Relationship Between Medication Literacy and Frailty in Elderly Inpatients With Coronary Heart Disease: A Cross-Sectional Study in China

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Background: Mastering medication literacy may be related to medication safety, and the identification of frailty is very important for the prognosis of coronary heart disease (CHD). Few studies have examined the relationship between medication literacy and frailty in patients with CHD. The aim of this study was to investigate the state of medication literacy and frailty in patients with CHD and to explore the relationship between medication literacy and frailty.

Methods: A cross-sectional investigation evaluated 295 inpatients with CHD recruited from hospitals in Yangzhou, China. Demographic and clinical data on participants were collected using a general information questionnaire. The Chinese medication literacy scale was used to evaluate medication literacy. The Fried Frailty Phenotype scale was used to evaluate frailty. Univariate analysis employed chi-square test and Kruskal-Wallis H test to examine the potential factors affecting frailty. Taking frailty status as the outcome variable, the ordered logistic regression model was used to analyze the relationship between the degree of medication literacy and frailty. Spearman’s correlation analysis was used to analyze the correlation between medication literacy and frailty.

Results: A total of 280 elderly CHD inpatients were included in the analysis. There were 116 (41.4%) individuals with inadequate medication literacy and 89 (31.8%) frail individuals. Ordered logistic regression analysis showed that the age ($p < 0.001$, $OR = 1.089$), Charson Comorbidity Index ($p = 0.029$, $OR = 1.300$), number of medications taken ($p = 0.012$, $OR = 1.137$), and medication literacy ($p < 0.05$, $OR > 1$) were independent predictors of debilitating risk factors. The population with inadequate medication literacy had a 2.759 times greater risk of frailty than adequate medication literacy ($p < 0.001$, $OR = 2.759$); The population with marginal medication literacy had a 2.239 times greater risk of frailty than adequate medication literacy ($p = 0.010$, $OR = 2.239$). Spearman’s correlation analysis showed that the medication literacy grade was associated with the frailty grade in elderly CHD patients ($R = -0.260$, $p < 0.001$).
INTRODUCTION

Frailty is defined as a series of syndromes caused by a decreased physiological reserve, such as decreased body function and chronic diseases (Schoufour et al., 2017). It seriously affects the health status and increases the risk of falls, fractures, infections, suicide, disability, and death among older people (Cunha et al., 2019; Houghton et al., 2020; Kurobe et al., 2021). The prevalence of frailty ranges from 10 to 60% in older adults in cardiovascular care (Afifalo et al., 2014). Frailty is an independent prognostic marker of the composite of mortality, reinfarction, and mortality in patients aged ≥75 years admitted due to myocardial infarction (Alonso Salinas et al., 2018). Studies have shown that higher aging trajectories in frailty scores were associated with elevated risks for cardiovascular, other-cause, and all-cause death among older Japanese individuals receiving health checkups (Taniguchi et al., 2020). Frailty is reversible, but requires intervention. A recent review and meta-analysis have shown that only 3% of frail older people spontaneously reverted to a robust state at a later date (Rodriguez-Mañas and Fried, 2015; Kojima et al., 2019). In order to reduce the incidence of death and complications in patients with coronary heart disease (CHD), it is essential to screen for frailty in a timely fashion, find the influencing factors of frailty in patients with CHD, and carry out an effective intervention according to these factors (Kang et al., 2015).

Patients with CHD usually require oral medications to achieve and maintain effective symptom control and prevent disease progression (Zhong et al., 2016). Good medication literacy is the premise of ensuring drug use safety (Li et al., 2020). The term “medication literacy” first appeared in a government document of the Committee of the Regulatory Agency for Medicines Safety and Healthcare Products in the United Kingdom in 2005. It referred to health literacy as “a series of skills required to obtain, understand and use drug information” (Shen et al., 2018). Pharmacy practices and laws vary widely around the world. In order to help healthcare workers around the world realize the importance of medical literacy in drug use, Pouliot et al. (Pouliot et al., 2018) consulted international experts using the Delphi method and proposed an expert consensus on the concept of medication literacy, which refers to the ability of individuals to obtain, understand, communicate, calculate, and process specific drug information and make informed drug treatment and health decisions in order to achieve safe and effective drug use. Research has shown that low health literacy is associated with frailty (Hou, 2019), and medication literacy is the embodiment of health literacy in the field of medicine (Raynor, 2009). Frailty is associated with an increased susceptibility to adverse drug events and drug-related injuries (Liau et al., 2021). However, there is no direct evidence of a link between medication literacy and frailty.

Therefore, the purpose of our study was to investigate the relationship between medication literacy and frailty in elderly patients with CHD in order to describe a new and targeted intervention problem for healthcare personnel, improve the quality of patient life, and reduce the risk of complications.

MATERIALS AND METHODS

Design, Setting, and Participants

The study was approved by the Ethics Review Committee of the School of Nursing, Yangzhou University (Ethical Batch Number: YZUHL20200012). A cross-sectional survey was conducted in a cardiology ward of a tertiary hospital in Yangzhou, Jiangsu Province, China between August 2020 and January 2021. The convenient sampling method was used to extract the research subject data.

Subjects were eligible if they met the following inclusion criteria: 1) age ≥60 years and good communication skills; 2) met the diagnostic criteria of coronary atherosclerotic heart disease of the American Heart Association; and 3) provided informed consent and voluntarily participated in the study. Patients were excluded if they had any of the following conditions: 1) acute or terminal stage of a disease, severe cardiopulmonary and renal insufficiency; 2) patients with grade IV cardiac function; and 3) engaged in healthcare-related work currently or before retirement.

Our study is a cross-sectional study, according to the cross-sectional sample size calculation formula, which is: \[ N = \frac{Z_{\alpha/2}^2 \cdot P(1-P)}{\delta^2} \]. According to existing studies (Hou et al., 2019), the frailty incidence (P) of elderly hospitalized patients with CHD evaluated by the fried frailty phenotype scale was 20.8%. In our study, we set \( \alpha = 0.05 \), \( Z_{\alpha/2} = 1.96 \), allowable error (d) = 5%; After calculation, the required sample size was 253 cases. Considering that invalid questionnaires constitute 10% of the total cases, the required sample size was 278 cases. A total of 295 questionnaires were sent out in the present study, and 15 invalid questionnaires were eliminated. Thus, a total of 280 valid questionnaires were finally recovered, with an effective recovery rate of 94.9%.

Survey Procedures

Inpatients anonymously filled out questionnaires after signing the informed consent form. The survey was conducted via one-to-one and face-to-face interviews. The interviewees were all postgraduate students from School of Nursing, Yangzhou University who had received similar training. The same assistive tools were used to measure frailty and medication literacy. If the respondents were illiterate or unable to fill in the forms by themselves, the investigators read the questionnaire to them and assisted them in completing it. After the
questionnaire was completed, the researcher checked and retrieved it immediately. If there were omissions or obvious mistakes, the researcher assisted the patient in correcting them.

Data Collection
General Condition Questionnaire
The investigators designed a self-administered general condition questionnaire, which included questions about age, sex, body mass index (BMI), education level, marital status, economic status, smoking status, drinking status, Charson Comorbidity Index (CCI), and number of medications taken. The patients who were unsure of their height and weight were measured on site. The medication number inquiry was as follows: How many drugs did you take for more than 3 months before hospitalization?

Chinese Version of the Medication Literacy Scale
The Chinese Version of the Medication Literacy Scale was used to evaluate medication literacy. This scale was originally developed by Sauceda et al. (2012) from the University of Texas at El Paso in the United States. Zheng et al. (2016) sinicized the English version of the scale. The retest reliability of the Chinese scale was 0.885 and the sub-half reliability was 0.840. The correlation coefficient between each item and the total score of the scale was 0.427–0.587. The scale was composed of four simulated drug use scenarios containing 14 items and was scored on a two-point scale (1 point for correct answers and 0 points for wrong answers). The score for each item was added to the total score of the questionnaire. The higher the score, the higher the patient’s level of medication literacy. Patients with scores ≥10 were considered to have “adequate medication literacy”. Those with scores of 4–10 were considered to have “marginal medication literacy”, whereas patients with scores <4 were considered to have “inadequate medication literacy”. This scale is mainly used to measure the ability of patients to read, understand, calculate, and deal with drug-related problems in the medical information environment in order to evaluate the level of their medication literacy.

Fried Frailty Phenotype Scale
The frailty assessment was based on the Fried Frailty Phenotype Scale proposed by Fried et al. (Fried et al., 2001) at the School of Medicine at Johns Hopkins University in 2001. There are five items on the scale, including weight loss, slowness, weakness, low physical activity, and exhaustion.

1) Weight loss: It is an unintentional loss of ≥4.5 kg or a loss of ≥5% body weight in the past 1 year.
2) Slowness: The time required to walk 4.6 m at a normal speed was used as an indicator of slowness. Slow walking speed was defined as ≥6 s when a male is >173 cm in height and a female is >159 cm in height or 7 s when a male is ≤173 cm in height and a female is ≤159 cm in height.
3) Weakness: Hydraulic dynamometer was used to measure grip strength as an indicator of weakness. Older adults in a sitting position used the dominant hand to grip an object three times and the researcher recorded the maximum value. Criteria proposed by Fried et al. (2001) was used to define the weakness.
4) Low physical activity: The International Physical Activity Questionnaire was used to assess physical activity (Liou et al., 2008); Males who expended <383 kcal/w and females who expended <270 kcal/w were considered to have low physical activity.
5) Exhaustion: Poor endurance and energy were assessed using the depression scale, specifically, to check whether the answer to either of these questions is yes: “Last week, I felt like everything I did needed an effort”; “I can’t walk forward”. If positive response was given to either of these questions, the participant was thought to be exhausted.

Each item scored one point if it was present. Otherwise, no points were scored. Patients with scores ≥3 were considered as “frail”, those with scores of one to two were considered as “pre-frail”, and patients with a score of 0 were considered as “not frail”. This scale is easy to evaluate objectively and it is widely used. In the present study, Cronbach’s α coefficient of the questionnaire was 0.671.

Statistical Analysis
Data were analyzed using SPSS (version 26.0, Chicago, IL, United States) software. A p-value of < 0.05 was considered statistically significant.

Descriptive statistical methods were used to describe the inpatient’s baseline characteristics, level of medication literacy, and frailty. Univariate analysis used the chi-square test and Kruskal-Wallis H test to examine the influencing factors of frailty. The frailty status was used as the outcome variable to conduct the ordered multi-classification logistic regression analysis for multivariate analysis. Spearman’s correlation analysis was used to analyze the correlation between medication literacy and frailty.

RESULTS
General Characteristics of Participants
A total of 280 elderly CHD inpatients were included in the analysis. The characteristics of the inpatients with CHD are shown in Table 1. The study included 137 (48.9%) males and 143 (51.1%) females. The median patient age was 73.0 (68.0–79.0) years. The median number of drugs used in the patients was 3.0 (1.0–5.0).

Chinese Version of the Medication Literacy Scale
The medication literacy of elderly patients with CHD is shown in Table 2. The median medication literacy score was 2.0 (0.0–3.0). There were 116 (41.4%) people with inadequate medication literacy, 70 (25.0%) with marginal medication literacy, and 94 (33.6%) with adequate medication literacy. The highest accuracy of item 9 was 165 (58.9%), and the lowest accuracy of item 11 was 76 (27.1%).
**TABLE 1 | Characteristics of inpatients with CHD (N = 280).**

| Variable name   | No. of participants (N = 280) | Percentage (%) |
|-----------------|--------------------------------|-----------------|
| Sex             |                                |                 |
| Male            | 137                            | 48.9            |
| Female          | 143                            | 51.1            |
| Education (year)|                                |                 |
| ≤9              | 207                            | 73.9            |
| >10             | 73                             | 26.1            |
| Marital status  |                                |                 |
| Free            | 201                            | 71.8            |
| Unaccompanied   | 79                             | 28.2            |
| Monthly income  |                                |                 |
| <$2000          | 113                            | 40.4            |
| ≥2000–5,000     | 112                            | 40.0            |
| >5,000          | 55                             | 19.6            |
| Smoke           |                                |                 |
| No              | 170                            | 60.7            |
| Yes             | 110                            | 39.3            |
| Drink           |                                |                 |
| No              | 174                            | 62.1            |
| Yes             | 106                            | 37.9            |

**TABLE 2 | Medication literacy for inpatients with CHD (N = 280).**

| Items                                           | No. of participants who answered correctly (n = 280) | Percentage (%) |
|-------------------------------------------------|------------------------------------------------------|-----------------|
| Case scenario 1                                 |                                                      |                 |
| 1 According to the label, how many times a day should your mother inject the medicine? | 157                                                   | 56.1            |
| 2 Please show me how much medicine you should put into the syringe in the morning and mark the amount on the syringe | 124                                                   | 44.3            |
| 3 According to the instructions, please tell us or point out where the three parts of the body where your mother can inject the medicine are? | 106                                                   | 37.9            |
| 4 According to the instructions, please tell me what is the right angle at which you should inject the medicine? | 95                                                     | 33.9            |
| 5 Looking at the prescription, if your mother’s medicine runs out, where should you get a new prescription? | 130                                                   | 46.4            |
| Case scenario 2                                 |                                                      |                 |
| 6 Looking at the instructions on this box, what is the dose of the medicine you should give to your niece? | 137                                                   | 48.9            |
| 7 If you know the medicine dosage that your niece needs to take, please mark on the cup up to what line you should pour the medicine | 118                                                   | 42.1            |
| Case scenario 3                                 |                                                      |                 |
| 9 Looking at this prescription, what is the name of the medicine that you need to buy at the pharmacy? | 165                                                   | 58.9            |
| 10 According to the prescription, how many pills should you take? | 112                                                   | 40.0            |
| 11 Looking at this bottle, the medicine in the bottle has a similar purpose compared to the medicine on the prescription. If you need to take 30 pills to treat the infection, how many boxes should you buy to have the correct amount of antibiotic required by the original prescription? | 76                                                     | 27.1            |
| Case scenario 4                                 |                                                      |                 |
| 12 Looking at the box, when does the medicine go out of date? | 143                                                   | 51.1            |
| 13 According to the directions, what is or what are the active ingredients in each pill? | 145                                                   | 51.8            |
| 14 Please look carefully at the box. For what reason should you stop taking the medicine? | 133                                                   | 47.5            |

**Fried Frailty Phenotype Scale**

The frailty of elderly patients with CHD is shown in Table 3. The median frailty score was 6.0 (0.0–12.7). There were 80 (28.6%) patients who were not frail, 111 (39.6%) who were considered pre-frail, and 89 (31.8%) frail individuals. The highest satisfaction for item 3 was 167 (59.6%), and the lowest satisfaction for item 1 was 43 (15.4%).

**Associated Factors of Frailty in Elderly Patients With CHD**

Results for univariate analysis of frailty determinants for inpatients with CHD are shown in Table 4. A total of four factors were significantly associated with frailty. Compared to the population with adequate medication literacy, those with marginal medication literacy and inadequate medication literacy were more likely to be in a frail state (p < 0.001). Older patients (p < 0.001), those with a higher CCI (p < 0.001), and individuals who used more drugs (p < 0.001) were more likely to be in a frail state.

The frailty grade (frailty, pre-frailty, and non-frailty) was taken as the dependent variable. The age, CCI, number of medications taken, and medication literacy were used as the independent variables. Ordered logistic regression analysis was then conducted. Table 5 represents the results of logistic regression analysis for frailty determinants for inpatients with...
CHD. The results showed that the age ($p < 0.001$, OR $= 1.089$), CCI ($p = 0.029$, OR $= 1.300$), number of medications taken ($p = 0.012$, OR $= 1.137$), and medication literacy ($p < 0.05$, OR $> 1$) were independent predictors of debilitating risk factors. The population with inadequate medication literacy had a 2.759 times greater risk of frailty than adequate medication literacy ($p < 0.001$, OR $= 2.759$); The population with marginal medication literacy had a 2.239 times greater risk of frailty than adequate medication literacy ($p = 0.010$, OR $= 2.239$).

### DISCUSSION

This population-based cross-sectional study described the medication literacy and frailty in a group of Chinese inpatients with CHD and explored the correlation between medication literacy and frailty.

Based on the analysis results, 107 people (44.03%) had inadequate medication literacy, 59 people (24.28%) had marginal medication literacy, and 77 people (31.69%) had adequate medication literacy. The incidence of inadequate medication literacy in this study was higher than the 20.0% in the Zheng et al. study (Zheng et al., 2019). The reasons for this

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**TABLE 3** | Fried for inpatients with CHD ($N = 280$).

| Items          | No. of participants ($n = 280$) | Percentage (%) |
|----------------|---------------------------------|----------------|
| 1 Weight loss  | 43                              | 15.4           |
| 2 Slowness     | 96                              | 34.3           |
| 3 Weakness     | 167                             | 49.6           |
| 4 Low physical activity | 79     | 28.2           |
| 5 Exhaustion   | 99                              | 35.4           |

**TABLE 4** | Results of univariate analysis of frailty determinants for inpatients with CHD ($N = 280$).

| Variable name | — | Number of cases (Percentage %) | $\chi^2$ / $H$ | $P$ |
|---------------|---|-------------------------------|---------------|-----|
| Age           | — | Not frail ($n = 80$) | Pre frail ($n = 111$) | Frail ($n = 89$) |               |
| Sex           | — | Male | 44 (32.1) | 57 (41.6) | 36 (26.3) | 4.002 | 0.135 |
|              | — | Female | 36 (25.2) | 54 (37.8) | 53 (37.1) | — | — |
| BMI           | — | 24.1 (22.2–30.0)$^a$ | 24.2 (22.2–25.7)$^a$ | 23.8 (21.1–27.2)$^a$ | 0.393 | 0.822 |
| Education (year) | ≤9 | | 52 (25.1) | 87 (42.0) | 68 (32.9) | 4.002 | 0.493 |
|              | ≥10 | | 28 (38.4) | 24 (32.9) | 21 (28.6) | — | — |
| Marital status | Yes | | 64 (31.8) | 76 (37.8) | 61 (30.3) | 3.731 | 0.158 |
|              | No | | 16 (20.3) | 35 (44.3) | 28 (35.4) | — | — |
| Monthly income | <2000 | | 29 (25.7) | 47 (41.6) | 37 (32.7) | 1.236 | 0.874 |
|              | 2000–5,000 | | 35 (31.3) | 44 (39.3) | 33 (29.5) | — | — |
|              | >5,000 | | 16 (29.1) | 20 (36.4) | 19 (34.5) | — | — |
| Smoke | No | | 45 (26.5) | 67 (39.4) | 58 (34.1) | 4.002 | 0.493 |
|              | Yes | | 35 (31.8) | 44 (40) | 31 (28.2) | — | — |
| Drink | No | | 42 (24.1) | 70 (40.2) | 62 (35.6) | 5.341 | 0.069 |
|              | Yes | | 38 (35.8) | 41 (38.7) | 27 (25.5) | — | — |
| CCI | — | 1.5 (0–3)$^a$ | 3 (2–5)$^a$ | 4 (2–6)$^a$ | 32.336 | <0.001 |
| Number of medications | — | 3 (2–3)$^a$ | 4 (3–5)$^a$ | 4 (4–5)$^a$ | 53.562 | <0.001 |
| Medication literacy | Inadequate | 21 (18.1) | 49 (42.2) | 46 (39.7) | 22.289 | <0.001 |
|              | Marginal | | 18 (25.7) | 25 (35.7) | 27 (38.6) | — | — |
|              | Adequate | | 41 (43.6) | 37 (39.4) | 16 (17) | — | — |

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**TABLE 5** | Results of logistic regression analysis of frailty determinants for inpatients with CHD ($N = 280$).

| Effect | $\beta$ | SE | Wald | $P$ | OR | 95% CI |
|--------|--------|----|------|-----|----|--------|
| Age    | 0.085  | 0.021 | 16.170 | <0.001 | 1.089 | 0.044 – 0.126 |
| CCI    | 0.262  | 0.120 | 4.777 | 0.029 | 1.300 | 1.027 – 0.498 |
| Number of medications | 0.128 | 0.051 | 6.966 | 0.012 | 1.137 | 1.028 – 0.227 |
| Medication literacy | Inadequate | 1.015 | 0.323 | 12.886 | <0.001 | 2.759 | 0.461 – 1.569 |
|              | Marginal | 0.806 | 0.316 | 6.495 | 0.011 | 2.239 | 0.186 – 1.425 |
|              | Adequate | — | — | — | — | — |

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**TABLE 5** | Results of logistic regression analysis of frailty determinants for inpatients with CHD ($N = 280$).

| Effect | $\beta$ | SE | Wald | $P$ | OR | 95% CI |
|--------|--------|----|------|-----|----|--------|
| Age    | — | 0.085 | 0.021 | 16.170 | <0.001 | 1.089 | 0.044 – 0.126 |
| CCI    | — | 0.262 | 0.120 | 4.777 | 0.029 | 1.300 | 1.027 – 0.498 |
| Number of medications | — | 0.128 | 0.051 | 6.966 | 0.012 | 1.137 | 1.028 – 0.227 |
| Medication literacy | Inadequate | 1.015 | 0.323 | 12.886 | <0.001 | 2.759 | 0.461 – 1.569 |
|              | Marginal | 0.806 | 0.316 | 6.495 | 0.011 | 2.239 | 0.186 – 1.425 |
|              | Adequate | — | — | — | — | — |

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**Correlation Between Frailty and Medication Literacy in Elderly Patients With CHD**

Spearman’s correlation analysis of the medication literacy grade and frailty grade in elderly CHD patients showed that the medication literacy grade was associated with frailty grade in elderly CHD patients ($R = -0.260$, $p < 0.001$), which was statistically significant.
needed to improve frailty in patients with chronic disease. The study will improve the understanding of the impact of medication literacy on health status. There were some limitations in this report. First, this study had a cross-sectional design, which could only explain the correlation between medication literacy and frailty in patients with CHD, but could not prove a causal relationship. In subsequent studies, follow-up will be added to dynamically observe the effect of medication literacy on frailty. Second, this study was conducted in a tertiary hospital in China, and the results may not be representative. More multicenter cohort studies with a larger sample size should be conducted.

CONCLUSION

The study showed that there was an association between medication literacy and frailty in patients with CHD. Medication literacy was an important consideration in the development, implementation, and evaluation of frailty. The study also provided preliminary information for the development of effective healthcare interventions.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Review Committee of the School of Nursing, Yangzhou University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

YL conceived the study. JQ, TZ, MX, HS, and YS collected, and analyzed the data. JQ drafted the manuscript. All authors provided critical revision of the manuscript for important intellectual content.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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