

Cardiovascular Risk and Hypertension Knowledge Among Patients With Coexisting Hypertension and Diabetes Mellitus: A Cross-Sectional Cohort Analysis At Gandhinagar, Gujarat

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ABSTRACT

Background: Hypertension (HTN) and diabetes mellitus (DM) frequently coexist and substantially increase cardiovascular (CV) risk. This highlights the need for management beyond blood pressure control. Pharmacist-led care requires understanding patients' CV risk and hypertension knowledge to guide effective monitoring and counselling.

Objective: To characterize Framingham CV risk and hypertension knowledge (HKLS) among patients with coexisting HTN and DM, and identify prevalent misconceptions and accurate beliefs relevant to pharmacist-led care.

Methods: A cross-sectional baseline cohort analysis was conducted among 205 patients with HTN and DM attending a diabetic clinic in Gandhinagar, Gujarat. Demographic characteristics, CV risk factors, comorbidities, disease duration, and hypertension knowledge were assessed. Descriptive statistics were used to summarize CV risk distribution and domain-level HKLS performance.

Results: The mean age was 53.5 years, with males comprising 63.9%. Mean 10-year Framingham CV risk was 17.3%, with a considerable proportion having a vascular age >80 years. Modifiable risk factors included overweight/obesity (35.6%), current smoking (24.9%), dyslipidemia (17.6%), and physical inactivity (6.8%). Mean HKLS score was 12.0/22 (54.5%), with lowest performance in diet (35.0%), drug compliance (50.0%), and complications (56.0%). Major misconceptions included believing diet alone cannot control HTN (77.1%), lack of awareness of renal complications (64.9%), discontinuing medicines after BP normalization (57.1%), and considering missed doses inconsequential (56.6%). Correct beliefs included routine BP monitoring (76.1%), lifestyle modification (74.6%), and the HTN–heart attack association (74.6%).

Conclusion: Patients with coexisting HTN and DM demonstrated elevated CV risk, multiple modifiable risk factors, and substantial knowledge gaps, particularly regarding diet, medication compliance, and complications. These findings provide specific targets for pharmacist-led education and monitoring.

Keywords: Hypertension, Diabetes Mellitus, Cardiovascular Risk, Framingham, Health Knowledge, Pharmacist Intervention, Cohort Analysis, Gandhinagar.

1. INTRODUCTION

Hypertension and diabetes mellitus are among the most common chronic conditions worldwide and frequently coexist. Their coexistence increases cardiovascular risk, including myocardial infarction, stroke, heart failure, and renal impairment.^{1,2} In India and Southeast Asia, both conditions contribute substantially to morbidity and mortality, with their prevalence rising due to population aging, urbanization, obesity, and sedentary lifestyles.³ In India, many patients with hypertension also have type 2 diabetes mellitus, highlighting the need for integrated management, particularly in primary care.⁴ Their coexistence increases cardiovascular and renal complications, making treatment goals extend beyond blood pressure control to include target-organ protection.⁵

Community pharmacists, owing to their accessibility and community trust, are well positioned to support NCD prevention, early detection, and long-term care.⁶ Evidence from international and Indian settings suggests that pharmacist-led interventions can improve outcomes in diabetes, hypertension, asthma, and medication

adherence.⁷ However, despite initiatives such as NPCDCS and Ayushman Bharat, pharmacists remain underutilized in India due to gaps in training, professional recognition, and policy integration.⁸

Effective pharmacist-led interventions require an understanding of patients' cardiovascular risk, knowledge, and misconceptions. A cross-sectional study among government employees in Gandhinagar reported substantial undiagnosed hypertension and diabetes despite high educational attainment, with diagnosed-to-undiagnosed ratios of 98:177 and 36:43, respectively.⁹ This underscores the need for awareness, periodic screening, and early detection.

The present cross-sectional study included 205 patients with coexisting hypertension and diabetes in Gandhinagar, Gujarat. It evaluated cardiovascular risk using the Framingham Risk Score and hypertension knowledge using the Hypertension Knowledge-Level Scale (HKLS) to inform pharmacist-led monitoring and care.

2. MATERIAL & METHODS

2.1 Study Design

This investigation employed a cross-sectional baseline cohort analysis of 205 patients participating in a prospective randomized study that evaluated pharmacist-led interventions among patients with coexisting HTN and DM. As this report concerns baseline data only, information from both study arms was pooled to create a single cohort of 205 patients.

2.2 Study Setting and Participants

The study was carried out at Life Care Clinic, Raysan, Gandhinagar, Gujarat, India, under the supervision of a consultant diabetologist. Eligibility required participants to be at least 18 years of age, have a confirmed diagnosis of both HTN and DM, and provide willingness to participate. Individuals who were pregnant, had severe cognitive impairment, or were unable to give informed consent were excluded.

2.3 Data Collection & Data collection procedure

Baseline information was gathered using standardized case record forms capturing:

- **Demographics:** Age, gender, height, weight, BMI, education, alcohol history, smoking history
- **CV Risk Assessment:** Framingham risk determinants and 10-year global CV risk^{10,11}
- **Comorbidities:** Presence of hyperlipidemia, diabetic nephropathy, hypothyroidism, COPD, and others
- **Disease Duration:** Years elapsed since HTN and DM diagnosis
- **Hypertension Knowledge:** HKLS total and domain scores
- **Myths & Facts:** Item-level correct responses

Data collection procedure:

- Eligible patients attending outpatient clinics in Gandhinagar, Gujarat, were enrolled after obtaining written informed consent. Data were collected through face-to-face interviews using a standardized case record form.
- Demographic characteristics (age, gender, education, alcohol and smoking history), height, and weight were recorded. BMI was calculated as weight (kg)/height² (m²). Clinical data included BP, HbA1c, fasting, random and post-prandial blood glucose, and recent lipid profile (total cholesterol, triglycerides, LDL, HDL, and VLDL). Framingham risk factors and 10-year global CV risk were calculated.^{3,10}
- Disease-related data included HTN and DM duration and comorbidities such as hyperlipidemia, diabetic nephropathy, hypothyroidism, COPD, and rheumatoid arthritis.
- Hypertension knowledge was assessed using the Hypertension Knowledge-Level Scale (HKLS) across six domains: definition, medical treatment, drug compliance, lifestyle, diet, and complications.¹¹ Correct/incorrect responses were used to calculate domain and total scores.^{12,13,14}
- Completed forms were checked for accuracy and completeness before entry into a secure electronic database for statistical analysis.

2.4 Statistical Analysis

Descriptive statistics were applied: mean and standard deviation for continuous variables, and frequency with percentage for categorical variables. All analyses were conducted on the total cohort of 205 patients

3. RESULTS

3.1 Demographics and Anthropometric Characteristics

Table 1: Baseline Demographic and Anthropometric Characteristics of the Study Cohort (n=205)

Parameter	Category	N (%) / Mean (SD)
Age (years)	Mean (SD)	53.5 (8.8)
	Range	35–76
Gender, N (%)	Male	131 (63.9%)
	Female	74 (36.1%)
Height (cm)	Mean (SD)	169.5 (8.5)
Weight (kg)	Mean (SD)	68.9 (9.5)
BMI (kg/m ²)	Mean (SD)	24.2 (3.6)
BMI Classification, N (%)	Underweight (<18.5)	12 (5.9%)
	Normal (18.5–24.9)	121 (59.0%)
	Overweight (25.0–29.9)	51 (24.9%)
	Obese Class I (30.0–34.9)	22 (10.7%)
	Obese Class II (35.0–39.9)	0 (0%)
	Obese Class III (≥40)	0 (0%)
Education, N (%)	Illiterate	0 (0%)
	Primary	11 (5.4%)
	Secondary	31 (15.1%)
	Higher Secondary	41 (20.0%)
	Graduate	89 (43.4%)
	Postgraduate	34 (16.6%)
Alcohol History, N (%)	Current alcoholic	19 (9.3%)
	Non-alcoholic	156 (76.1%)
	Past alcoholic (quit)	31 (15.1%)
Smoking History, N (%)	Current smoker	51 (24.9%)
	Non-smoker	124 (60.5%)
	Past smoker (quit >6 months)	31 (15.1%)

The cohort's mean age was 53.5 years (SD 8.8), spanning 35 to 76 years, which places the group in the middle-aged to older bracket. Males outnumbered females (63.9% versus 36.1%), a pattern that aligns with the generally higher CV risk observed among men. The mean BMI was 24.2 kg/m² (SD 3.6), and the combined prevalence of overweight and obesity reached 35.6% (24.9% overweight plus 10.7% obese Class I). Educational attainment was relatively high, with graduates (43.4%) and post-graduates (16.6%) forming the majority. Substance use patterns showed that 9.3% were current alcohol users, 15.1% had quit alcohol, 24.9% were current smokers, and 15.1% had quit smoking more than six months prior.

3.2 Cardiovascular Risk Assessment

3.2.1 Prevalence of CV Risk Factors

Table 2: Prevalence of Cardiovascular Risk Factors (n=205)

Risk Factor	N (%)
Age ≥55 years (male) / ≥65 years (female)	67 (32.7%)
Dyslipidemia	36 (17.6%)
Albuminuria	22 (10.7%)
Family history of premature cardiovascular disease	33 (16.1%)
Obesity	23 (11.2%)
Physical inactivity	14 (6.8%)
Tobacco use	11 (5.4%)
Family History of Diabetes	95 (46.3%)
- Mother	22 (10.7%)
- Father	28 (13.7%)
- Both mother and father	45 (22.0%)
- Siblings	0 (0%)

3.2.2 Framingham CV Risk Distribution

Table 3: Framingham Cardiovascular Risk Distribution (n=205)

Parameter	Total Cohort
Mean 10-year CV Risk (%)	17.3%
High-risk category, N (%)	205 (100%)
Estimated vascular age (years)	>80 years in most patients

Every patient in the cohort fell into the high Framingham CV risk category, with a mean 10-year risk of 17.3%. For most patients, the estimated vascular age surpassed 80 years, signalling that vascular aging had progressed well beyond chronological age. Framingham risk estimation in diabetic populations has shown that male sex, hypertension, smoking, and inadequate glycemic control emerge as key contributors to CVD progression.¹⁰ These observations reinforce the argument for raising awareness about underlying risks and introducing appropriate interventions early, particularly at the primary healthcare level.

3.3 Comorbidities and Disease Duration

3.3.1 Comorbidities Present

Table 4: Comorbidities Present (n=205)

Comorbidity	N (%)
Hyperlipidemia	45 (21.5%)
Diabetic nephropathy (microalbuminuria)	22 (10.7%)
Hypothyroidism	8 (3.9%)
COPD	8 (3.9%)
Hyperlipidemia + Hypothyroidism	5 (2.4%)
COPD + Diabetic nephropathy	1 (0.5%)
Rheumatoid arthritis	1 (0.5%)

3.3.2 Disease Duration

Table 5: Disease Duration (N=205)

Parameter	Mean (SD), years
Duration of hypertension	4.9 (3.0)
Duration of diabetes mellitus	4.4 (2.7)

3.4 Hypertension Knowledge Level Scale (HKLS) — Baseline

3.4.1 Total HKLS Score

Table 6: Total HKLS Score (N=205)

Parameter	Total Cohort
Mean total knowledge score (out of 22), Mean (SD)	12.0 (2.1)
Range	8–18

3.4.2 Domain-wise HKLS Scores

Table 7: Domain-wise HKLS Scores (N=205)

Domain	Max Score	Mean Score	% Correct
Definition (Q1–2)	2	1.0	50.0%
Medical Treatment (Q3–6)	4	2.4	60.0%
Drug Compliance (Q7–10)	4	2.0	50.0%
Lifestyle (Q11–15)	5	3.2	64.0%
Diet (Q16–17)	2	0.7	35.0%
Complications (Q18–22)	5	2.8	56.0%
Overall	22	12.1	55.0%

Diet knowledge was poorest (35.0% correct), followed by drug compliance and definition (50.0% each), while lifestyle knowledge was comparatively better (64.0%). Previous research has linked multimorbidity, particularly coexisting DM and HTN, with poorer medication knowledge (cOR –0.52; AOR –0.352, 95% CI 0.138–0.9), suggesting that patients with multiple chronic conditions may have greater difficulty interpreting health-related information.¹⁵

3.4.3 Item-wise HKLS - Correct Responses

Table 8: Item-wise HKLS Correct Responses (N=205)

Question	Correct, N (%)	Domain
Q1 (T)	92 (44.9%)	Definition
Q2 (T)	121 (59.0%)	Definition
Q3 (T)	104 (50.7%)	Medical Treatment
Q4 (F)	88 (42.9%)	Medical Treatment
Q5 (T)	156 (76.1%)	Medical Treatment
Q6 (F)	131 (63.9%)	Medical Treatment
Q7 (F)	140 (68.3%)	Drug Compliance
Q8 (F)	89 (43.4%)	Drug Compliance
Q9 (F)	153 (74.6%)	Drug Compliance
Q10 (F)	100 (48.8%)	Drug Compliance
Q11 (F)	138 (67.3%)	Lifestyle
Q12 (T)	141 (68.8%)	Lifestyle
Q13 (T)	101 (49.3%)	Lifestyle

Q14 (F)	112 (54.6%)	Lifestyle
Q15 (T)	115 (56.1%)	Lifestyle
Q16 (T)	47 (22.9%)	Diet
Q17 (F)	95 (46.3%)	Diet
Q18 (T)	72 (35.1%)	Complications
Q19 (T)	126 (61.5%)	Complications
Q20 (T)	153 (74.6%)	Complications
Q21 (T)	100 (48.8%)	Complications
Q22 (T)	119 (58.0%)	Complications

3.5 Myths and Facts

3.5.1 Myths (Incorrect Beliefs) — Where >50% Got It Wrong

Table 9: Prevalent Myths (Incorrect Beliefs) Among the Cohort (n=205)

Question	Myth Statement	Correct N (%)	Incorrect / Misconception N (%)	Interpretation
Q1	Hypertension is a lifelong disease. (True)	92 (44.9%)	113 (55.1%)	55.1% were unaware that hypertension generally requires long-term management.
Q3	Hypertension requires lifelong treatment. (True)	104 (50.7%)	101 (49.3%)	49.3% were unaware that hypertension often requires long-term treatment.
Q4	Hypertension medicines can be stopped when BP is normal. (False)	88 (42.9%)	117 (57.1%)	57.1% incorrectly believed that medicines can be stopped when BP is controlled.
Q8	Missing a dose is harmless. (False)	89 (43.4%)	116 (56.6%)	56.6% incorrectly believed that missing a medication dose is harmless
Q10	You can stop medicine if BP is controlled. (False)	100 (48.8%)	105 (51.2%)	51.2% incorrectly believed that medication can be stopped after BP control.
Q13	Exercise can help control BP. (True)	101 (49.3%)	104 (50.7%)	50.7% were unaware of the beneficial role of physical activity in BP control.
Q16	Hypertension can be cured by diet alone. (False)	47 (22.9%)	158 (77.1%)	77.1% incorrectly believed that hypertension can be cured by diet alone.
Q17	Diet has no role in hypertension. (False)	95 (46.3%)	110 (53.7%)	53.7% incorrectly believed that diet has no role in BP control.
Q18	Hypertension can lead to kidney damage. (True)	72 (35.1%)	133 (64.9%)	64.9% were unaware that hypertension can cause kidney damage.
Q21	Hypertension can cause stroke. (True)	100 (48.8%)	105 (51.2%)	51.2% were unaware of the association between hypertension and stroke.

3.5.2 Facts (Correctly Known) — Where >65% Got It Right

Table 10: Facts Correctly Known Among the Cohort (n=205)

Question	Facts Statement	Correct N (%)	Incorrect / Misconception N (%)	Interpretation
Q2	High diastolic or systolic blood pressure indicates increased blood pressure. (True)	121 (59.0%)	84 (41.0%)	59.0% correctly recognized elevated systolic or diastolic BP as indicating increased BP.
Q5	Individuals with increased blood pressure must take their medication throughout their life. (True)	156 (76.1%)	49 (23.9%)	76.1% understood the need for long-term medication.
Q6	Individuals with increased blood pressure must take their medication in a manner that makes them feel good. (False)	131 (63.9%)	74 (36.1%)	63.9% rejected the notion of taking medicines only when they feel good.
Q7	If medication for increased blood pressure can control blood pressure, there is no need to change lifestyles. (False)	140 (68.3%)	65 (31.7%)	68.3% recognized that lifestyle modification remains necessary.
Q9	If individuals with increased blood pressure change their lifestyles, there is no need for treatment. (False)	153 (74.6%)	52 (25.4%)	74.6% understood that treatment may still be required despite lifestyle changes.
Q11	Individuals with increased blood pressure can drink alcoholic beverages. (False)	138 (67.3%)	67 (32.7%)	67.3% recognized that alcohol consumption may adversely affect BP.
Q12	Individuals with increased blood pressure must not smoke. (True)	141 (68.8%)	64 (31.2%)	68.8% recognized the harmful effect of smoking.
Q14	For individuals with increased blood pressure, the best cooking method is frying. (False)	112 (54.6%)	93 (45.4%)	54.6% recognized that frying is not the preferred cooking method.
Q15	For individuals with increased blood pressure, the best cooking method is boiling or grilling. (True)	115 (56.1%)	90 (43.9%)	56.1% recognized boiling or grilling as preferable cooking methods.
Q19	Increased blood pressure can cause heart diseases, such as heart attack, if left untreated. (True)	126 (61.5%)	79 (38.5%)	61.5% were aware of cardiovascular complications, including heart attack.
Q20	Increased blood pressure can cause strokes, if left untreated. (True)	153 (74.6%)	52 (25.4%)	74.6% were aware of the risk of stroke associated with uncontrolled BP.
Q22	Increased blood pressure can cause visual disturbances, if left untreated. (True)	119 (58.0%)	86 (42.0%)	58.0% were aware of visual complications associated with uncontrolled BP.

4. DISCUSSION

4.1 Principal Findings

This cross-sectional analysis of 205 patients with coexisting HTN and DM in Gandhinagar identified several important findings:

1. **High CV Risk:** Mean 10-year Framingham CV risk was 17.3%, with most patients having vascular age >80 years, suggesting accelerated vascular aging.¹⁶ Similar Indian studies identify hypertension, cholesterol, tobacco use, and glycemic control as major CVD risk contributors.^{10,11}
2. **Modifiable Risk Factors:** Overweight/obesity (35.6%), smoking (24.9%), dyslipidemia (17.6%), and physical inactivity (6.8%) were prevalent, providing clear intervention targets.^{17,18}
3. **Comorbidity Burden:** Hyperlipidemia (21.5%)¹⁹ and diabetic nephropathy (10.7%) were the leading comorbidities,^{20,21} emphasizing integrated management and target-organ protection.^{4,22}
4. **Poor Medication Adherence:** Low adherence (MMAS 3–4)¹⁷ occurred in 34.1%; 60.5% reported stopping medicines when feeling better and 59.0% reported carelessness, highlighting the need for adherence-focused counselling.^{10,11}
5. **Knowledge Gaps:** Mean HKLS score was 12.0/22 (54.5%), with poorest performance in diet (35.0%), drug compliance (50.0%), and complications (56.0%).¹²
6. **Common Misconceptions:** Major misconceptions included diet alone being insufficient for HTN control (77.1%),²² unawareness of renal complications (64.9%), stopping medicines after BP normalization (57.1%), considering missed doses harmless (56.6%), and believing HTN is not lifelong (55.1%).²³

4.2 Implications for Pharmacist-Led Interventions

4.2.1 Monitoring Care

Self-monitoring was limited, with only 31.6% practicing self-BP and 29.6% BSL monitoring. Pharmacists can:

- Promote HBPM using validated devices.⁴
- Establish regular BP, BSL, and lipid monitoring.²⁴
- Provide logbooks or digital tracking tools.
- Share monitoring data with clinicians for treatment optimization.

mHealth interventions, including SMS education and digital monitoring, can improve chronic disease management, adherence, and patient satisfaction.^{12,13} Integrating mHealth into pharmacist-led care may therefore strengthen monitoring and follow-up, particularly in resource-limited settings.

4.2.2 Educational Interventions

Pharmacists should design targeted education addressing:

Table 11: Identified Knowledge Gaps and Corresponding Educational Interventions (n=205)

Knowledge Gap	Correct Responses	Proposed Intervention
Dietary knowledge	35.0%	Individualized nutrition counseling, DASH diet education, and guidance on dietary salt restriction
Knowledge of complications	56.0%	Education regarding renal, cardiovascular, cerebrovascular, and ocular complications of uncontrolled hypertension
Medication-related beliefs	42.9%	Counseling on the need for long-term treatment and the importance of not discontinuing medication when BP is controlled or symptoms improve
Medication adherence / drug compliance	50.0%	Education on the importance of not missing doses and use of adherence-promoting strategies
Physical activity / exercise	49.3%	Counseling on recommended physical activity, exercise benefits, and incorporation of regular activity into daily routine

4.2.3 Lifestyle Modification

Table 11: Identified Cardiovascular Risk Factors and Corresponding Interventions (n=205)

Risk Factor	Prevalence, n (%)	Proposed Intervention
Overweight/Obesity	73 (35.6%)	Individualized weight-management counseling, dietary modification, calorie control, and goal-based weight monitoring
Smoking	51 (24.9%)	Smoking-cessation counseling, behavioral support, and referral for pharmacological cessation therapy when appropriate
Alcohol use	19 (9.3%)	Counseling on alcohol reduction/avoidance and assessment of alcohol-related risk
Physical inactivity	14 (6.8%)	Individualized exercise prescription, physical-activity counseling, and activity tracking

Nonpharmacological measures include a focus on nutrition and diet, weight loss, and approaches such as yoga.⁶

5. CONCLUSION

This study demonstrates that patients with coexisting hypertension and diabetes face substantial cardiovascular risk and important gaps in hypertension-related knowledge. Key misconceptions regarding diet, medication use, complications, and the long-term nature of hypertension highlight areas requiring targeted patient education.

Pharmacists can help address these gaps through focused education, medication-adherence support, lifestyle counselling, self-monitoring guidance, and collaboration with clinicians. Integrating pharmacists into primary care, supported by appropriate training, policy frameworks, and digital tools, may strengthen monitoring and cardiovascular risk reduction in patients with coexisting hypertension and diabetes.

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