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Values and preferences of medication use in patients for primary and secondary prevention of cardiovascular diseases: a mixed-methods exploratory study☆

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ABSTRACT

Background: Medication therapy is a cornerstone for the primary and secondary prevention of cardiovascular diseases, yet values and preferences regarding medication use remain unclear.
Objective: To explore the values and preferences of medication use in patients for the primary and secondary prevention of cardiovascular diseases.
Methods: This study explanatory sequential mixed methods study recruited patients for primary or secondary prevention of cardiovascular diseases at West China Hospital of Sichuan University and Yulin Community Health Service Center from November 2021 to January 2022. The focus group interviews collected the understanding of the values and preferences related to medication use among the participants. After coding with MAXQDA 2020, the investigators sorted, analyzed, and extracted the themes using Colaizzi's seven-step analysis method. Following the findings from the qualitative study, a quantitative survey was conducted from November 2022 to February 2023 among a conveniently sampled group of participants in multidisciplinary departments before the quantitative analysis.
Results: The focus group interview included 21 participants, yielding four themes: (1) cognition and behavior towards medication; (2) barriers to medication use; (3) facilitators of medication use; and (4) needs for medical services. The quantitative survey collected 186 valid questionnaires (response rate: 93.5%), confirming common missed doses and medication stigma. Despite the heterogeneity in medication preferences, participants preferred fewer types of drugs and lower frequencies of medication and were averse to injectable formulations.
Conclusion: The study suggests the preference of the compound preparations to reduce the number of pills and the integrity of the therapeutic regimens and daily lives to reduce the burden of taking medications for people receiving cardiovascular prevention. Timely identification and intervention targeting the individual-level misconceptions and improper practices are critical to improve the adherence.

Atherosclerotic cardiovascular diseases (ASCVD), including coronary artery disease and peripheral artery disease, are among the most common chronic non-communicable diseases in China and a significant cause of disability and life expectancy loss among Chinese residents.[1,2] Primary and secondary prevention of cardiovascular diseases are crucial for public health and general practice services. For general practitioners (GPs), the primary prevention of cardiovascular diseases encompasses the management of all aspects of risk factors including hypertension, dyslipidemia, diabetes, smoking, and obesity, while secondary prevention involves medication and related lifestyle interventions. Medications remain the cornerstone for both primary and secondary prevention of cardiovascular diseases[3] Regarding the types, frequencies, timing, intensity of cardiovascular prevention, and the types and probabilities of adverse reactions of medications, wide variance contribute to significant heterogeneity in medication choice. These factors are closely related to patient values and preferences,[4-5] which are essential considerations in clinical decision-making.[6-8] For instance, diabetes treatment includes oral metformin and subcutaneous insulin injections. Despite

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considerable differences in efficacy and safety, the indications of these medications may overlap with each other. When selecting a medication, patients must balance risks, benefits, and costs, and the mode of administration is also closely linked to their daily lives. Ignoring patient preferences can reduce treatment adherence and satisfaction and fail to reflect the physician's respect for the patient. Understanding patient values and preferences helps identify the individual burden of treatment plans and provides patient-centered clinical practice, thereby improving adherence to medication therapy.

There is a lack of systematically discussion on patient values and preferences in current clinical practice guidelines and primary care handbooks in China. To better align with the development of clinical practice guidelines in China, this mixed-methods exploratory study employs both qualitative and quantitative research methods to explore the values and preferences of medication use among patients for the primary and secondary prevention of cardiovascular diseases. This approach aims to facilitate patient-centered clinical decision-making, reduce the burden of medication therapy, and improve medication adherence in patients.

Subjects and methods

This study employed an explanatory sequential mixed methods design. Initially, qualitative data was collected through focus group interviews to understand participants' behaviors, values, and preferences related to medication use. Based on the themes derived from these interviews, a quantitative questionnaire was developed to further analyze the quantitative aspects of participants' values and preferences regarding medication use. This study was approved by the Ethics Committee of West China Hospital of Sichuan University (Approval Number: 2021 Review [1556]).

Qualitative research

Subjects

Participants were selected using stratified purposive sampling from November 2021 to January 2022 at the cardiology, endocrinology, nephrology, and neurology departments of West China Hospital of Sichuan University, as well as Yulin Community Health Service Center in Wuhou District, Chengdu, China.

The inclusion criteria for patients in primary prevention of cardiovascular diseases were: (1)significant elevation of a single risk factor, such as total cholesterol >8 mmol/L, low-density lipoprotein cholesterol >4.9 mmol/L, or blood pressure >180/110 mmHg (1 mmHg = 0.133 kPa); (2)patients with type 2 diabetes, without a history of coronary heart disease or stroke, regardless of target organ damage (including microalbuminuria, retinopathy, or neuropathy); (3)chronic kidney disease stage 3 or higher [estimated glomerular filtration rate $\leq$59 mL·min^{-1}·(1.73 m^2)$^{-1}$]; (4)patients with early-onset and long-duration type 1 diabetes (20 years or more). For secondary prevention of cardiovascular diseases, the inclusion criteria were patients with documented ASCVD, including acute coronary syndromes (acute myocardial infarction or unstable angina), stable angina, coronary revascularization, stroke, transient ischemic attack, or peripheral artery disease. We excluded from patients with cognitive dysfunction or inability to express personal views, and minors.

Interview outlines

Core team discussion with comprehensive literature search formed the interview outline. This guide was revised by pre-interviews to finalize the following questions: (1) Do you have any concerns during your long-term medication use? (2) Which form of medication do you prefer? Why? (3) When there is no difference in efficacy and safety, would you consider using compound preparation? Why? (4) Do you prefer taking medication once a day or multiple times a day? Why? (5)Do you have any preferences regarding the interval between doses? (6)What aspects do you hope your doctor considers when prescribing medications?

Interview method

Participants who met the inclusion and exclusion criteria were informed about the study's purpose, significance, and format via phone, and their willingness to participate was confirmed along with the interview schedule. Two interviewers with qualitative research experience conducted the interviews (a licensed endocrinologist at West China Hospital of Sichuan University and a doctoral student from the research team). Neither interviewer previously provided healthcare services or advice before the interview. Each group consisted of 4 to 6 participants, each interview session lasted 90 to 120 minutes. The interviews were conducted in a quiet room in the hospital. The investigators confirmed the interview purpose, policy of personal information, and audio recording permission before the written informed consent. Demographic and disease information (name, age, gender, current diseases, medication usage) was collected through a questionnaire after the interview. During the interview, the moderator followed the guide and adjusted the sequence and form of questions based on the actual situation, probing deeper into valuable findings. The participants' language was maintained without guidance or interference, with attention to tone, expressions, and body language. All interviews were recorded for accuracy, and another interviewer observed and noted key points.

The qualitative research included at least 16 participants (4 groups). The interviews will be continued until no new data emerges in 2 consecutive focus group interviews, indicating informational saturation, at which point the interview concluded.

Quality control

Within 24 hours after the interview, the audio recordings were transcribed into text. Data collection and analysis were conducted simultaneously. Two researchers verified the accuracy of the transcripts and independently coded and categorized the interview content using MAXQDA 2020 software. Discrepancies in the coding results were discussed and resolved through consensus. Colaizzi's seven-step analysis method was used to organize, analyze, and extract themes from the data[9].

Quantitative research

Study subjects

From November 2022 to February 2023, we recruited patients visiting the outpatient clinics at divisions of cardiology, endocrinology, nephrology, neurology, and general internal medicine in West China Hospital of Sichuan University and the Yulin Community Health Service Center through convenience sampling with the same criteria with the qualitative study. Before starting the survey, participants were required to read and click "agree" to the informed consent content.

Questionnaire survey

The quantitative questionnaire was developed based on the results of the qualitative research, including: (1) demographic information (age, gender, occupation, educational level, marital status, residency); (2) disease and treatment Information (disease diagnosis, health insurance payment method, medical expenses, types and frequencies of medications); (3) patients' values and preferences regarding medication frequency, forms, types, and timing. After pilot survey and revision, the Cronbach's alpha was 0.923 for the questionnaire.

The preference was measured on a 5-point scale, ranging from "strongly not preferred" (1) to "strongly preferred" (5). Trained investigators sent the questionnaire was sent to patients undergoing primary

and secondary prevention of cardiovascular diseases. Respondents completed the electronic questionnaire under the guidance of researchers online through the Wenjuanxing platform after oral informed consent. The collected data was extracted and cured for analysis in Microsoft Excel.

Statistical methods

Using IBM SPSS 25.0, we presented the count data as frequency and percentage and numeric data as median (P25, P75) if not normally distributed. Group comparisons were performed using the multi-sample rank-sum test with the statistical level of 0.05.

Results

Qualitative research results

Baseline characteristics of the participants

As shown in Table 1, the qualitative research included 21 respondents for focus group interviews, comprising 9 men (42.9 %) and 12 women (57.1 %). The majority of respondents were aged 61 years or older (71.4 %). Among the respondents, 61.9 % were patients undergoing primary prevention for cardiovascular diseases. Approximately half of the respondents were currently taking seven or more types of medication.

This study identified four main themes: cognition and behavior regarding medication, barriers to medication use, facilitators of medication use, and needs for medical services, as shown in Table 2).

Theme 1: Cognition and Behavior toward Medication

1. Misconceptions and Inappropriate Behaviors

Respondents often held misconceptions about medication, such as beliefs that "every drug has some side effects," "Western medicine has more side effects than traditional Chinese medicine," "taking medicine after meals won't hurt the stomach," and "injections are more effective than oral medication." These misconceptions frequently led to inappropriate medication use, such as altering dosage, frequency, timing, and duration of medication.

Respondent 3: "I feel like once my blood lipid levels are normal, I can stop the medication."

Respondent 4: "I always believe that every medicine has its side effects, so it's best to manage the disease through diet."

Table 1
Demographic information of the interviewees in the focus group interview.

Characteristics	Cases(%)
Gender	
Male	9(42.9)
Female	12(57.1)
Age (years)	
≤30	0
31–60	6(28.6)
≥61	15(71.4)
Cardiovascular Disease Prevention	
Primary	13(61.9)
Secondary	8(38.1)
Type of disease	
Diabetes	14(66.7)
Hypertension	11(52.4)
Coronary heart disease	8(38.1)
Number of current medication types	
No medication	0
1–3	7(33.3)
4–6	4(19.1)
≥7	10(47.6)

Respondent 6: "I think taking medicine for a long time can harm the stomach. I avoid taking medicine on an empty stomach and take it about half an hour after meals."

Respondent 14: "I think imported medicines have fewer side effects."

2. Sources of Information About Medication

While some respondents accessed information about diseases and medications through credible sources like books, hospital WeChat accounts, health lectures, or doctors, most relied on informal sources such as social media, friends, family, or personal experience.

Respondent 6: "WeChat official accounts say that taking medicine after meals is the correct way."

Respondent 7: "I saw online that some people with type 2 diabetes said that managing diet and exercise can almost reverse the condition."

Respondent 9: "I actually prefer traditional Chinese medicine. People say it doesn't harm the stomach, and I think that might be true."

Respondent 12: "Later, I saw in short videos that not only blood sugar but also blood lipid levels are important."

3. Dynamic Changes in Medication Cognition and Behavior

Respondents' understanding and behavior regarding medication evolved over time due to factors such as disease progression, new knowledge, adverse reactions, and improvements in symptoms.

Respondent 7: "At first, I was really worried about whether taking these medications would affect my organs, but after learning more, I found out that metformin not only has no adverse effects but actually benefits the body."

Respondent 15: "As for side effects, I now have several check-ups every year, including routine blood tests. It seems to have no impact on the liver, or at least it affects only a few people. I'm doing pretty well now, so I don't have any psychological burden about taking this medication now."

Theme 2: Barriers to Medication Use

1. Concerns About Adverse Reactions

Respondents commonly worried about potential adverse effects on vital organs, particularly when informed of the need for long-term medication.

Respondent 3: "Will there be any side effects from the injection? Or will it affect my body?"

Respondent 5: "I worry that long-term medication might have some side effects on my body. I'm concerned about its impact on other organs and parts of my body."

2. Negative Patient Identity

For some, taking medication reinforced their identity as a "patient," leading to discomfort and psychological resistance.

Respondent 2: "Actually, (unwilling to take medication) is due to a kind of fear. Many people, especially those with low educational levels, are really afraid of taking medications."

Respondent 3: "Taking medications every day reminds me that I am a patient."

Respondent 9: "After my heart attack in February last year, I had to take various medications, and it affected my mood."

Respondent 15: "Psychologically speaking, it would be great if everything was normal without needing medication. Taking medicine several times a day and getting injections remind me that I am a patient. I do not feel uncomfortable."

3. Stigmatization of Disease

Some respondents avoided taking medication in front of others due to fear of being labeled as "sick," which could affect their social or professional lives.

Respondent 13: "Like tonight when I go out to eat, I can't drink alcohol. I don't want to tell them I'm sick and can't drink. How do you explain to people that you can't drink? It's still stressful, right?"

4. Medication Burden

The complexity of medication regimens, such as taking multiple drugs or using injectables, was a significant barrier to adherence. This

Table 2
Theme framework of values and preferences in medication habits.

Themes	Sub-themes
1.Cognition and behavior towards medication	1)Misconceptions and Inappropriate Behaviors Regarding Medications 2)Sources of Information About Medication 3)Dynamic Changes in Medication Cognition and Behavior
2.Barriers to Medication Use	1)Concerns About Adverse Reactions 2)Negative Patient Identity 3)Stigmatization of Disease 4)Medication Burden 5)Economic Burden 6)Lack of Disease Awareness
3.Facilitators of Medication Use	1)Concerns About the Outcomes of the Disease 2)Perceivable Effects of Medication 3)Family Support 4)Authority (Doctor) Recommendations
4.Needs for Medical Services	1)Need for Emotional Support 2)Need for Knowledge 3)Need for a Fixed Doctor-Patient Relationship

was particularly challenging for those with busy schedules or frequent travel.

Respondent 3: “If there are many doses to take, you might forget, especially if you’re older or if you’re out doing something and remember but don’t have the medication with you—it’s inconvenient.”

Respondent 8: “Injections are painful and a bit troublesome. You have to prepare the needles, sterilize them, and it’s all very cumbersome.”

Respondent 20: “Taking a handful of pills every morning is a hassle, and when traveling, I have to pack enough medication for several days—it’s really inconvenient.”

5. Economic Burden

The high cost of long-term medications significantly influenced respondents’ adherence.

Respondent 3: “I wouldn’t choose this medication because I can’t afford it—it costs more than my pension. Even if other medications don’t lower my lipid levels as effectively, I wouldn’t use this one because it’s too expensive.”

Respondent 9: “Due to financial constraints, I stopped taking (this) medication.”

6. Lack of Disease Awareness

Some respondents did not prioritize their condition due to a lack of awareness about its severity and importance of treatment.

Respondent 4: “I didn’t take my illness seriously and just didn’t care about it.”

Respondent 14: “The main issue is not understanding the disease and not knowing the importance of medication.”

Theme 3: facilitators of medication use

1. Concerns About the Outcomes of the Disease

The anxiety surrounding potential disease complications motivated respondents to adhere to their prescribed medication regimens.

Respondent 13: “I should start taking these medications as soon as possible. Health is the most important thing; taking medication is not a problem, and injections are not a problem. Without health, you have nothing.”

However, some patients were not fully informed about the necessity and benefits of their medications at the time of prescription. For example, Respondent 19 was initially told that statins were for "lowering blood lipids" but did not understand the association between blood lipids and cardiovascular disease. Once realizing that the purpose of statins was to reduce ASCVD by lowering blood lipids, her willingness to adhere to the medication increased.

Respondent 19: “I no longer have major concerns about taking medication because the harm caused by not taking it could be more severe.”

2. Perceivable Effects of Medication

Experiencing tangible improvements in symptoms or measurable health indicators reinforced respondents’ adherence to their treatment.

Respondent 3: “Since my blood lipid levels have decreased significantly after taking the medication, I feel I should continue taking it.”

3. Family Support

Support, supervision, and encouragement from family members play a positive role in improving medical compliance.

Respondent 2: “My family members place all the medications I need to take in a fixed place next to the dining table, so I take them right after meals.”

Respondent 6: “My son’s support is very important for my medication adherence.”

4. Authority (Doctor) Recommendations

Doctors, especially those recognized as authoritative figures from reputable hospitals, had a significant influence on patients’ willingness to adhere to treatment. Respondents often expressed trust in authoritative advice.

Respondent 2: “I decided to take statins long-term and not stop. The expert said so, and I believed it.”

Moreover, the level of authority, such as the reputation of the hospital or doctor, amplified the influence on patient adherence. This influence extended to non-physician authority figures as well.

Respondent 5: “I only considered getting injections because the doctor insisted I must have them.”

Theme 4: needs for medical services

1. Need for Emotional Support

Many respondents expressed a desire for empathy and attention from doctors during consultations, as well as more encouraging and reassuring communication.

Respondent 8: “Psychologically, I hope to feel cared for by the doctor. Hearing ‘your condition can be cured’ or ‘you’re much better now than before’ from the doctor would give me more confidence.”

Respondent 13: “The comforting role of the doctor is also very important.”

2. Need for Knowledge

Respondents commonly reported communication time with doctors during consultations was insufficient. They expressed the need for more detailed explanations and guidance regarding their disease, medication options, associated benefits and risks, and necessary precautions.

Respondent 5: “The doctor didn’t explain what to watch out for when taking medication or dietary considerations.”

Respondent 8: “I wish doctors could explain during consultations which medications are first-line and which are second-line treatments for the disease.”

Respondent 14: “Doctors need to explain how to use the medication. As others have said, the instruction leaflet is hard to understand.”

3. Need for a Fixed Doctor-Patient Relationship

Many participants emphasized the desire to have a fixed doctor for consultations. A fixed doctor would be better positioned to understand their medical history and provide more personalized, long-term care.

Respondent 4: "I still think it's better to have a fixed hospital for consultations, where the doctor knows my condition well. If I see one doctor today and another doctor tomorrow, none of them will fully understand my situation."

Quantitative research results

Baseline Characteristics of the Participants

The study received 186 valid responses from the 199 distributed questionnaires (response rate 93.5%). Among the 186 respondents, 99 (53.2%) were males and 87 (46.8%) were females. Participants aged 61 years and older accounted for 44.6% of the sample, and the majority (68.8%) had an educational level of junior college or below. Additionally, 76.9% of respondents were patients undergoing primary prevention of cardiovascular diseases, and with government medical insurance being the primary payment method for 83.9% of participants. The majority of respondents (87.6%) were currently taking 1-3 types of medications (87.6%), with a medication frequency of three of more times per day being the most common (51.6%). Notably, 31.2% of participants reported forgetting to take their medication at least once in the past week. Detailed demographic and baseline characteristics are presented in Table 3.

Table 3
Demographic information of the survey subjects in quantitative research.

Item	Cases(%)
Gender	
Male	99(53.2)
Female	87(46.8)
Age (years)	
≤30	14(7.5)
31–60	89(47.9)
≥61	83(44.6)
Occupation	
Mental laborer	41(22.0)
Manual laborer	42(22.6)
Freelance	40(21.5)
Retired	63(33.9)
Educational level	
Illiterate	22(11.8)
College and below	128(68.8)
Undergraduate	31(16.7)
Graduate student and above	5(2.7)
Residence	
Urban	90(48.4)
Rural	96(51.6)
Cardiovascular disease prevention	
Primary	143(76.9)
Secondary	43(23.1)
Payment method	
Out-of-pocket expense	25(13.4)
Government medical insurance	156(83.9)
Commercial insurance	5(2.7)
Out-of-pocket expenses for medical services(Yuan/year)	
<1 000	47(25.3)
1 000–5 000	109(58.6)
>5 000	30(16.1)
Medicine currently used(Type)	
Not taking medicine	7(3.8)
1–3	163(87.6)
4–6	16(8.6)
Frequency of medication(time/d)	
Not taking medicine	8(4.3)
≤1	34(18.3)
2	48(25.8)
≥3	96(51.6)
Forgetting to take medication in the past week	
Unknown	36(19.3)
No	92(49.5)
Yes	58(31.2)

Medication values of survey participants

Among the participants, 35.6% (66/186) reported that the package or taste of the medication affect their adherence to regular medication use, while a larger proportion (44.6%) remained neutral on this matter. Additionally, 28% (52/186) of patients expressed discomfort when taking medication in the presence of others, whereas 45.1% reported no discomfort. Furthermore, 44.6% (83/186) of participants found carrying medication while traveling to be inconvenient. Notably, a significant majority (82.3%, 153/186) believed that lower medication frequencies were preferable, with 37.1% strongly agreeing with this sentiment. Detailed findings are presented in Table 4.

Medication preferences of survey participants

Statistically significant differences were observed in medication preference scores based on packages, frequencies, timing of medication, relation to meals, and the number of medications taken ($P<0.05$). Participants demonstrated higher preference scores for tablets, capsules, and granules compared to injectable preparations. A lower medication frequency was associated with higher preference scores, with comparable preferences reported for frequencies of once daily or less (including once weekly, once monthly, or once every two months or more). Conversely, an increase in the number of medications taken was correlated with lower preference scores. Regarding the timing of medication, preference scores were notably lower for medication taken at noon or during meals, as summarized in Table 5.

Discussion

The study adopted an explanatory sequential mixed methods design to investigate patients' values and preferences regarding medication use for the primary and secondary prevention of cardiovascular diseases. Both qualitative and quantitative data revealed common misconceptions about medications and non-adherence behaviors among these patients. Barriers to medication use included concerns about adverse drug reactions, negative disease identity, social stigmatization, medication burden, economic burden, and a lack of emphasis on the importance of medication. Conversely, facilitators of medication use included awareness of the disease's risks, perceived medication effectiveness, family support, and doctor's recommendations. The quantitative research further validated the existence of social stigmatization and medication burden. Despite significant heterogeneity in medication preferences, patients tended to prefer fewer types and lower frequencies of medications and showed aversion to injectable preparations.

The findings from this study provide valuable evidence for general practitioners and specialists in developing medication treatment plans for patients in both cardiovascular primary and secondary prevention. The results demonstrate that misconceptions about diseases and medications are prevalent in the field of cardiovascular prevention. These misconceptions include exaggeration or underestimation of adverse drug reactions, a lack of understanding regarding the seriousness of asymptomatic diseases and their corresponding treatments, and a preference for lifestyle interventions or traditional Chinese medicine over standard treatments. Such issues are often linked to lower educational levels and insufficient communication between doctors and patients. Furthermore, unreliable knowledge sources, such as rumors and low-quality online resources - further contribute to these misconceptions.[10,11] These misconceptions often lead to inappropriate medication behaviors, such as discontinuing medication once symptoms improve. Such phenomena are not unique to China; for example, a study on medication adher-

Table 4
The viewpoints of the respondents on medication use.

Viewpoints	Completely disagree	Disagree	Neutral	Agree	Completely agree
Viewpoint 1: I feel that the dosage form and taste of the medication will affect my regular use of medication	6(3.2)	31(16.7)	83(44.6)	56(30.1)	10(5.4)
Viewpoint 2: I feel uneasy using medication in the presence of others	14(7.5)	70(37.6)	50(26.9)	45(24.2)	7(3.8)
Viewpoint 3: I find is inconvenient to carry medication when going out	22(11.8)	37(19.9)	44(23.7)	70(37.6)	13(7.0)
Viewpoint 4: I think taking medication frequently is burdensome	5(2.7)	6(3.2)	22(11.8)	84(45.2)	69(37.1)

Table 5
The medication preferences scores of the respondents.

Medication preferences	Scores	*H*	*P*
Dosage form			
Tablets	4.00(4.00, 5.00)	279.882	<0.001
Capsules	4.00(4.00, 4.00)		
Granules	3.00(2.00, 4.00)		
Liquid	2.00(2.00, 3.00)		
Injection	2.00(1.00, 2.00)		
Frequency			
4 times/d	2.00(2.00, 3.00)	355.474	<0.001
3 times/d	3.00(2.00, 4.00)		
2 times/d	4.00(3.00, 4.00)		
1 time/d	4.00(4.00, 5.00)		
1 time/week	4.00(4.00, 5.00)		
1 time/month	4.00(4.00, 5.00)		
1 time/≥2 months	4.50(4.00, 5.00)		
Dosing time			
Morning	4.00(3.00, 5.00)	38.506	<0.001
Noon	3.00(3.00, 4.00)		
Evening	4.00(3.00, 5.00)		
Bedtime	4.00(3.00, 4.00)		
Relationship to meals			
Before meal	4.00(3.00, 4.00)	49.008	<0.001
During a meal	3.00(2.00, 4.00)		
After meal	4.00(3.00, 5.00)		
Type of medication			
1	4.00(4.00, 5.00)	212.715	<0.001
2	4.00(3.00, 5.00)		
3–5	3.00(2.00, 4.00)		
>5	2.00(2.00, 3.00)		

ence among patients with cardiovascular diseases and diabetes in India revealed a tendency to use herbal medicines instead of guideline-recommended medications.[12] While these viewpoints may have some factual basis, patients frequently misunderstand and apply them subjectively when guiding their behaviors. For example, the belief that "every drug has its side effects" originates from traditional medicine and has a scientific foundation. However, patients often overemphasize the potential "side effects" of medications, ignoring their proven efficacy in cardiovascular prevention and treatment. This is especially problematic when patients lack scientific knowledge about the nature and likelihood of adverse reactions. In such cases, this nonspecific assertion in "every drug has its side effects" becomes a stronger deterrent to adherence, leading patients to stop their prescribed medication.

Importantly, the study found that patients' understanding of medications and their medication behaviors are dynamic and malleable. Updates in knowledge and noticeable improvements in symptoms and clinical signs following treatment can reshape patients' prior misconceptions and behaviors. This highlights the critical role of clinical physicians in actively assessing patients' cognition and medication behaviors. Physicians should communicate the significance of medication adherence, the potential risks, and strategies to mitigate side effects in a clear and accessible manner. possible preventive measures in a way that patients can easily understand, ensuring that patients comprehend this information to enhance medication adherence. Ensuring that patients fully comprehend this information is essential for improving medication adherence. Furthermore, it is crucial to recognize the highly heterogeneous nature of patients' acceptance and adoption of medical knowledge. A one-way transfer of information from physicians to patients risks overlooking how well patients internalize and apply this knowledge. Collaborative and patient-centered communication is therefore vital to addressing these gaps effectively.

This study identified several barriers to medication adherence among patients with cardiovascular diseases, including a lack of understanding of the disease and its treatment, medication burden, economic burden, concerns about adverse reactions, and disease stigmatization. While research specifically addressing cardiovascular disease patient is limited, studies on other chronic diseases (such as diabetes and inflammatory bowel disease) have found that negative perceptions of disease can reduce patients' self-management capabilities and adherence to medication.[13,14] Interestingly, unlike previous studies, this research did not identify negative factors such as limited medication accessibility or a lack of trust in doctors.[15] This discrepancy may be attributed the regional and institutional constraints of the study, indicating the need for further research across more diverse regions of China. Consistent with prior findings, the current study highlighted several factors that promote medication adherence among patients undergoing cardiovascular primary and secondary prevention. These include awareness of the risks associated with the disease, family support, authority advice, medication reminder systems, integrating medication into daily life, positive peer influence, and the use of compound preparations. Additionally, the study found that patients' perceptions of medication effectiveness, such as noticeable improvements in symptoms and clinical monitoring indicators, can significantly enhance their adherence to prescribed treaatments.

The study found that patients with cardiovascular diseases in primary and secondary prevention exhibit highly heterogeneous preferences for medications, considering factors such as medication package, frequency, timing, relation to meals, and types of medication. Patients generally prefer fewer types and lower frequencies of medications and have a lower acceptance of injectable formulations, consistent with previous research findings.[16] Numerous studies have confirmed that compound preparations, which simply medication regimens, significantly enhance patient adherence, increase long-term medication persistence with medication, and improve the management of multiple cardiovascular risk factors.[17]

The 2023 "Chinese Expert Consensus on Application of Fixed-dose Combination Pill for the Prevention and Treatment of Cardiovascular Disease"[18] recommends compound preparations as an optimized strategy for cardiovascular diseases prevention and treatment in broader populations in China.[18] Accordingly, in managing medications for patients with cardiovascular diseases in primary and secondary prevention, particularly for those requiring multiple medications, priority should be given to the use of compound preparations to reduce the number and frequency of medications, thereby improving medication adherence. While patients generally show greater acceptance of oral medications over injectable formulations; this study did not explore preferences between oral formulations and lower-frequency injectable formulations (e.g., weekly formulations) in the qualitative study. However, previous studies on type 2 diabetes have found that patients prefer oral medications over weekly formulations of glucagon-like peptide-1 (GLP-1) receptor agonists, a finding that aligns with the results of this study.[19]

The preference for taking medication at lunchtime or during meals showed lower scores and greater variability, possibly due to some patients' work commitments and the social stigma associated with the condition. The quantitative study also identified concerns about the

visibility of medication-taking behavior and the need to carry medications when going out as potential barriers to adherence. Lunchtime often involves increased social interactions, particularly in work settings, which may heighten the likelihood of medication-taking behavior being observed by others or the need to carry medications to the workplace. Therefore, when developing medication treatment plans, clinicians should consider potential barriers to medication adherence at noon, particularly for patients who are at work. Taking medication during meals may increase the visibility of medication-taking behavior in social contexts and may also disrupt eating routines. Consequently, clinicians should take into account the possible burden of taking medication during meals and engage in timely communication with patients when prescribing medication.

Conclusion

In conclusion, the qualitative and quantitative results of this study revealed that patients with cardiovascular diseases in primary and secondary prevention exhibit highly heterogeneous preferences for medication use. Generally, patients prefer fewer types and frequencies of medications and are less inclined to use injectable formulations. In clinical practice, increasing the use of compound preparations for such patients and integrating medication treatment plans into their daily routines and work may help reduce their medication burden. Additionally, it is crucial to address patients' misconceptions and inappropriate behaviors regarding their disease and medication through targeted interventions, thereby improving medication adherence. Selecting medication plans based on individual medication burdens holds significant value in promoting practice patient-centered clinical decision-making, enhancing medication adherence, and improving overall treatment satisfaction.

There are several limitations associated with this study. First, the study was conducted at a single center. Variations in cultural and economic factors across regions may influence patients' values and preferences regarding medication treatment. Therefore, the generalizability of these findings requires further validation. However, this limitation also underscores the importance of understanding patient values and preferences to implement patient-centered clinical decision-making effectively. Additionally, the study employed convenience sampling to select survey participants, which may compromise the representativeness of the population.

Availability of data and materials

Not applicable.

Declarations

Not applicable.

Ethics approval and consent to participate

The study received approval from West China Hospital (Trial No. 1556, 2021).

Consent for publication

Not applicable.

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Declaration of competing interest

The authors declare that they have no competing interests.

CRediT authorship contribution statement

Shenghan LI: Conceptualization, Methodology, Writing – original draft. **Heyue DU:** Data curation, Formal analysis. **Kang AN:** Data curation, Formal analysis. **Longtao HE:** Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Jing LI:** Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Sheyu LI:** Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Validation, Writing – review & editing.

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