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Cognitive factors associated with hypertension and diabetes control among diagnosed and treated patients; findings from a community cohort in India

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ABSTRACT

Uncontrolled hypertension and diabetes are a challenge for healthcare providers worldwide. The research documenting the underlying risk factors of uncontrolled chronic illnesses in community cohorts from India is negligible. The current cross-sectional household door-knock survey conducted among 759 participants aged 30 and above from a geographically well-defined area examines the cognitive risk factors associated with hypertension and diabetes control in the Indian population. The study used an assessment tool consisting of a socio-demographic questionnaire, items to measure cognitive factors, and onsite hypertension and diabetes measurements. Results suggested that among the participants, more than 36% had hypertension, 26% had diabetes, and of those with diagnosed diabetes and hypertension, more than 22% with hypertension and 48% with diabetes had uncontrolled conditions. Univariate analysis suggests that cognitive functioning was negatively associated with uncontrolled hypertension and psychological impairments of depression and anxiety were positively associated. The associations were not significant for uncontrolled diabetes. Only if treatments integrate psychological and cognitive interventions to ensure adherence to medical and lifestyle modifications will it achieve the WHO target of 80% control of detected conditions. The findings can inform the policies and programs to optimise government spending and modify the current chronic condition management practices.

1. Introduction

Chronic diseases like diabetes and hypertension are significant risk factors for increased morbidity and mortality worldwide (WHO, 2023a). A study among 2.4 million households in India found six- to eight-fold and two-fold increases in the odds of mortality related to ischemic heart diseases and stroke for patients with Hypertension (HTN) and Diabetes Mellitus (DM), respectively, suggesting the need for early detection and better management (Ke et al., 2021). Identifying the factors hindering chronic management is crucial for low and middle-income countries, as 82 % of people living with hypertension (NCD Risk Factor Collaboration (Risk Factor, 2021) and 80 % of people living with diabetes (International Diabetes Federation, 2019) reside in low and middle-income countries. Pooled analyses from low and middle-income countries identified 192 441 individuals with hypertension, of which only 10.3 % had achieved control (Geldsetzeret al., 2019) and 37 094 individuals with diabetes, of whom only 4.6 % reported that their needs related to treatment were met (Flood et al., 2021). Further, a prospective cohort study in Kerala found an overall prevalence of 43 % for hypertension (Saju et al., 2020) and 30.1 % for diabetes (Devassy et al., 2022) among which only half had those under control.

Uncontrolled hypertension and diabetes can result from non-compliance to medical prescriptions (Abegaz et al., 2017; Egede et al., 2014) and nonadherence to healthcare providers' dietary and lifestyle change recommendations (Sami et al., 2017). Psychological impairments like anxiety or depression (Wang et al., 2021a) or cognitive impairments like memory and orientation (Elliott et al., 2015; Hudani and Rojas-Fernandez, 2016) are associated with uncontrolled diabetes and hypertension. Difficulties understanding and accessing prescriptions (Hopkins, et al., 2016) perceptual errors in patients, such as medications being overused, harmful, and addictive (Lemay et al., 2018), or claiming self-expertise with the disease (Waheedi et al., 2017) associated with cognitive and psychological impairments can lead to medication non-compliance and uncontrolled diabetes and hypertension.

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Nations worldwide have considered chronic disease prevention a top health priority and have set up extensive programs under the World Health Organization's (WHO) Global Action Plan for the Prevention and Control of Non-Communicable Diseases (NCDs) (WHO, 2023b) with various degrees of success. Even after concerted efforts and heavy government investments through various national programs such as Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS) (Ministry of Health & Family Welfare, 2023) since its inception in 2010, the continuum of care for chronic illness management has not achieved, resulting in colossal hypertension and diabetes burden in India. There is a dearth of research demonstrating the role of underlying factors in controlling chronic conditions in low- and middle-income countries like India. Therefore, the study aimed to throw light on the association of various cognitive and psychological factors with uncontrolled BP and DM, which could aid in developing long-term, targeted programs for achieving health goals (United Nations, 2015).

2. Materials and methods

2.1. Study design

The study employed a cross-sectional survey design conducted in May 2019. We identified Keezhmadu panchayat (basic governing institution), located in the Vazhakulam block of Ernakulam district of Kerala, India, as the study location. The study catchment area was geographically well-defined and represented the mixed culture and socio-economic characteristics of the people of the state. Four wards (sub-units of Panchayat) of the selected Panchayath were randomly chosen to recruit participants for the current study.

2.2. Population and sample

A total of 759 participants were included in the survey. Data was collected through door-knock surveys by trained social work second-year students. The research team conducted a mapping exercise to identify and locate all households that had household IDs/ numbers within the selected geographical location. The research team underwent household door-knock surveys, with the help of community health volunteers to recruit all eligible participants. All community members, aged 30 or above, residing in that area, and who provided consent to participate were included in the study. Participants who were not available at their houses, who did not consent, and who were unable to participate in the interview due to mental illness, disabilities, or other concerns were excluded. Participant recruitment is explained in Fig. 1.

2.3. Measurements

2.3.1. Socio-demographics

A socio-demographic questionnaire with items tapping into age, gender, education, marital status, occupation, and income was used to collect the socio-demographic details of the participants.

2.3.2. Cognitive functioning

The cognitive functioning assessment included eight questions to assess the participants' potential to assess memory (immediate, remote, and recent), attention and concentration, and orientation (person, place, and time). The sum of the above elements generated a variable that could potentially be utilised for measuring cognitive functioning. The total score ranges from a minimum of zero and a maximum of 8 points,

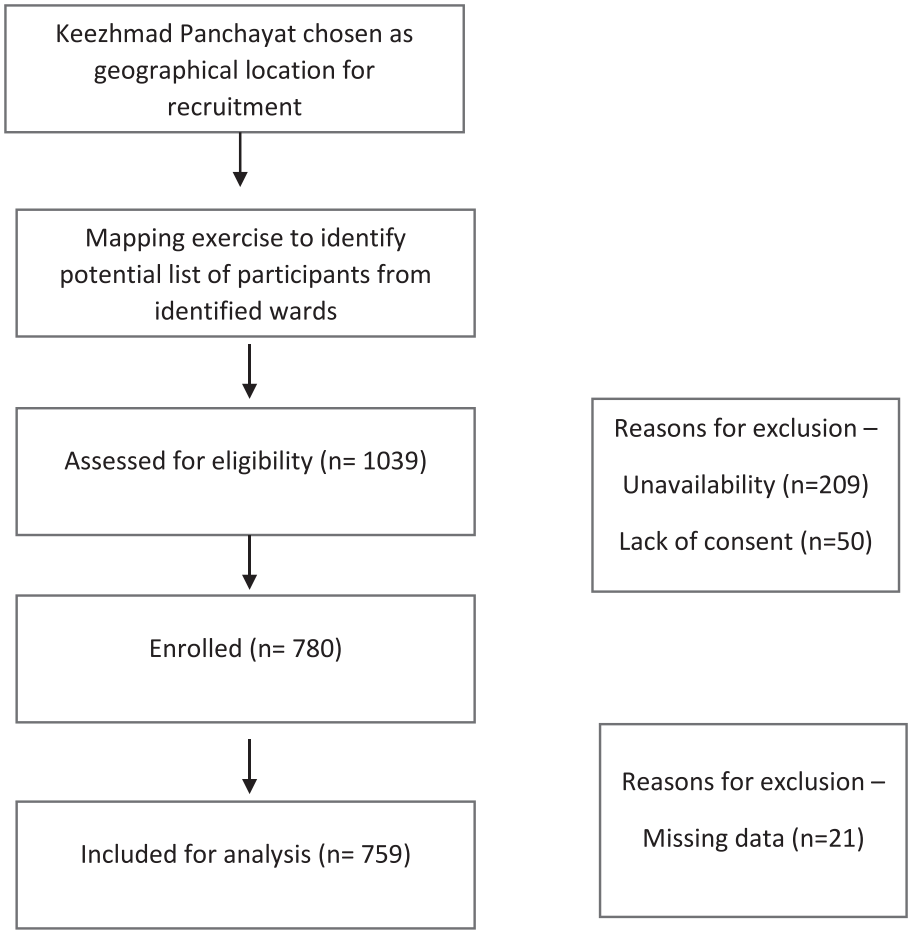

Fig. 1. Participant recruitment.

with a higher score indicating better cognitive functioning. The internal consistency of the items was measured using Cronbach's alpha. The estimated value for the items was 0.7103, regarded as an acceptable value for alpha (Bland, & Altman, 1997).

2.3.3. Psychological functioning

Items from Depression Anxiety Stress Scale, DASS 42 (Lovibond, & Lovibond, 1995) were utilized to assess psychological functioning. DASS is a 42-item self-report instrument that measures the three related negative emotional states of depression, anxiety, and tension/stress. Participants were asked to use 4-point severity/frequency scales to rate the extent to which they experienced each state over the past week. Total scores for the three domains were computed separately to assess the participant's psychological states. Participants with moderate and above depression (scores above 14), anxiety (scores above 10), and stress (scores above 19) were considered people with psychological impairment. DASS 42 is extensively used and validated in Indian settings to measure depression, anxiety, and stress (Singh et al., 2015).

2.3.4. Behavioural risk assessment

Behavioural risks such as smoking, alcohol use, physical activity, and dietary intake were ascertained with three questions: 1) Have you used cigars, pipes, and tobacco continuously at any time in the past few years? 2) Have you ever consumed alcohol in the past few years? 3) Do you engage in any form of physical activity, and how often? 4) How many servings of fruits and vegetables do you take on a typical day? The self-reported answers to the first and second items were coded as Yes/No, and the third item was coded as Very much; Average; Not much physical activity, and no physical activity at all. For the dietary measurement, consuming less than five total servings (400 g) of fruit and vegetables daily is considered inadequate dietary intake (Surveillance Manual, 2020).

2.3.5. Hypertension (HTN) assessment

Diagnosis of hypertension included the self-reported answer to the question 1) Have you been diagnosed with hypertension before? This was followed by measuring hypertension using Dr Morepen BP-02 Blood Pressure Monitor, a fully automatic blood pressure monitor that measures blood pressure. Hypertension was measured twice in a sitting position and once in a standing position at three different periods, and the average of the three was taken as the final value (Palatini et al., 2022). Hypertension was defined as a systolic blood pressure (SBP) $\geq$ 140 mm/Hg and a diastolic blood pressure (DBP) $\geq$ 90 mm/Hg, or on treatment (Chow et al., 2013).

2.3.6. Diabetes (DM) assessment

Diagnosis for Diabetes included the self-reported answer to the questions 1) Have you been diagnosed with Type 2 diabetes? This was followed by measurement of diabetes using capillary blood obtained by finger-prick using a digital device (FreeStyle Opium Neo H Meter Kit). Capillary blood was collected using a lancet, and a glucometer was used to measure the random glucose level. A blood glucose level between 79 and 200 mg/dl was considered normal, and $>$ 200 mg/dl was considered diabetic (American Diabetes Association, 2005).

2.4. Sample size estimation

We assumed that almost 30 % of the sample had a prevalence of chronic conditions of diabetes and hypertension based on secondary analysis from previous data (Chauhan et al., 2022). Further, sample size calculations found that a target sample of 756 accounted for 80 % power and an alpha value of 0.05.

2.5. Statistical analysis

All statistical analysis procedures used Stata (StataCorp LLC Version 15, Lakeway Drive, TX, USA). Descriptive statistics were used to explore the sample characteristics by hypertensive and diabetic status. Self-reported hypertension and diabetes were further sub-grouped into controlled and uncontrolled status for the two-way tables. The control status of hypertension was the proportion of people who had a self-reported hypertension status, with a SBP $<$ 140 and DBP $<$ 90 mmHg during the measurement. Similarly, the proportion of people who had a self-reported diabetes status and had their glucose level $<$ 200 during measurement was labeled as control for diabetes. Cognitive and behavioural aspects of hypertension and diabetes control were explored through descriptive two-way tables. Logistic regression was performed to test the association between variables and calculated a 95 % confidence interval and p-values to evaluate the statistical significance.

2.6. Ethical considerations

The study was approved by the Institutional Review Board of Rajagiri College of Social Sciences (Autonomous). Informed written consent was obtained from the participants prior to recruitment, and participants were informed about the voluntary nature of participation.

3. Results

The study included 759 participants with a mean age of 55.4 years. Most were females (66 %), and 4.5 % were uneducated. Among them, 274 (36 %) respondents reported having hypertension, while 198 (26.1 %) had diabetes. 213 of the 274 hypertensive patients had their condition under control by adhering to treatment, while 61 had uncontrolled hypertension. Similarly, 102 of the 198 respondents with diabetes reported having it under control, while 96 reported having it uncontrolled. Among the respondents with uncontrolled hypertension, a higher percentage were females (75 %), people with lower levels of educational attainment (79 %), people who were married (72 %), and homemakers (67 %). All the associations concerning hypertension were statistically significant. Further, among respondents with uncontrolled diabetes, the majority of them were homemakers and people with lower levels of educational attainment (Table 1).

The mean score for cognitive functioning was 7.5 $\pm$ 1.1; for psychological functioning, the mean score was 6.85 $\pm$ 6.7, and 6.84 $\pm$ 6.6, respectively, for depression, anxiety, and stress. Cognitive functioning was similar for both controlled and uncontrolled hypertension groups. However, the sub-group analysis by age category suggests that for patients aged above 60, cognitive functioning was lower for patients with uncontrolled hypertension compared to patients with controlled hypertension, and the difference was statistically significant. Further, depression and anxiety symptoms were higher for patients with uncontrolled hypertension than those with controlled hypertension. The differences were also higher for patients with uncontrolled hypertension when sub-grouped by age category. However, for diabetes, cognitive functioning was slightly higher for the uncontrolled diabetes group, and anxiety was similar for both groups (Table 2).

Table 3 describes the multivariable logistic regression analysis of major variables in the current study. Advanced age was a significant factor for uncontrolled diabetes and hypertension among the study population. Univariate analysis suggested that cognitive functioning and psychological impairments of depression and anxiety were associated with decreased and increased odds of uncontrolled hypertension respectively. People with better cognitive functioning had 0.8 times lesser odds of having uncontrolled hypertension. Also, people with depression and anxiety symptoms had 1.1- and 1.0 times higher odds of uncontrolled hypertension. However, multivariable regression models, with age, education, income, and occupation as covariates suggested that the associations were not statistically significant. Cognitive and psychological components were not significant factors for uncontrolled diabetes.

Table 1
Distribution of patients with detected, controlled, and uncontrolled diabetes and hypertension in India.

Variables		Normal levels of Hypertension	Self-reported Hypertension (n = 274)		P value*	Normal levels of Diabetes	Self-reported Diabetes (n = 198)		P value
	N(%)	*N (%)*	*Controlled HTN N (%)*	*Uncontrolled HTN N (%)*			*Controlled DM N (%)*	*Uncontrolled DM N (%)*	
Age- Mean[#]	55.4 (14.3)	51.1 (13.1)	63.3 (13.3)	62.4 (12.1)	p < 0.001	53.1 (14.4)	62.6 (12.7)	61.1 (10.7)	p < 0.001
Gender									
Male	256 (33.7)	183 (37.7)	58 (27.2)	15 (24.6)	p = 0.008	186 (33.2)	33 (32.4)	37 (38.6)	p = 0.559
Female	503 (66.3)	302 (62.3)	155 (72.8)	46 (75.4)		375 (66.9)	69 (67.6)	59 (61.5)	
Education									
Uneducated	34 (4.5)	11 (2.3)	18 (8.5)	5 (8.2)	p < 0.001	19 (3.4)	7 (6.8)	8 (8.3	p < 0.001
Less than primary	169 (22.3)	85 (17.5)	66 (31)	18 (29.5)		109 (19.4)	35 (34.3)	25 (26.0)	
Completed Primary	247 (32.5)	153 (31.5)	69 (32.4)	25 (41)		174 (31.0)	35 (34.3)	38 (39.6)	
Completed Secondary	162 (21.3)	118 (24.3)	34 (16)	10 (16.4)		129 (22.3)	15 (14.71)	18 (18.8)	
Completed Tertiary	147 (19.4)	118 (24.3)	26 (12.2)	3 (4.9)		130 (23.2)	10 (9.80)	7 (7.3)	
Marital Status									
Unmarried	13 (1.7)	10 (2.1)	3 (1.41)	–	p < 0.001	12 (2.1)	–	1 (1.0)	p = 0.059
Married	649 (85.5)	448 (92.4)	157 (73.7)	44 (72.1)		486 (86.6)	81 (79.4)	82 (85.4)	
Widowed/ divorced/ separated	97 (12.8)	27 (5.6)	53 (24.9)	17 (27.9)		63 (11.2)	21 (20.6)	13 (13.5)	
Occupation									
Unemployed	13 (1.7)	10 (2.1)	2 (0.9)	1 (1.6)	p < 0.001	12 (2.1)	1 (0.9)	–	p = 0.006
Employed	245 (32.3)	191 (39.4)	42 (19.7)	12 (19.7)		198 (35.3)	23 (22.6)	24 (25)	
Homemaker	390 (51.4)	226 (46.6)	123 (57.8)	41 (67.2)		282 (50.3)	54 (52.9)	54 (56.3)	
Retired	111 (14.6)	58 (11.9)	46 (21.6)	7 (11.5)		69 (12.3)	24 (23.5)	18 (18.8)	
Income[#]	18001.1 (16880.4)	17326.4 (14780.9)	20299.8 (21778.6)	15339.7 (11486.6)	p = 0.044	18206.2 (16883.7)	15995.1 (14747.8)	18934.4 (18882.5)	p = 0.403

* P-values were obtained from one-way ANOVA and Chi-squared statistics.
[#] Mean and SD are presented for Age and income.

Table 2
Cognitive aspects of hypertension and diabetes control among patients with self-reported diabetes and hypertension in India.

Variables		Normal levels of Hypertension	Self-reported Hypertension (n = 274)		P value*	Normal levels of Hypertension	Self-reported Diabetes (n = 198)		P value
			Controlled HTN (N = 213)	Uncontrolled HTN (N = 61)			Controlled DM (N = 102)	Uncontrolled DM (N = 96)	
Cognitive Functioning (mean = 7.5 ± 1.1)	Total (n = 759)	7.6 (0.9)	7.2 (1.4)	7.2 (1.1)	p < 0.001	7.5 (1.1)	7.2 (1.2)	7.4 (0.9)	p = 0.024
	Aged below 60	7.7 (0.7)	7.6 (0.7)	7.6 (0.6)	p = 0.522	7.7 (0.7)	7.6 (0.7)	7.7 (0.6)	p = 0.46
	Aged above 60	7.4 (1.2)	7 (1.5)	6.8 (1.3)	p = 0.036	7.1 (1.5)	7 (1.4)	7.2 (1)	p = 0.754
Depression symptoms (mean = 6.85 ± 6.7)	Total (n = 759)	5.9 (5.8)	8.2 (7.5)	9.6 (8.7)	p < 0.001	6.6 (6.5)	8.1 (7.3)	7.3 (7.5)	p = 0.078
	Aged below 60	5.7 (5.7)	7.3 (6.7)	9.3 (9.1)	p = 0.002	6.1 (6)	6.6 (5.8)	6.8 (7.8)	p = 0.71
	Aged above 60	6.4 (6.4)	8.7 (7.8)	9.9 (8.6)	p = 0.01	7.5 (7.4)	9	7.6 (7.4)	p = 0.37
Anxiety symptoms (mean = 6.84 ± 6.6)	Total (n = 759)	5.9 (5.9)	8.3 (6.9)	9.1 (8.7)	p < 0.001	6.5 (6.5)	7.9 (6.7)	7.9 (7.3)	p = 0.035
	Aged below 60	5.9 (6.1)	8.5 (7.1)	8.9 (8.4)	p = 0.001	6.2 (6.3)	9 (6.9)	7.7 (7.4)	p = 0.022
	Aged above 60	5.9 (5.7)	8.2 (6.8)	9.2 (9.1)	p = 0.004	7.1 (6.7)	7.2 (6.4)	8 (7.3)	p = 0.646

* P-values were obtained from one-way ANOVA tests.

4. Discussion

The current study explored the association of cognitive and psychological impairment with uncontrolled diabetes and hypertension among 759 respondents identified from a cohort in India. More than 36 % of the participants had hypertension, 26 % had diabetes, and of those

Table 3
Logistic regression analysis of the major variables with uncontrolled hypertension and diabetes in India.

Variables	Uncontrolled HTN (among total) OR, 95 % CI (P-value) Univariate	Uncontrolled HTN (among total) OR, 95 % CI (P-value) Multivariable*	Uncontrolled DM (among total) OR, 95 % CI (P-value) Univariate	Uncontrolled DM (among total) OR, 95 % CI (P-value) Multivariable
Cognitive Functioning (1-unit increase)	0.8 (0.7 – 0.9), p = 0.048	1.0 (0.8 – 1.3), p = 0.691	0.9 (0.7 – 1.1), p = 0.461	–
Depression symptoms (1-unit increase)	1.1 (1.0 – 1.1), p = 0.001	1.0 (0.9 – 1.1), p = 0.208	1.01 (0.9 – 1.04), p = 0.480	–
Anxiety symptoms (1-unit increase)	1.0 (1.0–1.1), p = 0.007	1.0 (0.9 – 1.1), p = 0.610	1.02 (0.9 – 1.06), p = 0.097	–

*adjusted for age, education levels, occupation, income levels.

with diagnosed diabetes and hypertension, more than 48 % of people with diabetes and 22 % of people with hypertension could not control their conditions. The prevalence of uncontrolled hypertension varied between countries, the values ranging as high as 54.4 % in Thailand (Meelab et al., 2019), 44.6 % in China (Yang et al., 2014), and 48.6 % in Ethiopia (Aberhe et al., 2020) among patients treated for hypertension. Similarly, the percentage of people with uncontrolled diabetes was 50 % in China (Wang et al., 2021b), 48.8 % in Iran (Najafipour et al., 2021), and 30.3 % in Ethiopia (Ayele et al., 2020) which is more or less similar to our study. These figures look alarming in line with the WHO global target of 80 % control by 2030 (WHO, 2022).

Univariate analyses described higher odds of uncontrolled hypertension and diabetes for people with psychological and/or cognitive impairments in the current study. Elderly females with fewer years of schooling with psychological and cognitive impairment had a higher chance of uncontrolled DM and BP. Findings were consistent with another nationally representative study conducted in India where higher education and male gender were associated with better treatment outcomes (Anjana et al., 2022). Cognitive functioning was a significant factor for uncontrolled hypertension among participants above 60, while psychological impairment of anxiety symptoms was significant for younger adults. Depression was a significant factor for all age groups. Findings are consistent with similar studies where advanced age (Aberhe et al., 2022) and female gender (Najafipour et al., 2021) were associated with a higher prevalence of uncontrolled hypertension or diabetes. Further, similar to the current study findings, cognitive dysfunctions (Alkethiri et al., 2021), and symptoms of depression were associated with having increased odds of uncontrolled hypertension (Wang et al., 2021b).

Family psychoeducation, focusing on cognitive and psychological factors, is essential for the patients to ensure better compliance with therapy and behavioural and dietary recommendations, particularly in India due to the collectivist mentality (Chacko, & Jeemon, 2020). Though diabetes is considered hazardous or more damaging than hypertension, many fail to implement strategies to control it. The reason could be that most people with diabetes do not adhere to healthy lifestyle recommendations for many reasons, including psychological impairments. This demonstrates the necessity for integrating psychological interventions to remove the psychological barriers to adherence to interventions.

Proper management and detection of the factors associated with poor control of hypertension and diabetes are critical to increased life expectancy, reduced healthcare costs, and better quality of life. Usual interventions often overlook the mediating role of cognitive factors in adhering to dietary and lifestyle recommendations and medical prescriptions. Psychological impairments like anxiety and depression cause non-adherence, necessitating the integration of psychological strategies into the current HTN and DM treatment regimen by healthcare professionals. Psychosocial interventions in young people and family-engagement-focused treatment adherence tactics in older adults with psychological and cognitive impairment would be beneficial to ensure control of HTN and DM, especially in the Indian population.

Notably, the study points to modifiable psychological impairments, including depression and anxiety, as critical predictors of uncontrolled hypertension and diabetes in the population. However, further research is needed to examine the underlying culturally driven mental processes and related behaviours of patients with psychological impairments that prevent them from achieving control of their blood pressure and blood sugar levels. Taking into account the significance of treatment compliance and lifestyle changes for controlling these conditions (Ojangba et al., 2023), further study is required to understand how psychological impairments affect the ability of adults to refrain from other behavioural risk factors that can potentially lead to these uncontrolled conditions.

The study has some limitations as well. Firstly, the cross-sectional data limits our capacity to assess the causality. Also, the behavioural risk factors and psychological and cognitive impairments would have been potentially underreported due to social desirability bias. Since our study was a community door-knock survey we could record only the random blood sugar which is a limitation. However, the self-reporting of the participants helped to verify their blood sugar status.

5. Conclusion

Considering the critical mediating role of cognitive factors in effectively managing HTN and DM, combining medical and psychological interventions is imperative. Less would be left out of the HTN and DM care continuum if detection gateways- evidence-based, cost-effective, cognitive and psychological interventions and family engagement models were included. Thus, findings inform the governments to revisit the policies and programs and professionals in their practices to achieve the chronic condition control targets of the countries.

6. Institutional Review Board statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of Rajagiri College of Social Sciences.

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Informed consent statement

Written informed consent has been obtained from the patients.

CRediT authorship contribution statement

Saju Madavanakadu Devassy: Conceptualization, Methodology, Writing – original draft, Supervision, Project administration, Funding acquisition. **Salini Baby John:** Conceptualization, Writing – review & editing, Supervision. **Lorane Scaria:** Formal analysis, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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