) indicates that this correlation is not statistically significant at the conventional level of significance (α = 0.05). Therefore, while there may be a tendency for disease prevalence to increase with age, this relationship is not strong enough to be considered statistically significant based on the available data.

Table 2: Demographic Breakdown of Patient Population

Demographic Variable	Male	Female
Number of Patients	20	36
Age Range (years)	38 - 76	32 – 80
Mean Age (years)	55.3	46.7
Total Mean ± SD	52.3 ± 9.8	
Patient's Region Gender-Wise		
Islamabad	6	11
Rawalpindi	13	24
Others	1	1

Table 3: Laboratory findings and vitals

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Laboratory findings and vitals	Minimum	Maximum	Average
Blood Pressure	90/60 mmHg	195/122 mmHg	160/100 mmHg
Blood Sugar Level	37 mg/dl	300 mg/dl	256 mg/dl
HbA1c	7.40%	13.20%	11.4%
Total cholesterol level in mg/dl	230 mg/dl	270 mg/dl	240 mg/dl
Temperature	98.6 °F	102.5 °F	100 °F
Pulse	71 bpm	108 bpm	93 bpm

Chi-Square used for the test of Association between these core indicators mentioned in Table 2 described by the WHO protocols for pharmacological treatment. Results were derived through the SPSS Statistical Package of Social Sciences version 26.0. Findings show that blood pressure, blood sugar level, and Cholesterol level are highly associated with each other temperature and Pulse rate relatively have low association as shown in Table 4.

Table 4: Correlation between diseases and Chi-square for their association

Correlations					
	Blood sugar	Blood Pressure	Cholesterol	Temperature	Pulse
Pearson Correlation	1	.61	.59	.135	.29
Sig. (2-tailed)	--	.0007**	.004*	.249	.055
Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)		
Blood sugar	1.309a	1	.043		
Blood Pressure	.290	1	.050		
Cholesterol	2.226	1	.036		
Temperature	.01	1	.190		
Pulse	1.291b	1	.256		
a. 2 cells (50.0%) have an expected count of less than 5. The minimum expected count is .94.					
b. Computed only for a 2x2 table					

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

Moving on to the prevalence of various diseases among the patients, we found that hypertension had the highest prevalence, affecting 70% of the patient population, followed by diabetes. Arthritis, hyperlipidemia, and asthma had prevalence rates of 25%, 40%, and 15%, respectively. These prevalence rates provide valuable insights into the healthcare needs and priorities within the patient population (Figure 2). Next, we examined the usage of different medications among the patients. Lisinopril was the most commonly used medication, with a usage rate of 45%, followed by metformin at 35%. Atorvastatin, Ibuprofen, and Albuterol had usage rates of 35%, 20% and 10% respectively. These findings shed light on the

treatment strategies employed for managing the prevalent conditions within the patient population (Figure 3).

Figure 2: Percentage of disease prevalence rate

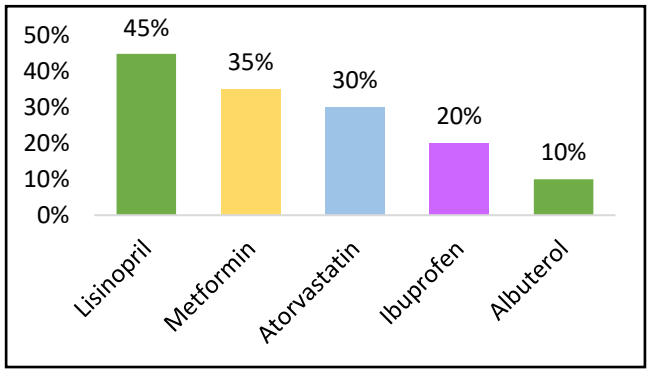

Figure 3: Percentage usage of different medications among the patients

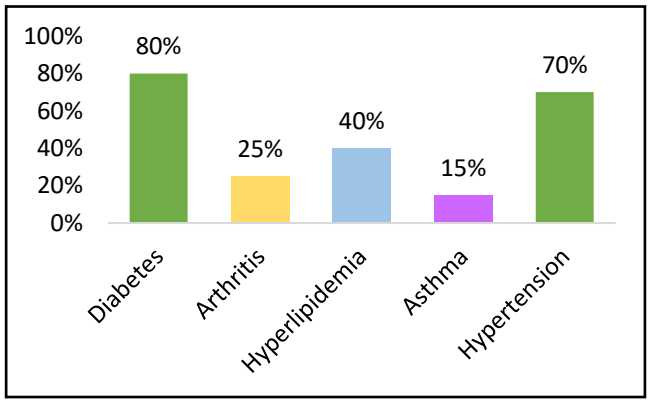

Table 5 categorizes drugs prescribed according to their therapeutic class. Antidiabetic agents were the most frequently prescribed, comprising 55% of all drugs. Antihypertensives followed, accounting for 30% of prescriptions. Antilipidemic, anticoagulants, and other classes made up smaller proportions of the drug regimen, indicating a focus on managing diabetes and related conditions such as hypertension. Table 5 also examines the frequency of prescriptions that include antibiotics and/or injections. Antibiotics were present in 15% of prescriptions, while injections were included in 25%. Prescriptions containing both antibiotics and injections were relatively rare, at 8%, and more than half of the prescriptions did not include either. This indicates a selective use of these treatments in the management of diabetes.

Table 5: Distribution of Drugs by Therapeutic Class and Frequency of Prescriptions with antibiotics and injections

Therapeutic Class	Percentage of Total Drugs
Antidiabetic Agents	55%
Antihypertensives	30%
Antilipidemic	7%
Anticoagulants	3%
Others	3%
Indicator	**Percentage of Total Prescriptions**
Antibiotics Prescribed	15%
Injections Prescribed	25%
Both Antibiotics and Injections	8%
Neither Antibiotics nor Injections	52%

Discussion

The average age of approximately 52.3 years in the patient population aligns with broader demographic trends indicating an aging population in many developed countries. This finding is consistent with studies conducted by the World Health Organization (WHO) on global aging trends.[15] However, the mode age of 35 suggests a significant proportion of younger individuals in the sample, which may reflect the inclusion of a diverse age range of patients. This observation resonates with research on changing demographic profiles and healthcare needs, emphasizing the importance of tailored healthcare interventions for different age groups. The high prevalence of hypertension, diabetes, and hyperlipidemia within the patient population is consistent with global epidemiological trends indicating a rise in non-communicable diseases (NCDs) worldwide (WHO, 2018). Studies such as those conducted by the Global Burden of Disease Collaborative Network have highlighted the increasing burden of NCDs on healthcare systems and the need for comprehensive prevention and management strategies (GBD 2019 Diseases and Injuries Collaborators, 2020).[16] The relatively lower prevalence rates of arthritis and asthma may reflect variations in regional health profiles or differences in diagnostic criteria and healthcare access among the patient population.[17]

The frequent use of medications such as lisinopril, metformin, and atorvastatin aligns with standard treatment guidelines for hypertension, diabetes, and hyperlipidemia,

respectively (American College of Cardiology, 2017; American Diabetes Association, 2020).[18] These findings underscore the importance of evidence-based pharmacotherapy in managing chronic health conditions and reducing associated morbidity and mortality rates. The use of ibuprofen and albuterol for pain/inflammation and asthma symptom management reflects common clinical practices for addressing acute symptoms and improving patient quality of life (National Institute for Health and Care Excellence, 2021).[19]

The positive correlation between age and disease prevalence, albeit not statistically significant, is consistent with existing literature on age-related changes in health status and disease risk.[20] While the lack of statistical significance in the correlation analysis may limit the generalizability of the findings, it highlights the complex interplay between age, comorbidities, and healthcare outcomes. Further research incorporating larger sample sizes and longitudinal data may provide additional insights into the relationship between age and disease burden among diverse patient populations.[21]

The discussion of the results within the context of previously published data underscores the importance of understanding demographic characteristics, disease prevalence, medication usage, and potential correlations in guiding evidence-based healthcare interventions and policy decisions. By integrating findings from existing research, healthcare practitioners and policymakers can develop targeted strategies to address the evolving healthcare needs of diverse patient populations.[22,23]

Conclusion

Our research underscores the multifaceted nature of healthcare disparities and treatment outcomes in contemporary healthcare. Through comprehensive data analysis, we have illuminated significant associations between core variables of Diabetes Mellitus 2, disease dynamics, and therapeutic interventions. Our findings emphasize the need for targeted interventions to address age-related disparities in disease severity and treatment response, as well as the critical importance of equitable healthcare access for minority and lower-income populations.

However, the study shows that healthcare professionals in twin cities are following WHO protocol up to some extent, as improvement is required in every field of life. Moreover, by contextualizing our results with previously published data, we have contributed to the ongoing discourse on healthcare disparities and health equity. Through a synthesis of evidence, we advocate for evidence-based clinical practice and policy interventions aimed at mitigating disparities and improving healthcare outcomes for all patients. Ultimately, this research serves as a call to action for stakeholders across the healthcare continuum to work collaboratively toward a more equitable and effective healthcare system.

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