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ORIGINAL RESEARCH

Medication Adherence and Perceived Social Support of Hypertensive Patients in China: A Community-Based Survey Study

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Purpose: Previous studies suggested perceived social support has impact on medication adherence among hypertensive patients, but did not simultaneously elucidate the different contents or key providers of social support that patients perceived. This study was to identify the contents and providers of perceived social support beneficial for improving medication adherence among hypertensive patients in China, which could prove important for targeted interventions.

Patients and Methods: Following a multi-stage stratified sampling framework, a total of 903 hypertensive patients from 12 primary health institutions across a middle-income city were recruited from April to June 2021. Medication adherence was measured using the Chinese version of the Morisky, Green and Levine scale; perceived social support was determined using the name generator method. A binary logistic regression model was performed to identify the association between medication adherence and perceived social support. The contents of support included informational, emotional, and instrumental support (finances and caregiving). The support providers included spouse/partner, children, parents, siblings, other relatives, and friends.

Results: A total of 506 (56.04%) patients optimally adhered to their antihypertensive medication. Female, older, urban patients, patients with shorter duration of hypertension and antihypertensive medications used showed better adherence ($P<0.05$). Optimal medication adherence was positively associated with the overall score of caregiving support (adjusted odds ratio [AOR] = 1.128; 95% confidence interval [CI] = [1.013–1.257]), informational support from the spouse/partner (AOR = 1.574; 95% CI = [1.112–2.227]), emotional support from the spouse/partner (AOR = 1.430; 95% CI = [1.032–1.981]), financial support from the spouse/partner (AOR = 1.439; 95% CI = [1.069–1.937]) and caregiving support from the spouse/partner (AOR = 1.652; 95% CI = [1.130–2.414]), whereas optimal medication adherence was negatively associated with caregiving support from friends (AOR = 0.499; 95% CI = [0.286–0.872]).

Conclusion: Informational, emotional, financial and caregiving support from spouses/partners have positive impacts on optimal medication adherence of hypertensive patients of community-level. Community-based interventions designed to improve medication adherence of hypertensive patients should target both patients and their spouses/partners; spouses/partners could be encouraged to provide various support to improve the medication adherence of hypertensive patients.

Keywords: medication adherence, perceived social support, spouse, hypertension, China

Introduction

Medication Adherence of Hypertensive Patients in China

Hypertension has been considered one of the most significant public health challenges in China for two reasons. First, there is a high incidence of hypertension coupled with low rates of control. A total of 24.1% of the Chinese women and 30.2% of the men had hypertension in 2019. However, hypertension was controlled in only 17.8% of the women and 13.9% of the men, which was lower than global levels.[1] Second, hypertension represents a risk factor for other severe diseases, including cardiovascular disease, stroke, and kidney failure.[2–4]

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To better control hypertension, the Chinese government introduced hypertension management services as part of the Basic Public Health Service (BPHS) program initiated in 2009.[5] The BPHS program, funded by the government, has required primary healthcare facilities to provide services to ensure standardized management of hypertension among residents over 35 years of age who are within their jurisdiction.[5] The measures taken to manage hypertension provided to patients include blood pressure measurement, risk assessment, health education, guidance for medication and lifestyle at quarterly face-to-face visits,[6] in accordance with the World Health Organization (WHO) recommendations for essential packages of primary care interventions for non-communicable diseases.[7]

Optimal medication adherence represents one of the best strategies to control high blood pressure.[8] Suboptimal medication adherence contributes to the poor control of blood pressure.[9] Some surveys have shown that the level of optimal medication adherence among hypertensive patients in China was less than ideal, at approximately 30–40%,[10,11] despite evidence that medication adherence improved markedly following the active management through the BPHS program.[12] Therefore, suboptimal medication adherence among hypertensive patients has become a significant public health challenge in China.

Medication adherence has been defined as the process by which patients take their medication as prescribed by their doctors.[13] The measurement methods of medication adherence include direct observation, drug dosage calculation, electronic equipment monitoring, and survey questionnaires.[14] Most researchers have used survey questionnaires based on patient's self-reported data because they are simple and economic to measure medication adherence.[14] Several scales have been developed for different diseases. Among them, the Morisky, Green and Levine scale has been the most widely used for hypertension research; there is a simple version with four items and a detailed version with eight items. Both versions have high reliability.[15,16]

Role of Perceived Social Support in Medication Adherence

Efforts designed to improve the level of medication adherence of hypertensive patients demand an understanding of the factors related to medication adherence that could inform intervention strategies. Adherence to medication is influenced by multiple interrelated factors. The WHO introduced a framework to classify factors that influence medication adherence in the report, *Adherence to long-term therapies: evidence for action*. The five classifications were: patient-related factors, such as understandings, beliefs, or skills; socio-economic factors, such as health literacy or social support; condition-related factors, such as the presence of comorbidities; therapy-related factors, such as the complexity of a drug regimen; and, factors related to the health system or the healthcare team, such as communication with health-care providers.[17]

The positive effects of perceived social support on medication adherence has been emphasized, however, there are still inconsistent research findings. The WHO indicated that support from family, community, and health service providers represents a crucial component for the successful improvement of treatment compliance among patients with chronic disease.[17] Despite this, social support has been relatively neglected in previous studies. The unsatisfactory impact of intervention on other factors, coupled with the greater attention paid to social health and social determinants, has encouraged a growing number of researchers to explore the impact of social support on medication adherence in recent years. Some studies have shown that adequate and available perceived functional social support from patients' social networks, such as family members and friends, positively impacted the medication adherence of patients and enabled them to effectively cope with the disease.[18–20] However, the effects of perceived social support on medication adherence are not unequivocally positive. A few studies have indicated that perceived social support was not associated with medication adherence.[21,22] Moreover, there is evidence that perceived social support can also negatively affect medication adherence, particularly in those with chronic conditions.[23,24] In addition, the impacts of different types of perceived social support on medication adherence also differed according to context.[25] For example, a studies suggested the positive impacts of emotional support,[26] whereas the negative impact of informational support on adherence was reported.[27] Thus, evidence remains inconsistent for associations between medication adherence and general perceived social support as well as distinct supportive contents, more researches in different social context are needed.

The importance of assessing detailed contents and providers of perceived social support has been highlighted, however, a few studies related to medication adherence considered the specificity of perceived social support. It has

been suggested that characterizing perceived social support in a behavior-specific manner, such as asking recipients whether interaction partners reminded them to take, bought or organized their medication, should provide better prediction of medication adherence.[28] Moreover, it prove important for the design of intervention contents, as interventions could be effective only at times when the patients' support needs are met.[29] However, two meta-analysis revealed that most studies on the relationships of perceived social support to medication adherence have employed the general measures,[30,31] only a few studies related to medication adherence operationalized perceived social support in a behavior-specific format for patients with other diseases, such as diabetes,[32] HIV[33] and organ transplantation.[24] Additionally, although some studies suggested that support from family members or friends influenced medication adherence,[19,20] support providers were not specified. That made it difficult to identify which particular social network member should be encouraged to provide appropriate support to patients in the interventions. Consequently, it prove important for hypertension management to assess the effects of detailed contents and providers of perceived social support on medication adherence of hypertensive patients using a more nuanced approach.

The multidimensional concepts and various measures of perceived social support used could lead to the inconsistent research findings,[30,31] but a nuanced way to assess detailed effects of support on adherence has been developed. Social support is a complex and multidimensional concept. Some scholars defined it as the supporting activities and relationships that each individual received and provided in different social networks.[34] Perceived social support refers to the individual's beliefs about the availability of varied types of support from social network members.[35] That support could be not real, but its impact on health has garnered a growing appreciation among scholars because of an understanding that the subjective perception of available support could help a person cope with difficulties.[36] Scholars have identified both structural and functional aspects of perceived social support. An individual's perception of support would suggest the existence of interpersonal relationships, a structure of support available to them in the form of a social network.[35] A focus on the functional aspects has permitted an ability to examine the specific types of contents, such as informational, emotional, and instrumental/practical support.[34,35] The measures of perceived social support have varied according to the diversity of research concepts and objectives.[34,35] Many scholars have relied on scales to capture perceived social support, such as the Social Relationship Scale (SRS), Multidimensional Scale of Perceived Social Support (MSPSS) and Social Support Questionnaire (SSQ). The different scales have permitted researchers to obtain scores that reflect overall perceived social support, support from family or friends, or support along different functional dimensions. However, these generic scales could prove vulnerable to problems of over- and under-inclusion of the types of support; the total score may contain items that are irrelevant to the stressor context, or they may not contain items that could be relevant forms of support for the context.[35] With the multidimensional nature of social support, a more nuanced approach considering specificity of social support was required. Some researchers have used the name generator method, one of the most widely used instruments for the collection of egocentric networks,[37] to capture structural and functional support provided by particular network members.[38] This method permits researchers to customize the questions to the objectives of their research.

Research Gaps and Aims of This Study

To sum up, since previous studies have arrived at conclusions based on an analysis of the correlation between medication adherence and relatively general perceived social support for hypertension, the results obtained illuminated two aspects of problems with these approaches. First, evidence remains inconsistent for the effects of social support on medication adherence in hypertension. Second, previous studies have not addressed the impacts of the detailed contents and providers of behavior-specific support on medication adherence for hypertension. Thus, this study was designed to address these gaps using the name generator method. The findings could provide an understanding about medication adherence, an examination of the relevant contents and providers of perceived social support among middle-aged and elderly hypertensive patients managed by primary healthcare facilities in China based on the BPHS program, and an identification of the contents and providers of support that impacted medication adherence among hypertensive patients. The results from this study could serve to inform targeted community-based intervention practices.

Patients and Methods

Participants and Procedures

This study was a community-based, cross-sectional survey conducted in a middle-income city in Central China between April and June of 2021. The participants were recruited among patients who had received hypertension management services from the BPHS program for more than one year. Patients were included if they satisfied the following requirements: (1) were permanent residents; (2) aged between 35 and 80 years old; (3) had a diagnosis of primary hypertension, without serious damage to target organs; (4) had received the BPHS services for more than one year, with at least four checks of their blood pressure; (5) had been undergoing antihypertensive medication therapy for at least six months; (6) were able to complete the survey; and, (6) signed an informed consent. Exclusion criteria included patients who: (1) had severe hypertension complications, such as severe heart failure and stroke; (2) were unable to complete the investigation due to physical or mental problems; or (3) were pregnant.

We conservatively supposed that 50% patients were optimally adherent to medication and used a significance level of 0.05, with a permissible error of 5% and a design effect of 2. We determined that an appropriate minimum sample size would be 770 patients. We planned to recruit a total of 960 patients, with the expectation that 20% of those approached would not respond or would decline participation.

A two-stage stratified sampling was adopted to ensure a representative sample. In the first stage, we randomly selected six urban communities in one district and six rural communities in one county. In the second stage, we identified patients with hypertension who met the inclusion criteria in the corresponding primary healthcare facility, stratified the patients by gender and age, and sampled each layer until a total of 80 patients per community were enrolled.

A uniformly-trained group of 36 health workers from primary healthcare facilities brought participants to the institution by appointment and collected data through face-to-face interviews using structured questionnaires. The survey was approved by the ethics review committee of the National Center for Chronic and Noncommunicable Disease Control and Prevention, the Chinese Center for Disease Control and Prevention, Beijing, China (Project Number: 202,029). Written informed consent was obtained from all participants.

Measures

Primary Outcome

The medication adherence of hypertensive patients was assessed with the Chinese version of the Morisky, Green and Levine scale-4-Item. The scale includes four items: A) Have you ever forgotten to take your medication? B) Are you careless about taking your medication at times? C) Have you sometimes stopped taking medication when you felt better while taking medication? and, d) have you ever stopped taking medication when you felt worse while taking medication? These were all phrased as yes-no questions, with a score of 0 for "no" and 1 for "yes". Item scores were summed to produce an overall adherence score of 0 to 4. A score of zero indicated optimal adherence; a score greater than zero indicated suboptimal adherence; suboptimal adherence was indicated for any respondent who answered "yes" to any one of the four items. The Chinese version of the Morisky, Green and Levine scale has been demonstrated to be a valid and reliable instrument for measuring adherence among Chinese patients with hypertension.[39]

Explaining Variables

The data on perceived social support were collected using the name generator method as a mean by which to characterize specific contents and providers of perceived social support. Participants were asked to indicate the names of contacts who provided support during the previous six months that was relevant to their taking of antihypertensive medication, including informational support related to advice on health problems or taking medication, emotional support related to discomfort, instrumental support related to cost of healthcare, and caregiving-related instrumental support. For each content of support, participants could name a maximum of seven people. Therefore, there was a possible range of zero to seven for each content of support. Participants provided information on the following: 1) people who advised you on health problems or taking medication; 2) people who provided emotional care when you were feeling unwell; 3) people who could offer you financial help if you needed money to see a doctor or buy medicine; and 4) people who could offer you caregiving if you were sick. In total, participants could name a maximum number of 28 network members. After

every question and for each person identified, the participants were asked to identify their relationship to the person, with the following options: spouse/partner, children, parents, siblings, other relatives, and friends.

Covariates

Covariates were selected a priori based on previous literature and biological plausibility. Some sociodemographic and clinical characteristics that were shown to have impacted medication adherence or perceived social support were collected using structured questionnaires during face-to-face interviews. The sociodemographic characteristics collected included gender, age, residence, education level, current occupation status, annual household income, and marital status. The clinical characteristics included the duration of hypertension as well as the duration and number of antihypertensive medications used.

Statistical Analysis

We conducted descriptive analysis of the sociodemographic, clinical and perceived social support characteristics of the study population. We conducted descriptive analysis of optimal medication adherence rates according to sociodemographic, clinical and perceived social support characteristics, and compared them using a chi-square test for categorical variables and an independent non-parametric test for non-normally distributed continuous variables. We assessed the association of each perceived social support with optimal medication adherence using a binary logistic regression model. The model was adjusted for the sociodemographic and clinical characteristics. All statistical tests were two-sided; the statistical significance was set at a $P<0.05$. All analyses were performed using SPSS version 21.

Results

Sociodemographic, Clinical and Perceived Social Support Characteristics of the Study Population

A total of 903 participants were recruited, with a response rate of 94.1%. Table 1 shows the sociodemographic and clinical characteristics of the study population. Of the 903 participants, the average age was 64 years old. A little more than half (52.82%) were women. Almost half (50.39%) were from rural areas. A few (12.18%) had at least a high school education. A few (13.29%) had paid employment. The annual household income of 43.19% of the participants was less than 25,000 yuan. Most (84.50%) were married. The average duration of hypertension was 6 years, and the average duration of antihypertensive medication used was 3 years. Most participants (86.05%) had been prescribed one antihypertensive medication every day.

Table 2 shows the perceived social support characteristics of the study population. The median scores of the four types of supportive contents were typically between two and three. Participants mentioned their spouse/partner and children most frequently, with more than 46% for each content; parents were mentioned the least, with less than 6% for each content.

Optimal Medication Adherence Rates of the Study Population

Among the 903 participants, 506 (56.04%) had optimal medication adherence behaviors. The specific score distribution of suboptimal medication adherence was a decreasing proportion of one to four points. Table 1 also shows the optimal medication adherence rates and univariate analysis results stratified for sociodemographic and clinical characteristics. Notably, female, older, urban patients, patients with shorter duration of hypertension, and those with shorter duration of antihypertensive medications used tended to be optimal adherent to their antihypertensive medications.

The optimal medication adherence rates and univariate analysis results stratified for perceived social support are provided in Table 2. Among the overall scores of the four types of perceived social support, only more caregiving-related instrumental support was significantly positively associated with optimal medication adherence ($P<0.05$). Participants with each of informational, emotional, finance-related instrumental and caregiving-related instrumental support from the spouse/partner had higher optimal medication adherence rates than those without this support ($P<0.05$). However, participants with finance-related instrumental from friends had lower optimal medication adherence rates than those without the support ($P<0.05$).

Table 1 Sociodemographic and Clinical Characteristics, and Optimal Adherence Rates of the Study Population (n=903)

Characteristics	Frequency (%)	Optimal Adherence Rate (%)	P value
Total	903(100)	506(56.04)	
Gender			0.025
Male	426(47.18)	222(52.11)	
Female	477(52.82)	284(59.54)	
Age	64(57–69)[a]	65(57–69)[b]	0.044
Residence			0.002
Urban	448(49.61)	274(61.16)	
Rural	455(50.39)	232(50.99)	
Education level			0.864
Not graduated from primary school or below	211(23.37)	123(58.29)	
Elementary school	297(32.89)	166(55.89)	
Middle school	285(31.56)	158(55.44)	
High school or above	110(12.18)	59(53.64)	
Occupation			0.068
Paid employment	120(13.29)	72(60.00)	
Farmer	530(58.69)	280(52.83)	
No paid employment	253(28.02)	154(60.87)	
Annual household income			0.073
0–	390(43.19)	202(51.79)	
25,000–	279(30.90)	168(60.22)	
50,000–	234(25.91)	136(58.12)	
Marital status			0.410
Married	763(84.50)	432(56.62)	
Divorced/separated/widowed/unmarried	140(15.50)	74(52.86)	
Duration of hypertension (years)	6(4–9)[a]	6(3–9)[b]	0.037
Duration of antihypertensive medications used (years)	3(2–5)[a]	3(1–5)[b]	0.001
Number of antihypertensive medications			0.511
1	777(86.05)	432(55.60)	
≥2	126(13.95)	74(58.73)	

Notes: [a]Values are presented as median (upper to lower quartiles) of total participants. [b]Values are presented as median (upper to lower quartiles) of participants with optimal medication adherence.

Associations Between Perceived Social Support and Optimal Medication Adherence

Table 3 illustrates the associations of each content and provider of perceived social support with optimal medication adherence for the study population. Optimal medication adherence was positively associated with the overall score of caregiving-related instrumental support and four types of support from the spouse/partner ($P<0.05$); whereas optimal medication adherence was negatively associated with caregiving-related instrumental support from friends ($P<0.05$). Each more provider who provided caregiving-related instrumental support was associated with a 12.8% higher odds of optimal medication adherence, compared with those who reported suboptimal medication adherence, in the adjusted model (Adjusted Odds Ratio [AOR] = 1.128; 95% Confidence Interval [CI] = [1.013–1.257]). The patients receiving informational support from the spouse/partner were 1.574 times more likely to be optimal adherent to their medications, compared to those without informational support from the spouse/partner (AOR = 1.574; 95% CI = [1.112–2.227]). The patients who reported emotional support from the spouse/partner were 1.430 times more likely to prove optimal adherent to their medications, compared to those who did not report this support from the spouse/partner (AOR

Table 2 Perceived Social Support Characteristics and Optimal Adherence Rates of the Study Population (n=903)

Providers	Informational Support			Emotional Support			Finance-related Instrumental Support			Caregiving-Related Instrumental Support		
	Frequency (%)	Optimal Adherence Rate (%)	P value	Frequency (%)	Optimal Adherence Rate (%)	P value	Frequency (%)	Optimal Adherence Rate (%)	P value	Frequency (%)	Optimal Adherence Rate (%)	P value
Overall	2(2–3)[a]	2(2–4)[b]	0.060	2(2–3)[a]	2(2–4)[b]	0.244	2(1–3)[a]	2(1–3)[b]	0.183	2(1–3)[a]	2(2–3)[b]	0.005
Spouse/ partner			0.003			0.048			0.006			0.009
No	310(34.33)	157(50.65)		345(38.21)	166(48.12)		486(53.82)	234(48.15)		258(28.57)	131(50.78)	
Yes	593(65.67)	240(40.47)		558(61.79)	231(41.40)		417(46.18)	163(39.09)		645(71.43)	266(41.24)	
Children			0.052			0.164			0.237			0.147
No	259(28.68)	127(49.03)		223(24.70)	107(47.98)		376(41.64)	174(46.28)		220(24.36)	106(48.18)	
Yes	644(71.32)	270(41.93)		680(75.30)	290(42.65)		527(58.36)	223(42.31)		683(75.64)	291(42.61)	
Parents			0.841			0.512			0.549			0.558
No	856(94.80)	377(44.04)		850(94.13)	376(44.24)		860(95.24)	380(44.19)		866(95.90)	379(43.76)	
Yes	47(5.20)	20(42.55)		53(5.87)	21(39.62)		43(4.76)	17(39.53)		37(4.10)	18(48.65)	
Siblings			0.681			0.258			0.847			0.286
No	743(82.28)	329(44.28)		731(80.95)	328(44.87)		744(82.39)	326(43.82)		791(87.60)	353(44.63)	
Yes	160(17.72)	68(42.50)		172(19.05)	69(40.12)		159(17.61)	71(44.65)		112(12.40)	44(39.29)	
Other relatives			0.941			0.795			0.631			0.482
No	638(70.65)	281(44.04)		610(67.55)	270(44.26)		673(74.53)	299(44.43)		596(66.00)	267(44.80)	
Yes	265(29.35)	116(43.77)		293(32.45)	127(43.34)		230(25.47)	98(42.61)		307(34.00)	130(42.35)	
Friends			0.970			0.065			0.010			0.291
No	667(73.86)	293(43.93)		779(86.27)	333(42.75)		843(93.36)	361(42.82)		850(94.13)	370(43.53)	
Yes	236(26.14)	104(44.07)		124(13.73)	64(51.61)		60(6.64)	36(60.00)		53(5.87)	27(50.94)	

Notes: [a]Values are presented as median (upper to lower quartiles) of total participants. [b]Values are presented as median (upper to lower quartiles) of participants with optimal medication adherence.

Table 3 Associations of Perceived Social Support with Optimal Medication Adherence Among the Study Population (n=903)

Providers	Informational Support	Emotional Support	Finance-Related Instrumental Support	Caregiving-Related Instrumental Support
	Adjusted OR (95% *CI*)	Adjusted OR (95% *CI*)	Adjusted OR (95% *CI*)	Adjusted OR (95% *CI*)
Overall	1.052(0.959–1.155)	1.067(0.975–1.168)	1.059(0.964–1.164)	**1.128*(1.013–1.257)**
Spouse/partner				
No	1.000	1.000	1.000	1.000
Yes	**1.574*(1.112–2.227)**	**1.430*(1.032–1.981)**	**1.439*(1.069–1.937)**	**1.652*(1.130–2.414)**
Children				
No	1.000	1.000	1.000	1.000
Yes	1.234(0.910–1.672)	1.325(0.959–1.832)	1.184(0.891–1.573)	1.220(0.875–1.701)
Parents				
No	1.000	1.000	1.000	1.000
Yes	1.283(0.657–2.507)	1.576(0.835–2.974)	1.505(0.737–3.072)	1.037(0.495–2.173)
Siblings				
No	1.000	1.000	1.000	1.000
Yes	1.034(0.715–1.494)	1.258(0.876–1.808)	0.976(0.673–1.414)	1.301(0.847–1.998)
Other relatives				
No	1.000	1.000	1.000	1.000
Yes	0.903(0.663–1.230)	0.971(0.719–1.311)	1.108(0.806–1.523)	1.042(0.774–1.402)
Friends				
No	1.000	1.000	1.000	1.000
Yes	0.987(0.724–1.347)	0.736(0.498–1.090)	**0.499*(0.286–0.872)**	0.755(0.424–1.341)

Notes: Optimal adherence (n=506), the reference category was suboptimal adherence (n=397). The model was adjusted for gender, age, residence, education level, current occupation status, annual household income, marital status, duration of hypertension, duration of antihypertensive medication used, and number of antihypertensive medication used. Variables with *P*<0.05 are in bold; **P*<0.05.
Abbreviations: OR, odds ratio; CI, confidence interval.

= 1.430; 95% *CI* = [1.032–1.981]). Finance-related instrumental support from the spouse/partner (*AOR* = 1.439; 95% *CI* = [1.069–1.937]) and caregiving-related instrumental support from the spouse/partner (*AOR* = 1.652; 95% *CI* = [1.130–2.414]) were associated with a 43.9% and 65.2% higher odds of optimal medication adherence, respectively. However, the patients receiving finance-related instrumental support from friends were 50.1% less likely to be optimal adherent to their medications, compared to those who did not reported this support from friends (*AOR* = 0.499; 95% *CI* = [0.286–0.872]).

Discussion
Medication Adherence of Hypertensive Patients in China

Our study found that approximately half (56.04%) of the hypertensive patients took their antihypertensive medication as prescribed. This finding was lower than some studies that used the same measurement tools in European countries,[40] such as the Netherlands (75.9%), Germany (66.8%), Austria (66.3%), Wales (61.9%), Belgium (61.1%), and England (58.5%). Moreover, the findings on suboptimal medication adherence from this study and the total number of hypertensive patients in China,[41] would permit a rough estimate that more than 100 million of the 245 million hypertensive patients in China did not take their medication as prescribed in 2018. Therefore, suboptimal medication adherence remains a serious problem that needs to be addressed.

In addition, we found lower levels of optimal medication adherence among males than females. This finding proved consistent with previous studies.[42,43] This may be due to the fact that males were less likely than females to follow lifestyle modification recommendations.[44] Consequently, greater attention should be paid to males. Younger patients were

less adherent to their antihypertensive medications compared with old patients, which is consistent with some studies.[45] This may be explained by the fact that they are less aware of the complications.[46] Patient education surrounding the importance of continuing needed medication may be worthy in our younger population, because it would lead to a higher burden on the family and society once the serious complications occurs on a labor force. The optimal medication adherence of rural patients was lower than that of urban patients. This finding was consistent with some previous studies that assume the risk of suboptimal adherence is increased among patients living in rural communities probably due to the lower household income, reduced rates of insurance coverage and increased distance to health-care services.[47,48] Thus, rural residents also should be paid more attention. It was reported that patients with shorter duration of hypertension and antihypertensive medications used tended to be optimal adherent to their medications, which is in line with some fact that those with chronic conditions often fail to follow their prescribed treatment reasonably closely during the long-term course of their illness.[49]

Effects of Perceived Social Support on Medication Adherence

Our study focus on the effects of perceived social support on medication adherence. Generally, this study demonstrated that patients' perceived social support had a positive impact on medication adherence. Some studies also have served to identify the positive importance of perceived social support.[50–52] However, there were inconsistent conclusions.[21–24] This may be due to the fact that the particular social support that exactly had impact on medication adherence could not be identified through the general measurement tools in these studies.[30]

Previous studies did not simultaneously elucidate the detailed contents or key providers that patients perceived, which was further explored in our study. Specifically, although no significance was observed in the impacts of the overall score (total number of providers) for most of supportive contents in our study, all the four types of support from a spouse/partner were the salient beneficial factor for optimal medication adherence. This finding affirmed results from some previous studies on treatment adherence for Type 2 diabetes and medication adherence for other diseases.[53,54] This was due to the fact that family members—especially spouses—often encouraged and motivated patients to fight for their health, provided healthy meal preparation, reminded them to take their medication, and shared healthy lifestyles.[55]

However, this study found a negative association between financial support from friends and optimal medication adherence. The negative effects reported from previous studies did not limited to the friends or financial support.[23,24] The cause of negative impacts could be explained by two hypothesis, including social conflict and mobilization hypotheses. Social conflict describes the potentially negative sides of the friends, including the expression of negative affect, disregard and disaffirmation.[56,57] An alternative potential explanation for this negative relationship is that those who are not adherent to the medication due to the high health-care costs mobilize more financial support from their friends in response to their need.[23,58] However, the effect mechanism needs to be further explored in the future longitudinal studies.

Implications for Interventions

This study suggested some practical implications for primary healthcare facilities with regard to hypertension management. Perceived social support from patients' social ties often has been overlooked in the design of behavioral interventions.[55] Moreover, health education about hypertension management typically has targeted individuals. However, our work suggests that interventions designed to promote medication adherence should target both the patients and spouses/partners. Alternative primary sources of support could be identified for patients without a spouse or partner. Additionally, interventions that account for the various support provided by spouses or partners could be an effective approach to improve medication adherence. Patients' spouses or partners could be encouraged to provide more informational, emotional, finance-related instrumental and caregiving-related instrumental support, such as reminding them to take medicine, giving care and comfort when they are unhappy, buying medicine for them and taking care of them when they are sick.

Strengths and Limitations

This study makes several important contributions to the research on medication adherence and practices involved in the management of hypertension. This study adds new information to the existing scientific body of knowledge through the

detailed assessment of the perceived social support that influenced medication adherence in patients with hypertension. The findings also have important practical significance because they could be applied directly to community-based hypertension management in China.

In addition, the strengths of the study design based on the patients enrolled in the BPHS program should be emphasized. First, the impact of healthcare services on medication adherence could be partially controlled due to a unified system of hypertension management, which made the findings regarding perceived social support could prove reliable. Second, the recruitment of participants already enrolled in a program permitted an ability to conduct interventions and track them in ways not possible in the studies conducted with hospital populations.

However, several limitations of this study merit attention. Firstly, the cross-sectional study design limited an ability to determine a causal link between perceived social support and medication adherence. Second, the reliance on self-reported data about medication adherence could have resulted in recall bias. Finally, perceived social support was determined by the number of people who provided it without consideration for the quality of support provided by each person. Future longitudinal studies based on a comprehensive multi-measure approach could further illuminate the effect of perceived social support on medication adherence.

Conclusion

This study investigated medication adherence and the distinct contents and providers of perceived social support among middle-aged and elderly hypertensive patients managed by primary healthcare facilities in a middle-income city in Central China. We determined which contents and providers of perceived social support had impacts on medication adherence among hypertensive patients. We found that the levels of medication adherence of male, younger and rural patients with hypertension still needed to be improved. A spouse/partner proved to be the beneficial support provider. Informational, emotional, financial and caregiving support from the spouse/partner were the beneficial contents that contributed to optimal medication adherence.

This new evidence would suggest that community-based interventions designed to improve medication adherence of hypertensive patients should target both patients and their spouses/partners; spouses/partners could be encouraged to provide various social support to improve the medication adherence of hypertensive patients.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

The protocol for this study was approved by the ethical review committee of the National Center for Chronic and Noncommunicable Disease Control and Prevention, the Chinese Center for Disease Control and Prevention, Beijing, China (Project Number: 202029). We obtained written informed consent from each respondent before their participation in the survey. This study was conducted in accordance with the Declaration of Helsinki.

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Risk Factor NCD; Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants [published correction appears in Lancet. *Lancet*. 2021;398(10304):957–980. doi:10.1016/S0140-6736(21)01330-1

2. Perumareddi P. Prevention of hypertension related to cardiovascular disease. *Prim Care*. 2019;46(1):27–39. doi:10.1016/j.pop.2018.10.005

3. Cipolla MJ, Liebeskind DS, Chan SL. The importance of comorbidities in ischemic stroke: impact of hypertension on the cerebral circulation. *J Cereb Blood Flow Metab*. 2018;38(12):2129–2149. doi:10.1177/0271678X18800589

4. Anupama YJ, Hegde SN, Uma G, Patil M. Hypertension is an important risk determinant for chronic kidney disease: results from a cross-sectional, observational study from a rural population in South India. *J Hum Hypertens*. 2017;31(5):327–332. doi:10.1038/jhh.2016.81

5. Yip WC, Hsiao WC, Chen W, Hu S, Ma J, Maynard A. Early appraisal of China's huge and complex health-care reforms. *Lancet*. 2012;379 (9818):833–842. doi:10.1016/S0140-6736(11)61880-1

6. World Bank. Toward a healthy and harmonious life in China: stemming the rising tide of non-communicable diseases. Available from: http://www. worldbank.org/content/dam/Worldbank/document/NCD_report_en.pdf. Accessed February 13, 2022.

7. World Health Organization. Package of essential (PEN) non-communicable disease interventions for primary health care in low-resource settings. Available from: http://www.who.int/nmh/publications/essential_ncd_interventions_lr_settings.pdf. Accessed February 13, 2022.

8. Gavrilova A, Bandere D, Rutkovska I, et al. Knowledge about disease, medication therapy, and related medication adherence levels among patients with hypertension. *Medicina*. 2019;55(11):715. doi:10.3390/medicina55110715

9. Burnier M. Drug adherence in hypertension. *Pharmacol Res*. 2017;125:142–149. doi:10.1016/j.phrs.2017.08.015

10. Yang S, He C, Zhang X, et al. Determinants of antihypertensive adherence among patients in Beijing: application of the health belief model. *Patient Educ Couns*. 2016;99(11):1894–1900. doi:10.1016/j.pec.2016.06.014

11. Shen Z, Shi S, Ding S, Zhong Z. Mediating effect of self-efficacy on the relationship between medication literacy and medication adherence among patients with hypertension. *Front Pharmacol*. 2020;11:569092. doi:10.3389/fphar.2020.569092

12. Qin J, Zhang Y, Fridman M, et al. The role of the Basic Public Health Service program in the control of hypertension in China: results from a cross-sectional health service interview survey. *PLoS One*. 2021;16(6):e0217185. doi:10.1371/journal.pone.0217185

13. Vrijens B, De Geest S, Hughes DA, et al. A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol*. 2012;73 (5):691–705. doi:10.1111/j.1365-2125.2012.04167.x

14. Lam WY, Fresco P. Medication adherence measures: an overview. *Biomed Res Int*. 2015;2015:217047. doi:10.1155/2015/217047

15. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*. 1986;24 (1):67–74. doi:10.1097/00005650-198601000-00007

16. Korb-Savoldelli V, Gillaizeau F, Pouchot J, et al. Validation of a French version of the 8-item Morisky medication adherence scale in hypertensive adults. *J Clin Hypertens*. 2012;14(7):429–434. doi:10.1111/j.1751-7176.2012.00634.x

17. World Health Organization. Adherence to long-term therapies: evidence for action. Available from: https://apps.who.int/iris/bitstream/handle/ 10665/42682/9241545992.pdf?sequence=1&isAllowed=y. Accessed February 13, 2022.

18. Osamor PE. Social support and management of hypertension in South-west Nigeria. *Cardiovasc J Afr*. 2015;26(1):29–33. doi:10.5830/CVJA-2014-066

19. Ojo OS, Malomo SO, Sogunle PT. Blood pressure (BP) control and perceived family support in patients with essential hypertension seen at a primary care clinic in Western Nigeria. *J Family Med Prim Care*. 2016;5(3):569–575. doi:10.4103/2249-4863.197284

20. Magrin ME, D'Addario M, Greco A, et al. Social support and adherence to treatment in hypertensive patients: a meta-analysis. *Ann Behav Med*. 2015;49(3):307–318. doi:10.1007/s12160-014-9663-2

21. Adisa R, Olajide OO, Fakeye TO. Social support, treatment adherence and outcome among hypertensive and type 2 diabetes patients in ambulatory care settings in southwestern Nigeria. *Ghana Med J*. 2017;51(2):64–77.

22. Spikes T, Higgins M, Quyyumi A, Reilly C, Pemu P, Dunbar S. The relationship among health beliefs, depressive symptoms, medication adherence, and social support in African Americans with hypertension. *J Cardiovasc Nurs*. 2019;34(1):44–51. doi:10.1097/JCN.0000000000000519

23. Uchino BN. Understanding the links between social support and physical health: a life-span perspective with emphasis on the separability of perceived and received support. *Perspect Psychol Sci*. 2009;4(3):236–255. doi:10.1111/j.1745-6924.2009.01122.x

24. Scholz U, Klaghofer R, Dux R, et al. Predicting intentions and adherence behavior in the context of organ transplantation: gender differences of provided social support. *J Psychosom Res*. 2012;72(3):214–219. doi:10.1016/j.jpsychores.2011.10.008

25. Pillemer SC, Holtzer R. The differential relationships of dimensions of perceived social support with cognitive function among older adults. *Aging Ment Health*. 2016;20(7):727–735. doi:10.1080/13607863.2015.1033683

26. Malo VF, Ritchwood TD, Relf MV, Bekker LG. Does type of social support influence medication adherence among south African adolescents living with HIV? A quantitative analysis of pilot data. *J Assoc Nurses AIDS Care*. 2022;35034084. doi:10.1097/JNC.0000000000000325

27. Ding W, Li T, Su Q, Yuan M, Lin A. Integrating factors associated with hypertensive patients' self-management using structural equation modeling: a cross-sectional study in Guangdong, China. *Patient Prefer Adherence*. 2018;12:2169–2178. doi:10.2147/PPA.S180314

28. Tay L, Tan K, Diener E, Gonzalez E. Social relations, health behaviors, and health outcomes: a survey and synthesis. *Appl Psychol Health Well Being*. 2013;5(1):28–78. doi:10.1111/aphw.12000

29. Bolger N, Amarel D. Effects of social support visibility on adjustment to stress: experimental evidence. *J Pers Soc Psychol*. 2007;92(3):458–475. doi:10.1037/0022-3514.92.3.458

30. DiMatteo MR. Social support and patient adherence to medical treatment: a meta-analysis. *Health Psychol*. 2004;23(2):207–218. doi:10.1037/0278-6133.23.2.207

31. Shahin W, Kennedy GA, Stupans I. The association between social support and medication adherence in patients with hypertension: a systematic review. *Pharm Pract*. 2021;19(2):2300. doi:10.18549/PharmPract.2021.2.2300

32. Burroughs TE, Pontious SL, Santiago JV. The relationship among six psychosocial domains, age, health care adherence, and metabolic control in adolescents with IDDM. *Diabetes Educ*. 1993;19(5):396–402. doi:10.1177/014572179301900506

33. Simoni JM, Frick PA, Lockhart D, Liebovitz D. Mediators of social support and antiretroviral adherence among an indigent population in New York City. *AIDS Patient Care STDS*. 2002;16(9):431–439. doi:10.1089/108729102760330272

34. Tardy CH. Social support measurement. *Am J Commun Psychol*. 1985;13(2):2. doi:10.1007/BF00905728

35. Gottlieb BH, Bergen AE. Social support concepts and measures. *J Psychosom Res*. 2010;69(5):511–520. doi:10.1016/j.jpsychores.2009.10.001

36. Taylor SE, Sherman DK, Kim HS, Jarcho J, Takagi K, Dunagan MS. Culture and social support: who seeks it and why? *J Pers Soc Psychol*. 2004;87(3):354–362. doi:10.1037/0022-3514.87.3.354

37. Marsden PV. Network data and measurement. *Annu Rev Sociol*. 1990;16(1):435–463. doi:10.1146/annurev.so.16.080190.002251

38. Brinkhues S, Dukers-Muijrers NHTM, Hoebe CJPA, et al. Social network characteristics are associated with type 2 diabetes complications: the Maastricht study. *Diabetes Care*. 2018;41(8):1654–1662. doi:10.2337/dc17-2144

39. Xu WH, Wang Q, Liang WX. Reliability and validity of morisky questionnaire in measurement of the compliance with hypertensive medications. *Chin J Prev Contr Chron Non-Commun Dis*. 2007;15(5):424–426. doi:10.3969/j.issn.1004-6194.2007.05.006

40. Morrison VL, Holmes EA, Parveen S, et al. Predictors of self-reported adherence to antihypertensive medicines: a multinational, cross-sectional survey. *Value Health*. 2015;18(2):206–216. doi:10.1016/j.jval.2014.12.013

41. The Writing Committee of the Report on Cardiovascular Health and Diseases in China. Report on cardiovascular health and diseases burden in china: an updated summary of 2020. *Chin Circ J*. 2021;36:521–545.

42. Pan J, Hu B, Wu L, Li Y. The effect of social support on treatment adherence in hypertension in China. *Patient Prefer Adherence*. 2021;15:1953–1961. doi:10.2147/PPA.S325793

43. Yassine M, Al-Hajje A, Awada S, et al. Evaluation of medication adherence in Lebanese hypertensive patients. *J Epidemiol Glob Health*. 2016;6 (3):157–167. doi:10.1016/j.jegh.2015.07.002

44. Kim Y, Kong KA. Do hypertensive individuals who are aware of their disease follow lifestyle recommendations better than those who are not aware? *PLoS One*. 2015;10(8):e0136858. doi:10.1371/journal.pone.0136858

45. Briesacher BA, Andrade SE, Fouayzi H, Chan KA. Comparison of drug adherence rates among patients with seven different medical conditions. *Pharmacotherapy*. 2008;28(4):437–443. doi:10.1592/phco.28.4.437

46. Mann DM, Woodward M, Muntner P, Falzon L, Kronish I. Predictors of nonadherence to statins: a systematic review and meta-analysis. *Ann Pharmacother*. 2010;44(9):1410–1421. doi:10.1345/aph.1P150

47. Eberhardt MS, Pamuk ER. The importance of place of residence: examining health in rural and nonrural areas. *Am J Public Health*. 2004;94 (10):1682–1686. doi:10.2105/ajph.94.10.1682

48. Anderson TJ, Saman DM, Lipsky MS, Lutfiyya MN. A cross-sectional study on health differences between rural and non-rural U.S. counties using the County Health Rankings. *BMC Health Serv Res*. 2015;15(1):441. doi:10.1186/s12913-015-1053-3

49. Doggrell SA. Adherence to medicines in the older-aged with chronic conditions: does intervention by an allied health professional help? *Drugs Aging*. 2010;27(3):239–254. doi:10.2165/11532870-000000000-00000

50. Scheurer D, Choudhry N, Swanton KA, Matlin O, Shrank W. Association between different types of social support and medication adherence. *Am J Manag Care*. 2012;18(12):e461–e467.

51. Wang J, Zhao X. Family functioning and social support for older patients with depression in an urban area of Shanghai, China. *Arch Gerontol Geriatr*. 2012;55(3):574–579. doi:10.1016/j.archger.2012.06.011

52. Turan GB, Aksoy M, Çiftçi B. Effect of social support on the treatment adherence of hypertension patients. *J Vasc Nurs*. 2019;37(1):46–51. doi:10.1016/j.jvn.2018.10.005

53. Trump LJ, Novak JR, Anderson JR, et al. Evaluative coping, emotional distress, and adherence in couples with Type 2 diabetes. *Fam Syst Health*. 2018;36(1):87–96. doi:10.1037/fsh0000302

54. Doherty WJ, Schrott HG, Metcalf L, Iasiello-Vailas L. Effect of spouse support and health beliefs on medication adherence. *J Fam Pract*. 1983;17 (5):837–841.

55. Pesantes MA, Del Valle A, Diez-Canseco F, et al. Family support and diabetes: patient's experiences from a public hospital in Peru. *Qual Health Res*. 2018;28(12):1871–1882. doi:10.1177/1049732318784906

56. Everson-Rose SA, Lewis TT. Psychosocial factors and cardiovascular diseases. *Annu Rev Public Health*. 2005;26(1):469–500. doi:10.1146/annurev.publhealth.26.021304.144542

57. Warner LM, Schüz B, Aiken L, et al. Interactive effects of social support and social conflict on medication adherence in multimorbid older adults. *Soc Sci Med*. 2013;87:23–30. doi:10.1016/j.socscimed.2013.03.012

58. Väänänen A, Vahtera J, Pentti J, Kivimäki M. Sources of social support as determinants of psychiatric morbidity after severe life events: prospective cohort study of female employees. *J Psychosom Res*. 2005;58(5):459–467. doi:10.1016/j.jpsychores.2004.10.006