


Social Support and Self-Efficacy as Mediating Factors Affecting the Association Between Depression and Medication Adherence in Older Patients with Coronary Heart Disease: A Multiple Mediator Model with a Cross-Sectional Study

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Purpose: Medication non-adherence is a major public health issue. Recent evidence suggests that depression, inadequate social support, and lower levels of self-efficacy are associated with poor medication adherence. However, the mechanism underlying the association among depression, social support, self-efficacy and medication adherence is unclear. This study aims to examine the mediating role of social support and self-efficacy between depression and medication adherence in older patients with coronary heart disease.

Patients and Methods: Data were collected from 238 hospitalized older patients with coronary heart disease. Depression, social support, self-efficacy, and medication adherence were assessed using structured questionnaires. A serial multiple mediation model was tested using the PROCESS macro for SPSS.

Results: A total of 238 older patients with CHD with a mean age of 70.5 years were involved in this cross-sectional study. Depression was negatively correlated with medication adherence in older patients with coronary heart disease. Social support and self-efficacy were positively associated with medication adherence, and fully mediated the relationship between depression and medication adherence. Three mediation paths were included in the model: (a) social support, (b) chain combination of social support and self-efficacy, and (c) self-efficacy.

Conclusion: Social support and self-efficacy explain the association of depression and medication adherence in older CHD patients and may be the keys target for enhanced intervention to improve medication adherence in older CHD patients with depression.

Keywords: coronary heart disease, depression, medication adherence, self-efficacy, social support

Introduction

Coronary heart disease (CHD) is the main cause of death worldwide, accounting for more than eight million deaths globally each year.¹ It is reported that approximately 85% of people aged 65 or older die as a consequence of CHD.² As a common chronic disease, CHD can lead to poor health-related quality of life^{3,4} and increase healthcare costs.⁵ As a result of lifestyle changing and an aging population, it is estimated that the number of people with CHD will increase from 8.1 to 22.6 million a year by 2030 in China.⁶ Evidence-based medication therapy is used as the primary treatment strategy for patients with CHD⁴ and the treatment is recommended to continue for the rest of their

life. Medication adherence, defined as taking medication as prescribed over time, is essential for patients with CHD to generate optimal clinical outcomes, eg, low all-cause mortality, low risk of cardiovascular rehospitalization, and high quality of life.^{4,7} Nevertheless, medication non-adherence is common and has become a serious public health issue owing to the fact that more than half of older patients with CHD do not take their medication as prescribed.^{8,9} Evidence has revealed that medication non-adherence is associated with adverse clinical outcomes and increased healthcare costs.^{10,11}

CHD patients with depression are less likely to adhere, at least in some aspects, to treatment regimens such as medication, exercise, and cardiac rehabilitation.^{12,13} Evidence suggests that depressive symptoms may contribute to poor medication adherence in CHD patients.^{14,15} Depression is prevalent in patients with CHD, with up to 51% of patients affected¹⁶ and over one-third of whom severely affected,¹⁷ thus it is imperative to explore effective measures to improve medication adherence among CHD patients with depression.

Medication adherence can be enhanced through support from family members, community, and friends, as well as other social services.¹⁸ Cohen et al¹⁹ define social support as “the social resources that individuals perceive to be available or that are actually provided to them by nonprofessionals in the context of both formal support groups and informal helping relationships”. Xiao et al²⁰ propose that individuals’ support utilization should be included in social support. Individuals’ attitude toward support utilization varies, for example, some people might be offered the support, but refuse to take it. With the increase of age, the need of CHD patients for social support increases over time.²¹ Findings from recent studies illustrate that social support can promote adherence to health behaviors, which is significantly associated with improved medication adherence.^{22–24}

On the other side, evidence shows that self-efficacy may play an important role in adherence to medication.^{14,25,26} Medication self-efficacy is generally defined as the belief or confidence in one’s ability to persist with taking medication for desired outcomes, and it has been demonstrated to be a strong predictor of health-promoting behaviors and health-related outcomes in patients with chronic disease.²⁷ Previous studies found that CHD patients with lower self-efficacy might show a poor medication adherence.^{14,28} Polsook et al²⁹ developed a self-efficacy enhancement program (SEP) based on Bandura’s self-efficacy components and implemented the SEP in patients with acute myocardial infarction, and found that SEP was significantly effective in improving medication adherence.

In summary, existing literature demonstrates that depression, social support, and self-efficacy are significantly associated with medication adherence among patients with CHD.^{14,23,28} Self-efficacy partially mediates the relationship between depression and medication adherence,^{30,31} and social support also mediates the association between the two.²³ In addition, self-efficacy totally mediates the association of social support with treatment adherence, after adjusted for demographic and medical covariates.³² However, limited information is available concerning the mechanism underlying the relationships among the three variables and medication adherence in CHD patients. Clarifying this mechanism will contribute to healthcare professionals to develop targeted interventions to improve medication adherence in older patients with CHD. Therefore, this study is aimed to examine the multiple mediating role of social support and self-efficacy between depression and medication adherence in older patients with CHD. The hypothesized mediator model is shown in [Figure 1](#).

Patients and Methods

Participants

This is a cross-sectional study. Participants were recruited from 8 cardiovascular units in four tertiary hospitals (each with >500 inpatient beds) in Baoding, a city in northern China. The inclusion criteria were as follows: (1) diagnosis as CHD by a physician, (2) age ≥ 60 years old, and (3) having history of cardiovascular medication use. Participants were excluded if they had (1) a cognitive disorder, or (2) cancer, or (3) were classified as having New York Heart Association class IV heart failure. The minimum number of patients was 178 based on a medium effect size of 0.15, α of 0.05 and a power of 0.90 (using G*power 3.1 version).³³ Considering 20% missing rate, a sample size of 214 was required in this study. A convenient sample of 238 participants met the sample size requirement for the study.

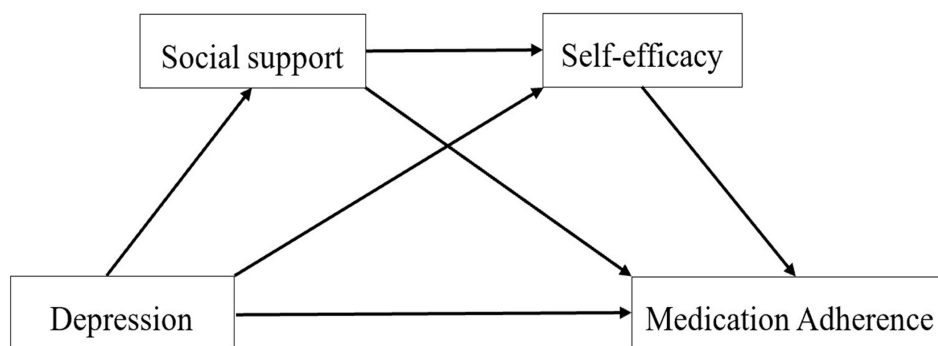


Figure 1 The hypothesized serial mediating model of social support and self-efficacy between depression and medication adherence. Independent variable: depression, mediating variables: social support and self-efficacy, dependent variable: medication adherence.

Instruments

Socio-Demographic and Clinical Characteristics

The socio-demographic and clinical data include age, gender, marital status, education attained, monthly income, family history of CHD, co-morbidity and duration of CHD. Data were reviewed from hospital medical records by three trained research assistants.

Depression

The 9-item Patient Health Questionnaire (PHQ-9) was used to assess depression. This scale consists of one dimension and nine items.³⁴ Each item is scored from 0 (not at all) to 3 (nearly every day). The total scores range from 0 to 27. Higher total scores correlate with more severe depression. Scores are categorized as follows: none (0–4), mild (5–9), moderate (10–14) and severe depression (≥ 15).³⁵ The scale has good validity and reliability (with Cronbach's alpha coefficient of 0.86), and is widely used in China.³⁶ The Cronbach's alpha coefficient was 0.836 in our study.

Social Support

Social support was measured using the Social Support Rating Scale (SSRS) developed by Xiao.²⁰ It consists of ten items that form three subscales: objective support (three items), perceived support (four items), and support utilization (three items). The total scores for SSRS range from 12 to 66. A higher score reflects better social support. Scores are categorized as follows: low social support (12–22), medium social support (23–44), and high social support (45–66). The SSRS has been widely used in China and has demonstrated good reliability and validity.³⁷ The internal consistency coefficient for this scale was 0.829 in this study.

Self-Efficacy

Self-efficacy for medication adherence was measured using the Self-Efficacy for Appropriate Medication Use Scale (SEAMS), developed by Risser et al.³⁸ This scale contains two dimensions (thirteen items): self-efficacy for taking medications under difficult circumstances (eight items), and self-efficacy for continuing to take medications when circumstances surrounding medication-taking are uncertain (five items). Each question is assigned points from 1 to 3 (1=not confident, 2=somewhat confident, and 3=very confident). The sum of the 13 items ranges from 13–39. Higher total scores indicate better self-efficacy for medication adherence. The Chinese version of SEAMS was translated by Dong et al (Cronbach's alpha coefficient of 0.915)³⁹ and has demonstrated good internal consistency, reliability, and validity in CHD patients.⁴⁰ In this study, the Cronbach's alpha coefficient was 0.913.

Medication Adherence

The medication adherence of CHD patients was measured by the medication adherence questionnaire for coronary heart disease developed by the researchers' team based on *Chinese cardiovascular disease rehabilitation/Secondary prevention guidelines* (2015 Edition).^{41,42} The questionnaire includes major elements related to medication adherence, such as

“schedule”, “dosage”, “frequency”, “type”, “regular review” and “medication adjustment”, and contains six items, each measuring a specific medication-related behavior (eg, “How often do you comply with the medication frequency as prescribed?” “How often do you comply with the medication dosage as prescribed?” “How often do you comply with the medication schedule as prescribed?” “How often do you never interruption of taking medication as prescribed?” “How often do you take medication as prescribed without adding or removing medication?” “How often do you review on time and adjust or continue to take medication as prescribed?”). The items are scored on a rating scale from 0 (Never) to 3 (Always). The total scores range from 0 to 18, with higher scores correlating to better medication adherence. The Cronbach alpha coefficient in this study was 0.831, and the test-retest reliability was 0.866. The criterion-related validity of the medication adherence questionnaire was 0.738, with MMAS-8⁴³ as a comparator criterion.

Data Collection

The data were collected from September to December 2017. Three research assistants received uniform training before the survey. The training includes the purpose, process, and methods of data collection of the study. To recruit participants from the cardiology ward in hospitals, the research assistants screened for participants who meet the eligibility and criteria and asked eligible patients if they were willing to participate in the survey. Upon expression of interest, the research assistants introduced themselves, explained the study, and obtained informed consent. The survey and the brief interview took about 30 minutes to complete and the research assistants explained content of the items if the participants expressed any questions or confusion. If the patients had no ability to complete the survey by themselves, the face-to-face interview was conducted to collect data.

Ethical Considerations

This study conformed with the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of Hebei University. The researchers explained the aim and procedure of the study to eligible patients, and obtained their informed written consent. The participants were guaranteed that their participation was voluntary, and that all data would be held securely and confidentially, and that it would only be accessed by the research team.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to present the socio-demographic and clinical characteristics, depression, social support, self-efficacy, and medication adherence of the sample. A Pearson correlation coefficient was computed to examine the relationship between the four variables (depression, social support, self-efficacy, and medication adherence). Multivariable linear regression was used to examine the multivariate relationships among depression(X1), social support(X2), self-efficacy (X3) and medication adherence(Y). To control the effects of covariates, all the demographic and clinical variables (such as age, gender, marital status, education, income, family history of CHD, co-morbidity and duration of CHD) were entered into the regression model.

The overall model (Figure 1) was tested using the approach proposed by Preacher and Hayes⁴⁴ which allows multiple mediators to be included in the mediation analysis. It is hypothesized that depression (X) would be associated with social support (M1), which, in turn, affects self-efficacy (M2) and influences medication adherence (Y) (Figure 1). A serial mediator model with two mediators of social support and self-efficacy provided three indirect effects that sum to a total indirect effect. The indirect effects in the model were through (a) social support, (b) self-efficacy, and (c) both social support and self-efficacy. We then run the SPSS PROCESS macro for a testing serial mediation model with model 6 and 5000 bootstrap samples. In addition, covariates (age, gender, marital status, education, income, family history of CHD, co-morbidity and duration of CHD) were controlled in the model. 95% confidence interval (CI) was estimated for the mediation effects, with CI not containing zero, indicating the mediation effects being significant. Harman’s single-factor test was used to examine the common method bias (CMB). The variance explained by the first factor was lower than 40%, indicating that no CMB exists in the research data.

Table 1 Sample Socio-Demographic and Clinical Characteristics (N=238)

	N	%/ Mean±SD
Age(60~87)	238	70.5±6.40
Gender		
Male	134	56.30
Female	104	43.70
Marital status		
Married or with life partner	207	86.97
Single(includes divorced, widowed, separated)	31	13.03
Education attainment		
Primary school or lower	98	41.18
Junior high school	81	34.03
Senior high school or higher	59	24.79
Income monthly per person RMB (USD)		
<3000 (471)	168	70.59
≥3000 (471)	70	29.41
Family history of CHD		
Yes	86	36.13
No	152	63.87
Co-morbidity		
Yes	227	95.38
No	11	4.62
Duration of CHD		
<1 year	21	8.82
1~5 years	79	33.20
5~10 years	67	28.15
≥10 years	71	29.83

Abbreviations: SD, standard deviation; CHD, coronary heart disease.

Results

Sample Characteristics

The sample consisted of 238 older patients with CHD, 134 males and 104 females, aged between 60 and 87 years old (mean=70.50, SD=6.40). Socio-demographic and clinical characteristics are shown in [Table 1](#).

Descriptive Statistics and Correlation Among Depression, Social Support, Self-Efficacy, and Medication Adherence

As shown in [Table 2](#), the mean score for medication adherence and depression were 14.77 ± 3.08 and 3.26 ± 3.60 , respectively, and the total prevalence rates of depression was 21.01%, with mild (13.03%), moderate (6.30%) and severe

Table 2 Descriptive Statistics and Correlations Among the Depression, Social Support, Self-Efficacy and Medication Adherence (N=238)

Variables	Range	Mean±SD	1	2	3	4
			r(P)	r(P)	r(P)	r(P)
1.Depression	0–27	3.26±3.60	1			
2.Social support	12–66	39.47±5.24	– 0.146 (0.025)	1		
3.Self-efficacy	13–39	35.71±4.25	–0.212 (0.001)	0.344 (<0.001)	1	
4.Medications adherence	0–18	14.77±3.08	–0.214 (0.001)	0.366 (<0.001)	0.573 (<0.001)	1

(1.68%), respectively. The mean SSRS score was 39.47 (SD=5.24) and the average self-efficacy score was 35.71 (SD=4.25). The depression was negatively related to social support ($r=-0.146$, $P=0.025$), self-efficacy ($r=-0.212$, $P=0.001$), and medication adherence ($r=-0.214$, $P=0.001$), whereas social support and self-efficacy were positively related to medication adherence ($r=0.366$, $P<0.001$ and $r=0.573$, $P<0.001$, respectively). Social support was positively associated with self-efficacy ($r=0.344$, $P<0.001$) (Table 2). Multivariate linear regression analysis showed that depression was not associated with medication adherence when social support and self-efficacy were entered into regression model after adjusting the covariates (Table 3).

Mediation Effects

The mediated indirect effects of a specific path are shown in Figure 2 and Table 4. Figure 2 displays that the standardized coefficient of depression on medication adherence decreased from -0.179 (95% CI $(-0.288, -0.070)$) to -0.073 (95% CI $(-0.165, 0.019)$), which was not statistically significant, after introducing the mediators of social support and self-efficacy into the model. Thus, both multivariate linear regression (Table 3) and mediation analysis results indicated full mediation, and the relationship between depression and medication adherence was totally mediated by social support and self-efficacy. The effect of the size of the mediational variable was derived from the ratio of the indirect effect over the total

Table 3 Associations of Demographic, Clinical and Other Variables and Medication Adherence Among Older CHD Patients (N=238)

	Model without Social Support and Self-Efficacy			Model with Social Support and Self-Efficacy		
	Coefficient ^a	SE	p value	Coefficient ^a	SE	p value
Self-efficacy	-	-	-	0.491	0.042	<0.001
Social support	-	-	-	0.191	0.036	0.002
Depression	-0.210	0.055	0.001	-0.085	0.047	0.118
Age	-0.028	0.033	0.685	0.031	0.027	0.590
Gender	-0.044	0.421	0.519	-0.075	0.350	0.183
Marital status	0.035	0.641	0.622	0.033	0.548	0.581
Education attainment	-0.003	0.284	0.972	-0.051	0.234	0.404
Income	0.176	0.481	0.014	0.105	0.403	0.079
Family history of CHD	-0.063	0.419	0.335	0.022	0.348	0.681
Co-morbidity	-0.002	0.940	0.979	-0.057	0.776	0.285
Duration of CHD	0.007	0.209	0.915	-0.013	0.172	0.817

Note: ^aStandardized coefficients.

Abbreviation: SE, standard error.

Table 4 Mediation Analysis of Depression and Medication Adherence (N=238)

	Effect	SE	95% CI	%*
Direct effect: Depression-medication adherence	-0.073	0.047	(-0.165, 0.019)	40.78%
Total indirect effect	-0.106	0.036	(-0.187, -0.046)	59.22%
Depression-social support-medication adherence	-0.020	0.013	(-0.056, -0.002)	11.17%
Depression-social support-self-efficacy-medication adherence	-0.018	0.012	(-0.050, -0.001)	10.06%
Depression-self-efficacy-medication adherence	-0.068	0.035	(-0.143, -0.002)	37.99%
Total effect	-0.179	0.055	(-0.288, -0.070)	100%

Note: *The percentage of effect/total effect.

Abbreviations: CI, confidence interval; SE, standard error.

effect of the relationship between depression and medication adherence. The mediation effect of depression on medication adherence through social support was -0.020 (95% CI $(-0.056, -0.002)$), with an effect size of 11.17%. As a result, the serial mediation effect was -0.018 (95% CI $(-0.050, -0.001)$), accounting for 10.06% of the total effect. The serial mediation effect of social support and self-efficacy was thus confirmed in the relationship between depression and medication adherence. The mediation effect of depression on medication adherence through self-efficacy was -0.068 (95% CI $(-0.143, -0.002)$), with an effect size of 37.99% (Table 4).

Common Method Bias

The Herman single-factor analysis was used to examine Common Method Bias, and 38 items of the four variables, ie, depression, social support, self-efficacy, and medication adherence were examined by non-rotation principal component factor analysis. The first factor resulted in 21.65% of variance lower than 40%, indicating that there was no Common Method Bias in our study.

Discussion

The current investigation provides a new insight towards understanding of how depression influences medication adherence among older patients with CHD. The results found that depression was indirectly related to medication adherence through three pathways, (a) social support only, (b) self-efficacy only, and (c) combined social support and self-efficacy.

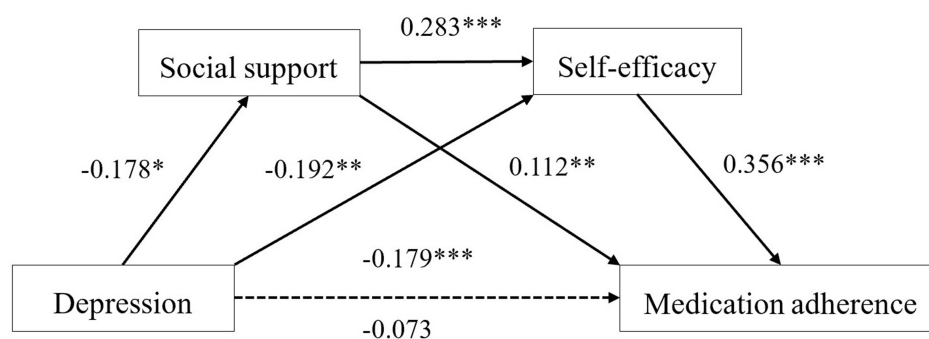


Figure 2 Result of multiple mediator model. The numbers are standardized coefficients. -0.179 =standardized coefficient before introducing social support and self-efficacy into the model; -0.073 =standardized coefficients after introducing social support and self-efficacy into the model. The mediation model was adjusted for the following covariates: age, gender, marital status, education, income, family history of CHD, co-morbidity, duration of CHD. * $P<0.05$, ** $P<0.01$, *** $P<0.001$.

Depression and Medication Adherence

Depression was significantly correlated with medication adherence in older patients with CHD, which matches well with previous findings,^{14,30} suggesting that older CHD patients with depression tend to have poor medication adherence. Patients with chronic conditions often require lifelong medication therapy, and are recommended to adhere lifestyles which are synchronous with treatment goals.⁴⁵ Expectations of the benefits of treatment recommendations are an essential component of patient adherence.⁴⁶ Depressed patients usually have an outlook of hopelessness, and lack energy and motivation, which may contribute to their poor adherence to medication, especially in the long term.⁴⁷ The results reported by Son et al,¹⁴ revealed that CHD patients who underwent primary percutaneous coronary intervention with depressive symptoms are more likely to be non-adherent to medication. In addition, our study confirmed that the relationship between depression and medication adherence was fully mediated by social support and self-efficacy. These findings comprise an essential knowledge base for developing interventions to improve medication adherence among older CHD patients with depressive symptoms.

The Mediation Role of Self-Efficacy Between Depression and Medication Adherence

Our results revealed that older CHD patients with higher self-efficacy had better medication adherence, which is in line with those of prior studies supporting a strong association between self-efficacy and medication adherence among CHD patients.^{14,28} Patients with higher self-efficacy may dedicate more effort and have a greater tendency to persist in their attempts to perform a target activity.²⁹ Also, our study confirmed self-efficacy as a mediator of the association between depression and medication adherence, revealing that older CHD patients with depressive symptoms have a lower confidence in their adherence to medication, ultimately leading to poor medication adherence. Son et al reported that CHD patients with depressive symptoms were more likely to develop low self-efficacy for medication, which was in accordance with our results.³⁰ Based on Bandura's self-efficacy theory,²⁷ an individual's self-efficacy for healthy behaviors may partially depend on his psychological or emotional state; positive emotion may enhance healthy behaviors, while negative emotion diminish them. Depressed patients, plagued by pessimism and hopelessness, tend to have reduced confidence in their ability to follow medication regimens persistently.

The Mediation Role of Social Support Between Depression and Medication Adherence

Social support was positively correlated to medication adherence, which is consistent with reports from previous studies.^{18,32} Patients with adequate social support may receive more external objective or subjective support from family members, relatives, or institutions, which promotes patients to likely obtain more health-related information to aid them to cope with diseases and adhere to medication.¹⁸ And this study showed that social support mediated the relationship between depression and medication adherence. Kim et al's study²³ indicated that the social support played a significant mediation role in reducing the negative effect of depression symptoms on medication adherence, which is similar to our view. Depression is more likely to affect the extent to which one may seek social support. Depressed patients with negative interpersonal effect and emotion tend not to make good use of social support network and may obtain less support, subsequently, lower level of social support may be related to poor medication adherence.

The Chain Mediating Effect of Social Support and Self-Efficacy Between Depression and Medication Adherence

Interestingly, our study also found that the relationship between depression and medication adherence was mediated by the chain combination of social support and self-efficacy. This indicates that older CHD patients with depression may have less social support, and inadequate social support may subsequently reduce their confidence in their ability to adhere to medication, eventually resulting in poor medication adherence. Tavor et al⁴⁷ showed that self-efficacy and social support mediated the relationship between depression and adherence and Maeda et al³² indicated that self-efficacy fully mediated the association of social support with treatment adherence, which support our findings. However, our results are

partially inconsistent with those of Kim et al²³ in their suggestion that social support totally mediated the association of depression with medication adherence in patients. The inconsistency may be due to that only one mediation variable (social support) was tested in Kim et al's study. Older CHD patients with depressive symptoms may have fewer external resources or poor social network utilization, which reduces their level of social support essential for managing their health.²¹ Patients with higher level of social support are possibly to have more diverse external resources for them to obtain verbal or behavioral encouragement, normative or informative influence, and take advantages therefrom to overcome their own problems, all of which may promote the level of self-efficacy for medication use.³² When social support including economical or psychological support is not inadequate, patients may have lesser confidence in taking their medication, relating to poor medication adherence.^{32,48}

Limitations

This study may have the following two limitations. One is that, due to the cross-sectional nature, this study suggested the association among social support, depression, self-efficacy and medication adherence. Therefore, the causal relationship could not be suggested in our analysis. The other is that, because the participants were recruited using a convenience sample process from only one region, it may not be sufficient to represent the population, thus generalizability of the findings is limited. And the number of participants enrolled in this study was small due to the limited time, our findings should be validated in a larger and more diverse CHD patients. Therefore, future studies with employing a larger and randomized sample and stronger statistical parametric analyses may be necessary to confirm the findings here. Additionally, longitudinal study designs with collecting multi-wave data are also recommended to identify the causal relationships among social support, self-efficacy, depression, and medication adherence in the future.

Clinical Practices

Despite these limitations, our study has some important implications for clinical practice. A considerable, existing body of evidence states that medication non-adherence in patients with CHD is a public health issue, necessitating the development and implementation of effective interventions.^{49,50} Based on our finding, healthcare professionals should recognize the effect of depression on older CHD patients, and the mediating role of social support and self-efficacy in the association of depression and medication adherence. Interventions focused on social support and self-efficacy may be beneficial to improve medication adherence in older CHD patients with depression. Thus, healthcare professionals should develop interventions focused on promoting social support and increasing self-efficacy to improve medication adherence in older CHD patients with depression in clinical practice.

Conclusion

The present study addressed a gap in the literature by exploring the role of self-efficacy and social support in the relationship between depression and self-reported medication adherence among older CHD patients. Social support and self-efficacy help to fully mediate the relationship between depression and medication. Additionally, this study identified that depression could affect medication adherence through the chain mediation of social support and self-efficacy. Thus, social support and self-efficacy are suggested to be given more attention to identify even better strategies for health professionals to improve medication adherence among CHD patients with depression.

Acknowledgments

The authors thank the participants for their contribution to this study.

Funding

This research was funded by the Hebei Provincial Department Science and Technology (Project of Hebei Province Key Research and Development Plan, No. 18277735D).

Disclosure

The authors declare that they have no conflicts of interest in this work.

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