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Clinical factors associated with multimorbidity, polypharmacy and medication regimen complexity among adults with hypertension: a multicentre cross-sectional study

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ABSTRACT

Objectives Factors associated with multimorbidity, polypharmacy and Medication Regimen Complexity Index (MRCI) may vary across countries. However, such data are lacking in the present study setting. This study aimed to identify factors associated with multimorbidity, polypharmacy and MRCI among adults living with hypertension in public hospitals of South Gondar Zone.

Design Multicentred cross-sectional design

Setting Public hospitals of Comprehensive Specialised and Primary Hospitals, Ethiopia.

Participants Adults living with hypertension who had follow-up visits at outpatient clinics and were selected by systematic random sampling from 1 December 2021 to 28 February 2022.

Primary and secondary outcome measures Medication regimen complexity was assessed using a 65-item medication regimen complexity tool. Sociodemographic data were collected through an interview, while polypharmacy and clinical characteristics were documented using a checklist. Data were entered into SPSS V.26 and analysed using STATA V.17. A binary logistic regression model was used to determine the AOR of factors associated with multimorbidity and polypharmacy. For factors influencing MRCI, an ordinal logistic regression was used.

Results We found participants from Nefas Mewucha Hospital (AOR = 0.3, 95% CI 0.15 to 0.59) and Mekane Eyesus Hospital (AOR = 0.17, 95% CI 0.07 to 0.38), compared with Debre Tabor Comprehensive Specialised Hospital, polypharmacy (AOR = 5.52, 95% CI 1.49 to 20.39), medium (AOR = 19.76, 95% CI 5.86 to 66.56) and high MRCI (AOR = 120.32, 95% CI 33.12 to 437.07) were associated with multimorbidity. Multimorbidity (AOR = 25.4, 95% CI 7.48 to 86.23), controlled blood pressure (AOR = 0.43, 95% CI 0.19 to 0.92) and duration of hypertension therapy 5 years or more (AOR = 2.12, 95% CI 1.08 to 4.16) were associated with polypharmacy. Whereas controlled BP (AOR = 0.48, 95% CI 0.32 to 0.72) and multimorbidity (AOR = 14.55, 95% CI 9.00 to 23.52) were significantly associated with high MRCI. The prevalence of multimorbidity, high MRCI and polypharmacy was found in 46.1%, 35.22% and 12.29% of participants, respectively.

Conclusion A considerable proportion of participants with hypertension experienced multimorbidity, polypharmacy and high medication complexity. Polypharmacy, primary hospital setting and high MRCI were independent variables associated with multimorbidity. On the other hand, multimorbidity and controlled BP were associated with polypharmacy and MRCI. Hypertension care should consider multimorbidity, polypharmacy and medication complexity.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study used objective measures to assess multimorbidity, polypharmacy and medication regimen complexity, strengthening the methodological rigour.
⇒ The multicentred design nature of the study is considered an additional strength of the present study.
⇒ However, this study has a limitation being cross-sectional that did not establish a true cause-effect relationship between outcome and independent factors.
⇒ Moreover, the relatively small sample size and exclusion of inpatient settings restrict the findings' generalisability to adults living with hypertension who have chronic follow-up at outpatient departments only.
⇒ Under-representation of older adults and medication adherence were not adequately addressed, potentially affecting study results.

INTRODUCTION

Multimorbidity is defined as the co-occurrence of two or more chronic health conditions in an individual.[1 2] It has become a major public health problem, with prevalence ranging from 12.9% to 95.1%.[3 4] Multimorbidity has been linked with premature death, poor quality of life, increased

healthcare utilisation, advanced age, higher body mass index, reduced kidney function, lower socioeconomic status, birth gender, suboptimal blood pressure (BP) control and polypharmacy.[2 3 5–7]

The definition of polypharmacy has not been standardised; however, it is commonly defined in the literature as the routine use of five or more concurrent medications. This includes over-the-counter drugs, prescription medications, traditional remedies and complementary medicines.[8] The prevalence of polypharmacy has increased worldwide and is associated with factors such as duration of treatment, comorbidities, chronic illness and advanced age.[9 10]

Medication regimen complexity includes factors such as dosage forms, dosing frequency and additional instructions related to medications. It accounts for both prescription and over-the-counter medications to calculate the Medication Regimen Complexity Index (MRCI).[11] This complexity is associated with clinical outcomes such as hospitalisation, hospital readmission, medication adherence, BP, age and comorbidity.[12–14]

Literature has shown that the prevalence of multimorbidity varies across countries. Lifestyle and demographic factors contribute to the development of multimorbidity in diverse populations.[15] Unhealthy lifestyles[16] and lower socioeconomic status[17 18] have been associated with multimorbidity, which in turn contributes to polypharmacy. A study conducted in Saudi Arabia found that non-Saudi nationalities were associated with polypharmacy compared with Saudi nationals.[19] These findings suggest that factors associated with multimorbidity, polypharmacy and the MRCI may vary across countries.

There are limited data regarding factors associated with multimorbidity, polypharmacy and medication regimen complexity among adults with hypertension in outpatient settings in Ethiopia. Therefore, the purpose of the present study was to identify factors associated with polypharmacy, medication regimen complexity and multimorbidity among adults with hypertension attending the outpatient follow-up department in the South Gondar Zone.

METHODS

Study area, design and period

The study was conducted in one purposively and three randomly chosen public hospitals in South Gondar Zone. According to the 2007 census, conducted by the Central Statistical Agency (CSA) in Ethiopia, this Zone has a total population of 2 051 738. Based on the 2011 CSA population projection, the South Gondar Zone has a total population of 2 239 077 (1 103 490 women and 1 135 587 men). An institution-based multicentred cross-sectional design was used, and data were collected from 1 December 2021 to 28 February 2022.

Study participants

The source population embraced all adults with hypertension attending follow-up appointments at outpatient departments. The study findings were reported according to the guidelines for reporting observational studies, Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.[20]

Eligibility criteria

Inclusion criteria

- Adults aged 18 years and above
- Receiving antihypertensive medications for at least 6 months
- Following up at the outpatient departments of the study hospitals
- Willing to participate

Exclusion criteria

- Cognitive impairment
- Hearing problems
- Admitted to inpatient wards

Sample size determination and sampling technique

There were no previous studies that we used to determine the sample size of the present study. Therefore, we used a single population proportion formula considering a 95% CI and a prevalence of 50% for outcomes. Then, we reached a sample size of 384. Accounting for a 10% non-response rate, the final sample size was 423. Debre Tabor Comprehensive Specialised Hospital, being the only specialised hospital in the zone, was selected purposively, while Addis Zemen Hospital, Nefas Mewucha Hospital, and Mekane Eyesus Hospital were chosen randomly. A proportional allocation and a systematic random sampling technique were applied, with a sampling interval of four; thus, every fourth participant was included until the desired sample size was reached.

Study variables

Dependent variables: Multimorbidity, MRCI, polypharmacy.

Independent variables: Age, gender, residence, marital status, income, BP status, educational status, number of medications, duration of treatment, health insurance, aerobic exercise.

Operational definitions

Medication regimen complexity: Comprised the dosage form, dosing interval and additional instructions to calculate the patient's medication burden. It is quantified using the 65-item MRCI and then categorised into three levels: low (≤4), medium (5-8) and high (>8) MRCI scores.[21]

Multimorbidity: Co-existence of two or more chronic conditions in an individual.[1 2]

Controlled BP: Defined as BP <140/90 mm Hg for individuals with hypertension without comorbidity, or BP <130/90 mm Hg for those with diabetes mellitus, chronic kidney disease, or known cardiovascular diseases.[22]

Regular aerobic exercise: Participants engaged in activities like brisk walking, recreational swimming, cycling and tennis for at least 150 min per week.[23]

Table 1 Characteristics of study participants

Variable	Category of variable	Patient level medication regimen complexity		
		Low	Medium	High
Sex	Female	55 (13.00%)	114 (26.95%)	84 (19.86%)
	Male	33 (7.80%)	72 (17.02%)	65 (15.37%)
Age in years	<65	65 (15.37%)	109 (25.77%)	96 (22.70%)
	65+	23 (5.44%)	77 (18.20%)	53 (12.53%)
Marital status	Single	4 (0.95%)	15 (3.55%)	8 (1.89%)
	Married	60 (14.18%)	123 (29.08%)	104 (24.59%)
	Divorced	7 (1.65%)	19 (4.49%)	6 (1.42%)
	Widowed	17 (4.02%)	29 (6.86%)	31 (7.33%)
Residence	Urban	55 (13.00%)	114 (26.95%)	98 (23.17%)
	Rural	33 (7.80%)	72 (17.02%)	51 (12.06%)
Income in Ethiopian birr	<6000	76 (17.97%)	174 (41.13%)	140 (33.10%)
	6000+	12 (2.84%)	12 (2.84%)	9 (2.13%)
Religion	Christian	82 (19.39%)	176 (41.61%)	137 (32.39%)
	Muslim	6 (1.42%)	10 (2.36%)	12 (2.84%)
Education	Unable to read and write	56 (13.24%)	105 (24.82%)	87 (20.57%)
	Can read and write	4 (0.95%)	10 (2.36%)	4 (0.95%)
	Primary	9 (2.13%)	38 (8.98%)	26 (6.15%)
	Secondary	5 (1.18%)	15 (3.55%)	12 (2.84%)
	Higher education	14 (3.31%)	18 (4.26%)	20 (4.73%)
Occupation	Farmer	16 (3.78%)	30 (7.09%)	24 (5.67%)
	Merchant	11 (2.60%)	37 (8.75%)	29 (6.86%)
	Daily labourer	1 (0.24%)	2 (0.47%)	0 (0.00%)
	Retired	8 (1.89%)	13 (3.07%)	10 (2.36%)
	Unemployed	38 (8.89%)	89 (21.04%)	69 (16.31%)
	Employed	14 (3.31%)	15 (3.55%)	17 (4.02%)
Multimorbidity	Yes	3 (0.71%)	69 (16.31%)	123 (29.08%)
	No	85 (20.09%)	117 (27.66%)	26 (6.15%)
Polypharmacy	Yes	0 (0.00%)	0 (0.00%)	52 (12.29%)
	No	88 (20.80%)	186 (43.97%)	97 (22.93%)
BP controlled	Yes	54 (12.77%)	73 (17.26%)	48 (11.35%)
	No	34 (8.04%)	113 (26.71%)	101 (23.88%)
Aerobic exercise	Yes	30 (7.09%)	45 (10.64%)	23 (5.44%)
	No	58 (13.71%)	141 (33.33%)	126 (29.79%)
Health insurance	Yes	58 (13.71%)	132 (31.21%)	115 (27.19%)
	No	30 (7.09%)	54 (12.77%)	34 (8.04%)
Study setting	Debre Tabor	22 (5.20%)	71 (16.78%)	57 (13.48%)
	Nefas Mewucha	16 (3.78%)	39 (9.22%)	45 (10.64%)
	Addis Zemen	34 (8.04%)	35 (8.27%)	31 (7.33%)
	Estie	16 (3.78%)	41 (9.69%)	16 (3.78%)
Therapy duration	<5 years	64 (15.13%)	132 (31.21%)	87 (20.57%)
	5+ years	24 (5.67%)	54 (12.77%)	62 (14.66%)

Polypharmacy: Routine use of five or more medications by a patient.[8] Fixed-dose combinations (FDCs) were accounted for in the methodology, although no FDCs were identified in the medication regimens of the participants. FDCs would have been counted as a single medication in the patient's regimen, regardless of the number of active ingredients, in cases where FDCs were present. This strategy helps to avoid overestimating the medication burden while considering the contribution of such combinations to the regimen complexity.

Chronic health condition: A chronic health condition is defined as a health problem that cannot be cured once acquired or one that persists for at least 3 months.[24]

Data collection procedures

A questionnaire was developed and translated into Amharic, and then, back-translated into English to ensure consistency. Interviews were conducted to gather sociodemographic and clinical characteristics not found in patient charts, such as monthly income, regular aerobic exercise, over-the-counter medications, marital status, educational level and health insurance. A checklist was used to collect data on BP level, dosage forms, dose frequency, number of medications and additional administration instructions. The 65-item MRCI tool, including sections on dosage forms, dose frequency and additional

Table 2 Morbidities among hypertensive patients

Disorder	Frequency	Percent
Type 2 diabetes mellitus	52	21.40
Dyslipidaemia	25	10.29
Dyspepsia	21	8.64
Hypertensive heart disease	21	8.64
Bronchial asthma	21	8.64
Rheumatoid arthritis	19	7.82
Peripheral neuropathy	19	7.82
Congestive heart failure	12	4.94
Ischaemic stroke	10	4.12
Ischaemic heart disease	7	2.88
Hyperthyroidism	6	2.47
HIV	5	2.06
Chronic kidney disease	3	1.23
Type 1 diabetes mellitus	3	1.23
Myalgia	3	1.23
Generalised tonic-clonic	3	1.23
Others* (each 1 (0.41%))	13	5.35

*Rheumatic fever, Pulmonary tuberculosis, Glaucoma, Parkinson's disease, Fatty liver disease, Degenerative aortic stenos, Degenerative spondylosis, Osteoarthritis, Hypocalcaemia, Bilateral flank pain, Schizophrenia, Trigeminal neuralgia, and Soft tissue injury.

instructions with corresponding scores, was used to determine the MRCI.[11]

The average of two BP readings taken 2 min apart during a visit was used to determine BP status.[25]

Data quality control

To ensure data quality, we conducted a pretest with trained data collectors and checked the completed questionnaires and checklists daily for completeness and correctness. The training covered the study objectives, methods and ethical concerns.

Statistical analysis

Data were entered into SPSS v. 26 and analysed using Stata 17. We checked that there is no multicollinearity (variance inflation factor less than two). We checked the reliability of the 65 items MRCI tool for our study settings and found a 0.7 value of Cronbach's alpha indicates the reliability of the tool. Categorical variables were described using frequencies, while means and SD were used for continuous variables. After checking assumptions, ordinal logistic regression for MRCI and binary logistic regression for multimorbidity and polypharmacy were employed to identify factors associated with MRCI and multimorbidity, respectively. Variables with a p value of <0.25 in univariate analysis were included in the multivariate analysis, and statistical significance was set at a p value of <0.05.

Ethical consideration

The present study was approved by the Institutional Research and Ethical Review Committee (IRERC), College of Health Sciences, Debre Tabor University (Ref: CHS/DTU1421//2021), and conducted in accordance with the guidelines and standards of the Declaration of Helsinki. IRERC gave us approval to receive verbal informed consent as the study does not have any known potential risk to participants. Therefore, verbal consent was obtained from study participants after explaining the study's methods and purpose. Personal identifiers were anonymised to keep the participants' confidentiality.

Public and patient involvement

Patients and the public were not involved in the design of this study.

RESULTS

Sociodemographic and clinical characteristics of study participants

A total of 423 participants were included in the study analysis. The participants' ages ranged from 23 to 90 years with a mean ± SD of 58.48 ± 12.96 years, and the majority of participants (59.81%) were female. The number of medications taken by each participant ranges from one to seven with mean ± SD of 2.65 ± 1.35.

Multimorbidity and polypharmacy were found in 46.10% and 12.29% of participants, respectively. Hypertension-specific MRCI was low in 56.26%, medium in 40.43% and high in 3.31% of participants. Concerning patient level MRCI, we found low in 20.80%, medium in 43.97%, and high in 35.22% (table 1).

Patterns of multimorbidity

Type 2 diabetes mellitus (T2DM) was the most common comorbidity coexisting with hypertension, while the least encountered comorbidities included rheumatic fever, Parkinson's disease, fatty liver disease, pulmonary tuberculosis, glaucoma, degenerative aortic stenosis, degenerative spondylosis, osteoarthritis, hypocalcaemia, bilateral flank pain, schizophrenia, trigeminal neuralgia and soft tissue injury) (table 2).

The most common body system morbidity encountered among the sampled study participants with hypertension was cardiovascular disorder, which accounted for 77 cases (31.69%). In contrast, the least common was special sense disorder, accounting for just one case (0.41%) (figure 1).

Hypertension combined with T2DM was the most commonly observed multimorbidity, followed by hypertension combined with hypertensive heart disease. Conversely, hypertension combined with T2DM and HIV, hypertension combined with hypertensive heart disease and dyspepsia, and other combinations were the least frequently encountered multimorbidity among the study participants. Regarding the number of multimorbidities per participant, 53.9% had none,

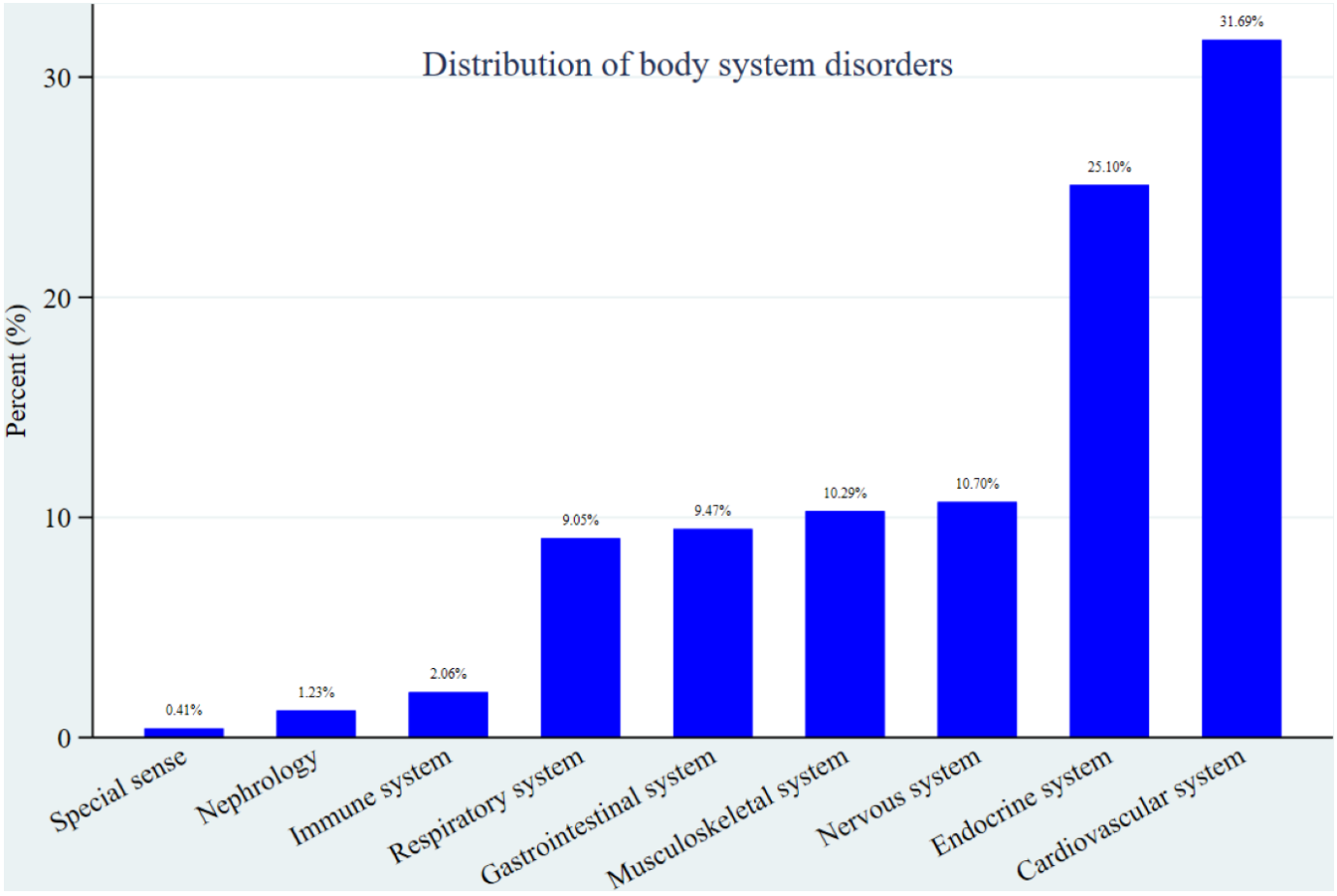

Figure 1 Percentage distribution of body system disorders.

35.22% had two, 10.4% had three and 0.24% each had four and five morbidities. Others (each accounts for 0.24%) include: hypertension + degenerative spondylosis, hypertension + type 2 diabetes mellitus + bilateral flank pain, hypertension + type 2 diabetes mellitus + HIV, hypertension + hypertensive heart disease + dyspepsia, hypertension + type 2 diabetes mellitus + fatty liver disease, hypertension + type 2 diabetes mellitus + ischaemic heart disease, hypertension + Parkinson's disease + hypertensive heart disease, hypertension + glaucoma, hypertension + trigeminal neuralgia, hypertension + type 2 diabetes mellitus + chronic kidney disease + dyslipidemia, hypertension + rheumatoid arthritis + bronchial asthma, hypertension + schizophrenia, hypertension + hypocalcaemia, hypertension + type 2 diabetes mellitus + degenerative aortic stenosis, hypertension + peripheral neuropathy + HIV, hypertension + rheumatoid arthritis + hypertensive heart disease, hypertension + congestive heart failure + bronchial asthma, hypertension + rheumatic fever, hypertension + soft tissue injury, hypertension + type 2 diabetes mellitus + ischemic stroke, hypertension + hypertensive heart disease + ischaemic stroke + bronchial asthma + dyslipidaemia, hypertension + osteoarthritis, hypertension + HIV + bronchial asthma, hypertension + hypertensive heart disease + pulmonary tuberculosis, and hypertension + dyslipidaemia + congestive heart failure (table 3).

Factors associated with multimorbidity, polypharmacy and MRCI

In the final adjusted binary logistic regression, we found that polypharmacy, patient-level medication regimen complexity and the study hospital were associated with the presence of multimorbidity.

Polypharmacy was significantly associated with a duration of hypertension treatment of 5 years or more, multimorbidity and controlled BP in the adjusted binary logistic regression analysis.

We identified several factors associated with MRCI for inclusion in a multivariate ordinal logistic regression analysis. These factors include the presence of multimorbidity, controlled BP, duration of hypertension treatment of 5 years or more, engaging in aerobic exercise, having health insurance and an income greater than 6000 Ethiopian birr.

In the adjusted analysis, participants experiencing multimorbidity were fourteen times more likely to have a complex medication regimen (AOR = 14.55, 95% CI 9.00 to 23.52, p<0.0001). Furthermore, participants with controlled BP, as per the 2021 WHO pharmacological treatment of hypertension guidelines were 52% less likely

Table 3 Pattern of multimorbidity among hypertensive patients

Multimorbidity		Frequency	Percent
Hypertension+T2 diabetes mellitus		30	7.09
Hypertension+Hypertensive heart disease		16	3.78
Hypertension+Dyspepsia		12	2.84
Hypertension+Rheumatoid arthritis		12	2.84
Hypertension+Dyslipidaemia		11	2.60
Hypertension+Peripheral neuropathy		10	2.36
Hypertension+Bronchial asthma		10	2.36
Hypertension+Ischaemic stroke		8	1.89
Hypertension+T2 diabetes mellitus+Dyslipidaemia		7	1.65
Hypertension+Congestive heart failure		7	1.65
Hypertension+Hyperthyroidism		6	1.42
Hypertension+Ischaemic heart disease		6	1.42
Hypertension+Peripheral neuropathy+Dyspepsia		3	0.71
Hypertension+T2 diabetes mellitus+Peripheral neuropathy		3	0.71
Hypertension+T2 diabetes mellitus+Bronchial asthma		3	0.71
Hypertension+Generalised tonic-clonic epilepsy		3	0.71
Hypertension+T1 diabetes mellitus		3	0.71
Hypertension+Myalgia		3	0.71
Hypertension+Congestive heart failure+Bronchial asthma		3	0.71
Hypertension+Dyslipidaemia+Rheumatoid arthritis		2	0.47
Hypertension+Dyspepsia+Bronchial asthma		2	0.47
Hypertension+Dyslipidaemia+Bronchial asthma		2	0.47
Hypertension+Rheumatoid arthritis+T2 diabetes mellitus		2	0.47
Hypertension+HIV immunodeficiency virus		2	0.47
Hypertension+Chronic kidney disease		2	0.47
Hypertension+Peripheral neuropathy+Rheumatoid arthritis		2	0.47
Others		25	5.91
Number of multimorbidity	0	228	53.90
	2	149	35.22
	3	44	10.40
	4	1	0.24
	5	1	0.24

to have a complex medication regimen (AOR = 0.48, 95% CI 0.32 to 0.72, p<0.0001) (table 4).

DISCUSSION

In the present study, we found that 46.10% of participants had multimorbidity, 12.29% experienced polypharmacy and 35.22% had a high patient-level MRCI. Additionally, we identified associations between polypharmacy, patient-level MRCI and the study hospital with multimorbidity. We also found that the duration of hypertension therapy, controlled BP and multimorbidity were associated with polypharmacy, while controlled BP and multimorbidity were associated with a high patient-level MRCI.

The magnitude of multimorbidity observed in our study is higher than that reported in studies conducted in Sweden (21.6%),[26] Japan (29.9%)[7] and Hong Kong, China (40.4%),[6] but lower than findings from studies conducted in Bahir Dar, Ethiopia (54.8%),[27] Ghana (55%),[28] India (55%),[29] United Kingdom (73.9%)[5] and another study in China (56.7%).[30]

Concerning polypharmacy, our finding is lower than those findings from studies conducted in Gondar, Ethiopia (46.6%),[31] Ghana (64.8%),[28] Somaliland (71%),[10] Saudi Arabia ((21%), (79%))[9 32] and Japan (22.3%).[7]

We found high patient level MRCI in 35.22% of study participants, which is lower than the 57.2% reported in a study conducted in Gondar, Ethiopia.[31]

Participants with polypharmacy (≥5 medications) were more likely to experience multimorbidity compared with those without polypharmacy, a finding supported by a

Table 4 Univariate and multivariate logistic analysis of predictors of MRCI, polypharmacy and multimorbidity

Variable	Variable category	Outcome Patient MRCI* ≤4 5–8>8	COR (95% CI)	AOR (95% CI)
Income	<6000 ETB ≥6000 ETB	76 174 140 12 12 9	1 0.52 (0.26 to 1.03)†	1 0.59 (0.28 to 1.24)
Multimorbidity	No Yes	85 117 26 3 69 123	1 15.19 (9.47 to 24.37)†	1 14.55 (9.00 to 23.52)‡
Controlled BP	No Yes	34 113 101 54 73 48	1 0.46 (0.32 to 0.67)‡	1 0.48 (0.32 to 0.72)‡
Aerobic exercise	No Yes	58 141 126 30 45 23	1 0.49 (0.32 to 0.74)‡	1 0.77 (0.48 to 1.23)
Health insurance	No Yes	30 54 34 58 132 115	1 1.47 (0.99 to 2.19)†	1 1.53 (0.98 to 2.39)
Hypertension therapy	<5 years ≥5 years	64 132 87 24 54 62	1 1.66 (1.13 to 2.44)‡	1 1.17 (0.77 to 1.78)
		Polypharmacy§ Absent Present		
Study hospital	DCSH NMWH ADZH MEH	126 24 85 15 94 6 66 7	1 0.78 (0.38 to 1.62)† 0.39 (0.16 to 0.96)‡ 0.56 (0.23 to 1.36)†	1 1.06 (0.47 to 2.38) 0.73 (0.28 to 1.93) 1.96 (0.67 to 5.71)
Multimorbidity	No Yes	225 3 146 49	1 24.49 (7.49 to 80.08)‡	1 25.39 (7.48 to 86.22)‡
Hypertension therapy	<5 years ≥5 years	258 25 113 27	1 2.58 (1.43 to 4.66)‡	1 2.12 (1.08 to 4.16)‡
Controlled BP	No Yes	206 42 165 10	1 0.42 (0.19 to 0.92)‡	1 0.42 (0.19 to 0.92)‡
		Multimorbidity§ Absent Present		
Age	<65 years ≥65 years	152 118 76 77	1 1.31 (0.87 to 1.94)†	1 1.09 (0.64 to 1.88)
Study hospital	DCSH NMWH ADZH MEH	59 91 56 44 56 44 57 16	1 0.51 (0.30 to 0.85)‡ 0.53 (0.32 to 0.88)‡ 0.18 (0.09 to 0.35)‡	1 0.30 (0.15 to 0.59)‡ 0.80 (0.36 to 1.77) 0.16 (0.07 to 0.38)‡
Aerobic exercise	No Yes	165 160 63 35	1 0.56 (0.35 to 0.90)‡	1 0.86 (0.41 to 1.81)
Hypertension therapy	<5 years ≥5 years	169 114 59 81	1 2.01 (1.33 to 3.02)‡	1 1.49 (0.85 to 2.61)
Controlled BP	No Yes	124 124 104 71	1 0.69 (0.47 to 1.03)‡	1 1.12 (0.64 to 1.95)
Polypharmacy	Absent Present	225 146 3 49	1 24.49 (7.49 to 80.08)‡	1 5.52 (1.49 to 20.39)‡
Patient MRCI	≤4 5–8 >8	85 3 117 69 26 123	1 12.38 (4.35 to 35.26)‡ 99.34 (33.45 to 295.07)‡	1 19.76 (5.87 to 66.56)‡ 120.32 (33.12 to 437.07)‡

*Ordinal logistic regression was used.
†p<0.25
‡p<0.05
§Binary logistic regression used
AOR, Adjusted OR; BP, Blood pressure; COR, Crude OR; DCSH, Debre Tabor Comprehensive Specialised Hospital; ETB, Ethiopian birr; MEH, Mekane Eyesus Hospital; MRCI, Medication Regimen Complexity Index; NMWH, Nefas Mewucha Hospital, ADZH, Addis Zemen Hospital.

study from Japan.[7] Moreover, participants with medium or high patient level MRCI were more likely to experience multimorbidity compared with those with low patient level MRCI. This finding is in line with the finding from Sweden.[26] Study participants who had follow-up visits at primary care hospitals were less likely to experience multimorbidity compared with those who had follow-up visits at comprehensive specialised hospital. This finding is supported by a study conducted in India, which reported that multimorbidity varied between different healthcare

settings, such as public versus private care setting.[33] Additionally, a study conducted in Sri Lanka found that higher multimorbidity in tertiary care than in primary setting, although the difference was not statistically significant.[34] While previous studies have identified factors such as age, being male and uncontrolled BP that are associated with multimorbidity,[5 6 27] these factors were not significantly associated with multimorbidity in our study.

We found that participants who had been undergoing hypertension treatment for 5 years or more were twice as likely to experience polypharmacy. This finding is supported by a study from Saudi Arabia.[9] In addition, we identified that controlled BP and the presence of multimorbidity were associated with polypharmacy; however, we did not find comparable studies to further discuss these findings.

We found that those participants with controlled BP were 52% less likely to have medium or high patient level MRCI compared with those with uncontrolled BP. This finding is similar to the finding of the study from Japan in which those participants with higher MRCI were more likely to have poor BP control.[13] Additionally, we identified that participants with multimorbidity were 14 times more likely to have medium or high patient level MRCI, in line with a finding from a study in Korea.[35]

The observed differences between findings may be attributed to variations in inclusion criteria and the sociodemographic distribution of study participants. In our study, we determined multimorbidity, polypharmacy and MRCI as well as associated factors specifically among hypertensive adults, whereas most of the previous studies assessed multimorbidity,[30] polypharmacy[10 31 32] and MRCI[31] among participants with any chronic conditions, without requiring a hypertension diagnosis as a mandatory inclusion criterion.

Strengths and limitations

The present study is the first in the Ethiopian healthcare setting that identified factors associated with multimorbidity, polypharmacy and MRCI among adult hypertensive patients. The multicentred design enhances the generalisability of the findings to outpatient settings in diverse healthcare facilities. However, this study has a limitation being cross-sectional, which limits the ability to establish true cause-effect relationships between outcomes and identified factors. Moreover, exclusion of inpatient settings restricts the generalisability of the findings to adult hypertensive patients receiving chronic care in outpatient departments only. Although we employed probability sampling techniques, a higher proportion of the population aged under 65 years included in the study may under-represent factors associated with multimorbidity, polypharmacy and MRCI in older populations. Adherence to therapy was not assessed in our study, which might influence the results of the study. The relatively small sample size of this multicentre study may limit the generalisability of its findings to similar healthcare settings.

Clinical implication of the study findings

The high prevalence of multimorbidity (46.10%) in adults living with hypertension highlights comprehensive care strategies. Healthcare providers should consider multiple chronic conditions when managing hypertension patients, as multimorbidity is often linked to more complex treatment regimens and adverse health outcomes. Adjusting treatment plans that address multimorbidity may improve patient outcomes and reduce complications. The observed high MRCI (35.22%) in our study indicates the need to simplify medication regimens without compromising treatment effectiveness whenever possible, particularly in patients with multimorbidity. Healthcare providers should use strategies like combining medications with fewer doses or using fixed dose combinations to help optimise treatment for patients with high MRCI.

Polypharmacy (12.29%) was strongly associated with multimorbidity, underscoring the importance of regular medication reviews to minimise unnecessary polypharmacy, risk of drug interactions and side effects. Clinicians should monitor patients on multiple medications closely and regularly assess the appropriateness of each medication for the patient's current health status.

The association of uncontrolled BP with both polypharmacy and high MRCI suggests that these patients may require more intensive treatment strategies, including close monitoring of BP, medication adjustments and identifying the underlying cause. The association between longer duration of hypertension treatment (5 years or more) and polypharmacy emphasises the need for ongoing assessment of treatment effectiveness over time. Patients with long-standing hypertension are more likely to develop additional comorbidities, so healthcare providers should ensure that the long-term hypertension management plan is regularly updated to reflect changes in the patient's health and medication needs.

Based on our findings, we recommend strengthening the integrated care model that involves physicians, pharmacists and nurses to address multimorbidity and optimise medication use. Emphasis should be given to patient-centred care to simplify medication regimens and education on adherence and lifestyle modifications. Health systems should be strengthened to enhance the capacity of primary hospitals to manage hypertension and its comorbidities effectively. Further longitudinal research with a large sample size is needed to explore the long-term outcomes of these findings. Health policy makers should address these challenges in designing guidelines for chronic disease management.

CONCLUSION

The present study showed that a considerable proportion of adults living with hypertension experienced multimorbidity, polypharmacy and patient level MRCI. We identified the primary hospital setting, polypharmacy and MRCI as associated factors of multimorbidity. Additionally,

multimorbidity and controlled BP were associated with polypharmacy and MRCI in this study. Furthermore, the duration of hypertension treatment was significantly associated with polypharmacy. However, it is important to note that the relatively small sample size of the study may limit the generalisability of these findings. Therefore, hypertension care should consider multimorbidity, polypharmacy and MRCI to optimise their care, while recognising that further research with a large sample size is needed to support these findings.

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