ORIGINAL ARTICLE

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# Extension of the theory of adherence to treatment in patients with coronary heart disease

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## Abstract

**Background:** Increased knowledge of the concept of adherence is needed for development patient-centered care, nursing interventions, and guidelines for patients with coronary heart disease (CHD). The aim of this study was to test and extend the Theory of Adherence to Treatment regarding informational support in patients with CHD.

**Methods:** The study utilized an explanatory and descriptive survey. The study was conducted in 2013 and involved 416 patients in five hospitals in Finland. The Adherence of Patients with Chronic Disease instrument and the Social Support for People with CHD instrument were used. The model was tested using structural equation modeling (SEM).

**Results:** SEM confirmed direct associations between motivation ($\beta = 0.49$, $p < 0.001$) and results of care ($\beta = 0.29$, $p < 0.01$), and indirect associations between sense of normality, fear of complications, support from nurses and next of kin, and informational support to adherence to a healthy lifestyle and medication. Informational support included information and advice on CHD risk factors, physical exercise, chest pain, medication, continuum of care, and rehabilitation. Indirect standardized path coefficients varied between 0.14 and 0.45. The model explained 45% of adherence to a healthy lifestyle and medication.

**Conclusion:** The results of this study showed that informational support is a justified extension to the original Theory of Adherence to Treatment in Patients with CHD. Informational support seems to offer a new perspective that can be used to develop patient-centered nursing interventions and thus support adherence to treatment by patients with a lifelong disease such as CHD.

**KEYWORDS**
adherence to treatment, cardiovascular nursing, Nursing theory

## Key points

- The Theory of Adherence to Treatment in Patients with Chronic Disease has already been found to be suitable for evaluating adherence to treatment in different patient groups, but must nonetheless be critically examined, because patients' role in care has changed significantly over time.

- Informational support is a justified extension to the original Theory of Adherence to Treatment in Patients with Chronic Disease
- Informational support as part of patient-centered nursing interventions supports adherence to treatment among post-PCI patients.

## 1 | INTRODUCTION

Coronary heart disease (CHD) is a major public health problem worldwide with significant financial and human costs, even though advanced treatment options have markedly decreased the disease burden of CHD.[1,2] Treatment for CHD falls into three main types: lifestyle treatment, optimal medication, and revascularisation with percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG). It is worth noting that these treatment methods are not mutually exclusive: rather, they complement each other.[3]

PCI has become the most common revascularisation procedure for treating obstructive CHD, improving angina in patients whose symptoms persist despite optimal medical and lifestyle treatment, and those with acute coronary syndrome. The most significant benefits of PCI include rapid recovery, improved overall health status, and increased quality of life. To sustain the positive results of PCI, good adherence to treatment is of paramount importance.[3,4] It is therefore important to critically examine and further develop theoretical understanding of adherence to treatment, and associated factors that address the treatment needs of post-PCI patients.

The Theory of Adherence to Treatment in Patients with Chronic Disease is a middle-range theory originally proposed by Kyngäs[5] and later developed further by researchers working with different patient groups in practical contexts.[6–8] According to this theory, adherence to treatment is defined as an active, intentional, and responsible process of care in which patients with chronic conditions work to maintain their health in collaboration with healthcare professionals.[5]

The Theory of Adherence to Treatment in Patients with Chronic Disease has been tested using the Adherence of People with Chronic Disease Instrument (ACDI)[5] and found to be an appropriate theoretical framework for evaluating adherence to treatment among patients with CHD following PCI.[7] According to this study adherence consisted of adherence to medication and a healthy lifestyle which includes a healthy diet, physical activity, no smoking, and moderate alcohol consumption. The explanatory factors associated with adherence were: responsibility, cooperation, a sense of normality, motivation, the results of care, support from next of kin, support from nurses, support from physicians, and a fear of complications.[5,7,9]

Cohen and Wills[10] have theorized that social support consists of informational, emotional, and functional support. Social support provides security, a feeling of love, and community spirit.[11] A low level of social support is considered a risk factor both for CHD in healthy people, and for poorer prognoses and higher mortality for patients diagnosed with CHD.[12,13] It has also been proven to be a significant factor associated with better adherence to treatment among patients with chronic disease.[5,7,9]

Informational support occurs when people receive information, feedback, and recommendations regarding their disease. Social support is particularly important during stressful life events such as an acute cardiac event. The dimension related to informational support among CHD patients contains the items related to advice on physical exercise after PCI, advice on risk factors, knowledge of own risk factors, advice on how to behave when experiencing chest pain, information on medication, and information on the continuum of care and rehabilitation.[4] Emotional support involves listening to the patient, providing care and encouragement, and earning their trust. Functional support includes offering one's time, assisting, and caring for those who are having trouble coping.[10]

Even though functional and emotional support has been strongly considered as a manifestation of the social support in the Theory of Adherence to Treatment in Patients with Chronic Disease, it does not include a perspective on informational support, which is the third keystone of the Social Support Theory by Cohen and Wills.[10] However, disease-related informational support is an important element which supports adherence to healthy lifestyle behaviors[14] and medication[15] in post-PCI patients. There is evidence that a lack of information about chronic disease is associated with poorer lifestyle adherence, at least among patients with hypertension[16,17] and heart failure.[18]

It is important to investigate and further develop existing theories to meet the changing needs of patient-centered cardiovascular nursing, and inform practice.[19] Empirical theory testing is a systematic process, through which theoretical statements are tested to reveal the structure of theory. Based on its results, statements may be modified and retested as needed.[6,20] The ultimate purpose of theory testing is to verify the validity of a presented hypothesis, the theoretical structure of theory, and the relationships between concepts in the real-life context. A theory should be corrected or rejected if it is not supported by empirical data. A theory can be considered valid

when the presented hypotheses are supported by empirical evidence.[20,21]

The aim of the present study was to further develop the Theory of Adherence to Treatment in Patients with Chronic Disease using the ACDI and explore the dimension of informational support after a PCI among patients with CHD using the Social Support for People with Coronary Heart Disease (SSCHD) instrument. The goal was to test whether the empirical data would fit the proposed hypothetical model of adherence to a healthy lifestyle, medication, and informational support. The main hypothesis of this study was that the hypothetical model of adherence to a healthy lifestyle and medication, and informational support is suitable for explaining adherence among patients with CHD following PCI (Figure 1).

## 2 | METHODS

### 2.1 | Study design

The study utilized an explanatory and descriptive survey. The study procedures and findings were reported according to STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies (File S1).

### 2.2 | Settings

A convenience sample was recruited through a multi-center arrangement involving two university hospitals and three central hospitals in Finland. Data were collected between January and December 2013.

### 2.3 | Sample

Patients were recruited to participate 4 months after PCI when they had recovered and adapted to everyday life using convenience sampling. Convenience sampling means that every patient who was treated with PCI and met inclusion criteria was invited to participate in the study before discharge.[22] This multihospital survey study was conducted in 2013, including two university hospitals and three central hospitals in Finland. The inclusion criteria were patients aged between 18 and 75 years, who had undergone PCI in elective or acute circumstances, and were fluent in the Finnish language. Patients diagnosed with a memory disorder were excluded. Potential participants were evaluated for suitability to participate, giving 572 patients who met the inclusion criteria and received verbal and written information about the study from the registered nurse on the medical ward during their hospitalization. Ninety-one percent (520) of those invited to participate agreed to do so and provided informed consent. A total of 416 patients, representing a response rate of 81%, completed the postal questionnaire 4 months after the PCI. According to power analysis, this sample size was large enough to detect statistical significance with a power of 80% and a significance level of 0.05 given relatively small correlations (0.14). This number of observations and incidence rate can detect about 7%–13% of the difference between groups (length of education).

Data were collected using a postal questionnaire that was sent out 4 months after PCI and included the following four instruments:

(1) The *Adherence of Patient with Chronic Disease Instrument (ACDI)* (Table 1), which is based on a theoretical model of chronically ill patients, originally developed and tested by Kyngäs (1999). The
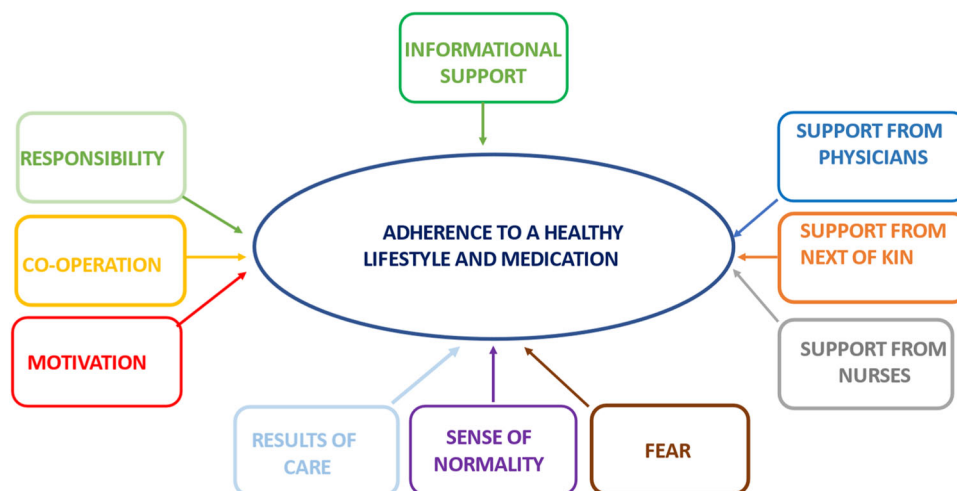


**FIGURE 1** Testing the hypothesis: hypothetical model of adherence to a healthy lifestyle and medication, and informational support is suitable for explaining adherence among patients with coronary heart disease following percutaneous coronary intervention.

**TABLE 1** Factors, factor loadings, and Cronbach's $\alpha$ related to mean sum variables of adherence ($n = 416$).

| Mean sum variables and factor loadings | Factor loading | Cronbach's $\alpha$ |
|---|---|---|
| *Mean sum variables related to adherence to treatment* | | 0.84 |
| Adherence to medication | | 0.69 |
| Item 1: Related to patient's adherence to medication instructions | 0.80 | |
| Item 2: Related to patient's medication changes | 0.69 | |
| Adherence to healthy lifestyle | | 0.53 |
| Item 3: Related to patient's smoking habits | 0.37 | |
| Item 4: Related to patient's alcohol consumption | 0.44 | |
| Item 5: Related to patient's physical activity | 0.39 | |
| Item 6: Related to patient's diet | 0.52 | |
| Mean sum variables related to adherence to treatment | | |
| Cooperation | | 0.71 |
| Item 7: Related to patient's secondary prevention follow-up treatment | 0.37 | |
| Item 8: Related to possibility for patient to discuss with physician | 0.87 | |
| Item 9: Related to possibility for patient to discuss with nurse | 0.77 | |
| Responsibility | | 0.41 |
| Item 10: Related to patient's own responsibility | 0.40 | |
| Item 11: Related to patient's willingness to practice good self-care | 0.40 | |
| Support from next of kin | | 0.60 |
| Item 16: Related to support from next of kin for patient's self-care | 0.30 | |
| Item 25: Related to acceptance and support from next of kin | 0.60 | |
| Item 26: Related to how interested next of kin are in patient's life | 0.76 | |
| Item 27: Related how next of kin remind patient about treatment | 0.54 | |
| Item 28: Related to how next of kin motivate patient to self-care | 0.86 | |

**TABLE 1** (Continued)

| Mean sum variables and factor loadings | Factor loading | Cronbach's $\alpha$ |
|---|---|---|
| Sense of normality | | 0.88 |
| Item 14: Related to patient's refusal of treatment regimens | 0.26 | |
| Item 18: Related to patient's inability to live normal life | 0.51 | |
| Item 19: Related to patient's willingness to stay at home because of illness | 0.66 | |
| Item 20: Related to how patient experiences self-care as a part of life | 0.64 | |
| Item 21: Related to how self-care limits patient's independence | 0.87 | |
| Item 22: Related to how self-care limits patient's daily routine | 0.84 | |
| Item 23: Related to how self-care causes dependence on next of kin | 0.58 | |
| Motivation | | 0.65 |
| Item 13: Related to fatigue | 0.47 | |
| Item 15: Related to lack of motivation | 0.47 | |
| Results of care | | 0.40 |
| Item 17: Related to the maintenance of health status | 0.40 | |
| Item 24: Related to wellbeing | 0.40 | |
| Support from nurses | | 0.60 |
| Item 33: Related to nurse's ability to make complete plan for the patient's care | 0.90 | |
| Item 34: Related to nurse's complete interest in patient | 0.85 | |
| Item 35: Related to nurse's ability to motivate patient | 0.79 | |
| Item 36: Related to nurse's interaction skills | 0.62 | |
| Support from physicians | | 0.88 |
| Item 29: Related to physician's ability to make complete plan for the patient's care | 0.77 | |
| Item 30: Related to physician's complete interest in patient | 0.87 | |
| Item 31: Related to physician's ability to motivate patient | 0.61 | |
| Item 32: Related to physician's interaction skills | | |

**TABLE 1** (Continued)

| Mean sum variables and factor loadings | Factor loading | Cronbach's $\alpha$ |
|---|---|---|
| Fear of complications | | 0.88 |
| Item 37: Related to patient's fear of cardiac events | 0.89 | |
| Item 38: Related to patient's fear of comorbidities | 0.88 | |

*Note*: Modified adherence of chronic disease instrument has been described in accordance with copyright agreement.

ACDI contains 37 items about adherence to treatment, which are rated on a 5-point Likert scale ("definitely disagree" to "definitely agree").

(2) The *Social Support for People with Coronary Heart Disease (SSCHD) instrument* (Table 2), developed by Kähkönen et al.,[23] is based on Cohen and Wills's[10] theory of social support. The SSCHD includes 14 items related to receiving social support—*informational* (7 items), *emotional* (4 items), and *functional support* (3 items)—which are rated on a 5-point Likert scale ("definitely disagree" to "definitely agree"). In this study, only the informational support scale was used. SSCHD instrument is a disease-specific instrument developed to measure perceptions of social support among CHD patients. The dimension related to informational support contains the following items: advice on physical exercise after PCI; advice on risk factors; knowledge about their own risk factors; advice on how to behave when experiencing chest pain; information on medication; and information on the continuum of care and rehabilitation. The dimension measuring emotional support includes perceived support from other cardiac patients, family, and friends, along with the patients' perceived importance to their next of kin. The dimension measuring functional support includes the opportunity to ask questions about issues of concern, feeling support and care, and cooperation with healthcare professionals. This study used only the scale for informational support because items related to emotional and functional support are included in the ACDI.

## 2.4 | Validity and reliability

Regarding ACDI, the validity (criterion and construct validity) and reliability (internal consistency) were found to be high in earlier studies.[6,24] In this study an explanatory factor analysis (EFA) with Principal Axis Factoring and Promax rotation was conducted to evaluate the construct validity of the ACDI. EFA produced a factor solution with satisfactory statistical values (Table 1). Missing values were replaced with each item's mean value. The internal consistency of the mean sum variables was evaluated using

**TABLE 2** Factors, factor loadings, and Cronbach's $\alpha$ related to mean sum variables of perceived social support ($n = 416$).

| SSCHD Instrument | Factor loading | Cronbach's $\alpha$ |
|---|---|---|
| | | Total 0.78 |
| **Factor 1: Informational support** | 0.50–0.72 | 0.84 |
| *Information on the continuum of care and rehabilitation* | | |
| *Information on medication* | | |
| *Information on physical exercise after PCI* | | |
| *Advice on own risk factors* | | |
| *Information on how to act in the case of chest pain* | | |
| *Information on CHD* | | |
| *Knowledge of own risk factors* | | |
| **Factor 2: Emotional support** | 0.34–0.75 | 0.60 |
| *Support from friends* | | |
| *Support from family* | | |
| *Importance to next of kin* | | |
| *Support from other patients* | | |
| **Factor 3: Functional support** | 0.81–0.86 | 0.90 |
| *Healthcare professionals care about patient coping with CHD* | | |
| *Opportunity to ask healthcare professionals about issues of concern* | | |
| *Support from healthcare professionals* | | |

Abbreviations: CHD, coronary heart disease; PCI, percutaneous coronary intervention.

Cronbach's $\alpha$ values: the $\alpha$ coefficients ranged from 0.40 to 0.90, indicating sufficient-to-high internal consistency, and the $\alpha$ coefficient of the entire scale was 0.84, which indicates high internal consistency.[22]

The SSCHD instrument was self-developed, meaning that instrument validity needed to be confirmed. The construct validity of the SSCHD instrument was confirmed with EFA using Principal Axis factoring and Promax rotation. All missing values were replaced with the mean value of the corresponding item. EFA produced statistically satisfactory values, which are presented in detail in Table 2. Further, Cronbach's $\alpha$ values were calculated to evaluate the internal consistency of sum variables: these values indicated weak internal consistency for the dimension of informational support ($\alpha = 0.84$), which represents an acceptable level of internal consistency.[22] In addition, three experienced cardiac nurses and 15 CHD patients who had undergone PCI evaluated the face validity of the

questionnaire. Based on their feedback, a few sentences were changed to be more understandable.

## 2.5 | Data analysis

Data analysis was conducted using the Analysis of Moment Structures (AMOS) version 27. The hypotheses were tested using structural equation modeling (SEM), which allowed for a confirmatory or hypothesis-testing approach when investigating a complex phenomenon. SEM combines both factor and regression analyses. The idea of SEM is to allow the study of causal relationships between factors using regression analysis. For example, factors can be built using factor analysis, and SEM can be used to study the causal relationships between factors.[22,25]

In this study, the goodness of fit between the theoretical model and the observed correlation matrix was tested using the Chi-square test and its derivates, Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA); a sufficiently good model should have a CFI of 0.90 and RMSEA 0.06–0.07.[26] Regarding standardized regression weights, a weak effect is indicated by values <0.10, a medium effect is indicated by values 0.30, and *a major* effect is indicated by values >0.50.[27]

## 2.6 | Ethical considerations

A statement from the Ethical Review Board of the university hospital (ref. 74//2012) and approval for the study were obtained from each research center separately. The research was conducted following the ethical principles of the Finnish Advisory Board on Research Integrity (2021)[26] and the World Medical Association, Declaration of Helsinki.[28] Patients provided their informed consent to participate in the study, before being discharged. Participants signed informed consent forms after receiving verbal and written information about the study from a registered nurse, in accordance with the Declaration of Helsinki. Participants were informed about the voluntary nature of their participation and given the option to withdraw at any point. Participants were also provided with the researcher's contact details in case they had any additional questions. Participants were also informed about the confidential nature of the research. The researcher collected the data via the postal questionnaire 4 months after PCI, and analysed the data confidentially, using codes in place of respondents' names.[26,28]

## 3 | RESULTS

## 3.1 | Sample characteristics

The sample for the present study consisted of 416 respondents, of whom almost three-quarters were male.

The majority were married or cohabitants. More than half of respondents were retired, while about a fifth worked regularly. Participant details are presented in Table 3.

**TABLE 3** Background data on participants (n = 416).

| Variables | % (n) | Mean | SD |
|---|---|---|---|
| Gender | | | |
| Female | 24 (101) | | |
| Male | 76 (314) | | |
| Age (years) | | 63 | 8 |
| Marital status | | | |
| Married, cohabiting | 77 (319) | | |
| Single, widowed, divorced | 23 (95) | | |
| Duration of education (years) | | 11 | 6 |
| Working status | | | |
| Retired | 61 (251) | | |
| Part-time retired | 10 (43) | | |
| Unemployed | 7 (29) | | |
| Employed | 22 (89) | | |
| Duration of CAD (years)[a] | | 5 | 7 |
| Blood pressure systolic (mmHg) | | 130 | 14 |
| Normal ≤139 mmHg | 67 (279) | | |
| I don't know | 8 (35) | | |
| Blood pressure diastolic (mmHg) | | 76 | 10 |
| Normal ≤89 | 87 (360) | | |
| I don't know | 9 (36) | | |
| Total cholesterol (mmol/L) | | 4 | 0.9 |
| Normal ≤4.5 | 52 (218) | | |
| I don't know | 34 (141) | | |
| LDL cholesterol (mmol/L) | | 2.3 | 1.5 |
| Normal ≤1.8 | 23 (96) | | |
| I don't know | 39 (163) | | |
| Medication to hypertension | 81 (311) | | |
| AMI | 38 (154) | | |
| Previous PCI | 24 (99) | | |
| Previous CABG | 13 (52) | | |
| Physical training (30 min/day) | | 3 | 2 |
| Smoking | | | |
| Yes | 16 (64) | | |
| No | 84 (350) | | |
| Use of vegetables (dL/day) | | 2 | 1 |

[a]Median 1 year, range 0.3–45.0 years.

## 3.2 | SEM of informational support and theory of adherence to treatment in patients with chronic disease

In the first phase, the direct positive associations between the adherence to a healthy lifestyle and medication, and other various dimensions of ACDI and dimension of informational support in SSCHD were tested (Figure 1). The model included the predictors based on the original Theory of Adherence to Treatment in Patients with Chronic Disease, which previous studies have found to be statistically significant among post-PCI patients: motivation, results of care, responsibility, cooperation, sense of normality, fear of complications, support from physicians, support from next of kin, and support from nurses. The model also included the dimensions relating to informational support.[7,9] These factors were hypothesized to be predictors of adherence to a healthy lifestyle and medication.

The first phase of testing the hypothetical model (Figure 2) indicated direct positive relationships between adherence to a healthy lifestyle and medication, motivation ($\beta = 0.51$, $p < 0.001$), responsibility ($\beta = 0.37$, $p < 0.001$), and perceived results of care ($\beta = 0.27$, $p < 0.05$). However, the model was rejected because the regression weights and the model fit were insignificant. The estimates were as follows: $\chi^2 = 2929.3$, $df = 1197$, $p < 0.001$, $\chi^2/df = 2.4$, IFI = 0.8, CFI = 0.8, RMSEA = 0.6, indicating that the hypothetical model did not fit the empirical data.

In the next step (Figure 3), the model was modified. In addition to the direct associations, the factors indirectly associated with adherence to a healthy lifestyle and medication were tested. The strongest association found was between adherence to a healthy lifestyle and medication, and motivation ($\beta = 0.49$, $p < 0.001$). Additionally, a direct association was observed between adherence to a healthy lifestyle and medication, and results of care ($\beta = 0.29$, $p < 0.01$). Further inspection of the model indicated that informational support ($\beta = 0.16$, $p < 0.05$), support from next of kin ($\beta = 0.18$, $p < 0.05$), and support from nurses ($\beta = 0.14$, $p < 0.05$) were directly associated with fear of complication. Apart from these findings, informational support ($\beta = 0.17$, $p < 0.05$) and support from nurses ($\beta = 0.14$, $p < 0.05$) were associated with sense of normality; sense of normality was associated with fear of complications ($\beta = 0.25$, $p < 0.001$) and results of care ($\beta = 0.45$, $p < 0.001$); and fear of complications ($\beta = 0.19$, $p < 0.01$), support from next of kin ($\beta = 0.24$, $p < 0.001$), and results of care ($\beta = 0.34$, $p < 0.001$) were associated with motivation. In conclusion, direct associations between motivation and results of care to adherence to a healthy lifestyle and medication were confirmed. In addition, informational support, support from next of kin, support from nurses, fear of complications, and sense of normality had indirect, but statistically significant associations with adherence to a healthy lifestyle and medication.

In consequence, the outlined SEM indicated an acceptable model fit, with the following standardized estimates: the Chi-square test results were as follows: $\chi^2 = 2276.9$, $df = 1009$, $p < 0.001$, $\chi^2/df = 2.3$, IFI = 0.9, CFI = 0.9, RMSEA = 0.06. The standardized path coefficients varied between 0.14 and 0.49). The model explained 45% of the variance in the factors associated with adherence to a healthy lifestyle and medication.

## 4 | DISCUSSION

The Theory of Adherence to Treatment in Patients with Chronic Disease has been studied extensively, and it has been found to be a suitable theoretical framework for
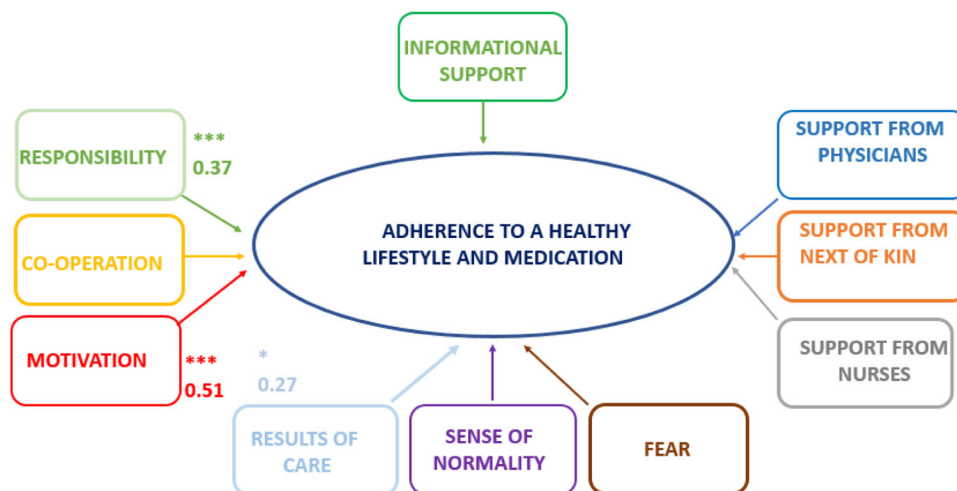


**FIGURE 2** Testing the associations between the adherence to a healthy lifestyle and medication, and the various dimensions of ACDI and informational support, direct connections. Standardized Regression Weights were used, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
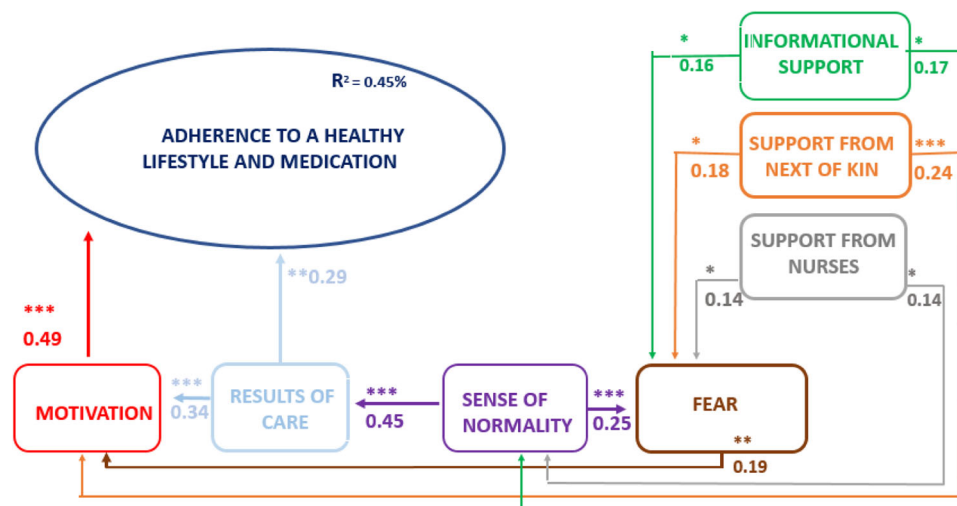
**FIGURE 3** Testing the associations between the adherence to a healthy lifestyle and medication, and the various dimensions of ACDI and informational support, indirect connections. Standardized Regression Weights were used, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

evaluating adherence to treatment in various patient groups.[5,8,9,24,29,30] However, theories should also be critically examined over time.[31] In this study we tested whether the informational support could be used as an extension of this theory. According to results of this study, the strongest predictors to adherence to a healthy lifestyle were motivation and results of care, while informational support, support from next of kin, support from nurses, fear of complications, and sense of normality had indirect, but statistically significant associations with adherence to a healthy lifestyle and medication. These results highlight patient adherence as a multidimensional concept emphasizing patient's active role and participation in their own care, which are currently at the center of nursing and nursing science.[8]

In order for patients to be able to participate fully in their own care and relevant decision-making they must have sufficient information and knowledge about their disease and its treatment. This is backed up by evidence of previous studies, which show that information and knowledge were perceived as the most important aspects of patient involvement. It is worth noting that, in patient participation, the focus is not simply on providing information but also on building competence for cooperation between patients and professionals, which has been found to be associated with adherence to treatment.[8,9] Further, it has been suggested that adherence to lifestyle change is more likely to be attained if counseling is patient-centered, interactive, and informative, and the counselor has sufficient resources.[32,33] The results of this study confirm that including informational support within the Theory of Adherence to Treatment in Patients with Chronic Disease is justified. Informational support can be understood as the practical manifestation of patient education, which occurs when patients receive information, feedback, and recommendations.[10]

PCI is associated with faster recovery, immediate relief of symptoms, shorter hospital stays, and improved short-to-medium-term prognoses as compared with CABG, another commonly used revascularisation method.[34] Matysek et al.[35] have indicated that which treatment method for CHD is used might impact patients' adherence to treatment after the revascularization procedure. Their results demonstrated that patients who have undergone CABG have better knowledge and risk factor control than a post-PCI patient group, which may be explained by better education being provided during postoperative hospitalization and early in-hospital rehabilitation.[35] In addition, there are common misunderstandings about the nature of CHD following PCI.[36] One very common perception among post-PCI patients is that they were cured,[37] even though CHD is a lifelong chronic disease.[4] This is important because it is well-documented that adherence to lifestyle changes is poor, and many post-PCI patients do not follow the guidelines for secondary prevention.[36,37] This suggests that informational support could play a significant role in ensuring that patients have a realistic understanding of the nature of their disease, and of the importance of adherence to treatment with regard to their prognosis with CHD.[4,36]

In this study, informational support, along with support from nurses and next of kin, was associated with reduced fear of complications. This is clinically noteworthy because fear of complications may lead to anxiety,[38,39] which may in turn cause activation of the autonomous nervous system, lowered immune response, impaired heart rate variety, endothelial dysfunction, and vascular inflammation. These symptoms may be associated with worse clinical outcomes

following PCI.[40] Informational support, along with support from nurses, was also associated with the sense of normality, and thus an indirect predictor of adherence to treatment. The main content of the dimension relating to sense on normality in the Theory of Adherence to Treatment in Patients with Chronic Disease is that the patient can live a normal life and adapt to everyday life with his or her disease.

## 4.1 | Limitations

The present study has some limitations. Using self-reported data collection methods always involves a risk of the social desirability effect, meaning that patients provide answers that they think are favorable rather than saying what they actually believe, or sharing information about the actions they actually take. In addition, it is known that patients who adhere to treatment well are more likely to respond to the questionnaire. Another limitation relates to the bias associated with the recruitment process for the study: in accordance with current practice, patients are discharged 24 h after PCI. This rapid turnover means that there is a risk that patients who met the inclusion criteria for the study were overlooked.

As this study confirms, informational support is a significant part of Theory of Adherence to Treatment in Patients with Chronic Disease. However, 75% of the respondents were male. In some studies, it has been indicated that men's and women's needs for informational support and their adherence to treatment can differ from each other.[33,41] Additionally, the results of this study are based on a single cross-sectional design, so the generalizability of the results should be viewed with caution. Thus, it is necessary to critically examine the theories of nursing science in the future, and test and develop them to meet the changing needs of practical nursing work.

## 5 | CONCLUSION

The results of this study emphasize that informational support is a justified extension of the original Theory of Adherence to Treatment in Patients with Chronic Disease. Informational support seems to offer a new perspective that can be used to develop patient-centered nursing and thus support adherence to treatment by patients with a lifelong disease.

## Implications for nursing practice

Theoretical evidence is needed on issues related to adherence to treatment, which is extremely important for improving patients' prognosis after PCI. In addition, theory-based knowledge is a key factor in developing nursing interventions. The Theory of Adherence to Treatment in Patients with Chronic Disease has been found to be suitable for evaluating adherence to treatment but nonetheless, must be critically examined because treatment practices have changed. Informational support is a justified extension to the original theory because as part of patient-centered nursing interventions, it supports adherence to treatment of post-PCI patients.

## AUTHOR CONTRIBUTIONS
Outi Kähkönen completed the data collection and analysis and drafted the first version of the manuscript, including the table's design with feedback from all authors. The manuscript was then revised in different steps from all authors by Anne Oikarinen, Leila Paukkonen, and Hannu Vähänikkilä with Outi Kähkönen taking the main responsibility for writing. All authors approved the final version of the study.

## CONFLICT OF INTEREST STATEMENT
The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT
The data underlying this article will be shared upon a reasonable request to the corresponding author.

## ETHICS STATEMENT
Approval for the study was obtained from each research center and the Ethical Review Board of the University Hospital of Kuopio (Ref. 226/2015).

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## REFERENCES
1. World Health Organization. *World Health Statistics 2022. Monitoring Health for the Sustainable Development Goals.* World Health Statistics (who.int); 2022.

2. Neumann FJ, Sousa-Uva M, Ahlsson A, et al. 2018 ESC/EACTS guidelines on myocardial revascularization. *Eur Heart J.* 2019; 40(2):87-165. doi:10.1093/eurheartj/ehy394

3. Roffi M, Patrono C, Collet JP, et al. 2015 ESC guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: task force for the management of acute coronary syndromes in patients presenting without persistent ST-Segment elevation of the European Society of Cardiology (ESC). *Eur Heart J.* 2016;37(3):267-315. doi:10.1093/eurheartj/ehv320

4. Knuuti J, Wijns W, Saraste A, et al. 2019 ESC guidelines for the diagnosis and management of chronic coronary syndromes. *Eur Heart J.* 2020;41(3):407-477.

5. Kyngäs H. A theoretical model of compliance in young diabetics. *J Clin Nurs.* 1999;8(1):73-80. doi:10.1046/j.1365-2702.1999.00213.x

6. Kääriäinen M, Kanste O, Elo S, Pölkki T, Miettunen J, Kyngäs H. Testing and verifying nursing theory by confirmatory factor analysis. *J Adv Nurs.* 2011;67(5):1163-1172. doi:10.1111/j.1365-2648.2010.05561.x

7. Kähkönen O, Kankkunen P, Saaranen T, Miettinen H, Kyngäs H, Lamidi ML. Motivation is a crucial factor for adherence to a healthy lifestyle among people with coronary heart disease after percutaneous coronary intervention. *J Adv Nurs.* 2015;71(10): 2364-2373. doi:10.1111/jan.12708

8. Paukkonen L, Oikarinen A, Kähkönen O, Kyngäs H. Adherence to self-management in patients with multimorbidity and associated factors: a cross-sectional study in primary health care. *J Clin Nurs.* 2022;31(19-20):2805-2820. doi:10.1111/jocn.16099

9. Kähkönen O, Kankkunen P, Saaranen T, Miettinen H, Kyngäs H. Hypothetical model of perceived adherence to treatment among patients with coronary heart disease after a percutaneous coronary intervention. *Nurs Open.* 2019;7(1):246-255. doi:10.1002/nop2.381

10. Cohen S, Wills TA. Stress, social support, and the buffering hypothesis. *Psychol Bull.* 1985;98(2):310-357. doi:10.1016/j.jvn.2016.04.003

11. Aazami S, Jaafarpour M, Mozafari M. Exploring expectations and needs of patients undergoing angioplasty. *J Vasc Nurs.* 2016;34(3): 93-99.

12. Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart.* 2016;102(13):1009-1016. doi:10.1136/heartjnl-2015-308790

13. Xia N, Li H. Loneliness, social isolation, and cardiovascular health. *Antioxid Redox Signal.* 2018;28(9):837-851. doi:10.1089/ars.2017.7312

14. Shi W, Ghisi GLM, Zhang L, Hyun K, Pakosh M, Gallagher R. Systematic review, meta-analysis and meta-regression to determine the effects of patient education on health behaviour change in adults diagnosed with coronary heart disease. *J Clin Nurs.* 2022;32:5300-5327.

15. Pettersen TR, Schjøtt J, Allore HG, et al. Perceptions of generic medicines and medication adherence after percutaneous coronary intervention: a prospective multicentre cohort study. *BMJ Open.* 2022;12(9):e061689. doi:10.1136/bmjopen-2022-061689

16. Tibebu A, Bekele DM, Negesa L. Adherence to recommended lifestyle modifications and factors associated for hypertensive patients attending chronic follow-up units of selected public hospitals in Addis Ababa, Ethiopia. *Patient Prefer Adherence.* 2017;11:323-330. doi:10.2147/PPA.S126382

17. Adinkrah E, Bazargan M, Wisseh C, Assari S. Adherence to hypertension medications and lifestyle recommendations among underserved African-American middle-aged and older adults. *Int J Environ Res Public Health.* 2020;17(18):6538. doi:10.3390/ijerph17186538

18. Seid MA, Abdela OA, Zeleke EG. Adherence to self-care recommendations and associated factors among adult heart failure patients. From the patients' point of view. *PLoS One.* 2019;14(2):e0211768. doi:10.1371/journal.pone.0211768

19. Grace PJ, Willis DG, Roy C, Jones DA. Profession at the crossroads: A dialog concerning the preparation of nursing scholars and leaders. *Nurs Outlook.* 2016;64(1):61-70. doi:10.1016/j.outlook.2015.10.002

20. Fawcett J, DeSanto-Madeya S. *Contemporary Nursing Knowledge: Analysis and Evaluation of Nursing Models and Theories.* 3rd ed. F. A. Davis Company; 2013.

21. Im EO. The current status of theory evaluation in nursing. *J Adv Nurs.* 2015;71(10):2268-2278. doi:10.1111/jan.12698

22. Kellar S, Kelvin E. *Munro's Statistical Methods for Health Care Research.* 6th ed. Wolters Kluwer/Lippincott Williams & Wilkins; 2014.

23. Kähkönen O, Kankkunen P, Miettinen H, Lamidi M-L, Saaranen T. Perceived social support following percutaneous coronary intervention is a crucial factor in patients with coronary heart disease. *J Clin Nurs.* 2017;26(9-10):1264-1280. doi:10.1111/jocn.13527

24. Kyngäs HA, Skaar-Chandler CA, Duffy ME. The development of an instrument to measure the compliance of adolescents with a chronic disease. *J Adv Nurs.* 2000;32(6):1499-1506. doi:10.1046/j.1365-2648.2000.01611.x

25. Kline RB. *Principles and Practice of Structural Equation Modeling.* 4th ed. The Guilford Press; 2016.

26. Finnish Advisory Board on Research Integrity. Responsible conduct of research and procedures for handling allegation of misconduct in Finland. Guidelines of the Finnish advisory board on research integrity; 2021. Retrieved from Responsible Conduct of Research (RCR) | Finnish National Board on Research Integrity TENK.

27. Bollen KA, Harden JJ, Ray S, Zavisca J. BIC and alternative Bayesian Information criteria in the selection of structural equation models. *Struct Equn Model.* 2014;21(1):1-19.

28. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA.* 2013;310(20):2191-2194. doi:10.1001/jama.2013.281053

29. Kääriäinen M, Paukama M, Kyngäs H. Adherence with health regimens of patients on warfarin therapy. *J Clin Nurs.* 2013; 22(1-2):89-96. doi:10.1111/j.1365-2702.2012.04079.x

30. Ylimäki EL, Kanste O, Heikkinen H, Bloigu R, Kyngäs H. The effects of a counselling intervention on lifestyle change in people at risk of cardiovascular disease. *Eur J Cardiovasc Nurs.* 2015; 14(2):153-161. doi:10.1177/1474515114521725

31. Roy C. Key issues in nursing theory: developments, challenges, and future directions. *Nurs Res.* 2018;67(2):81-92. doi:10.1097/NNR.000000000000026610.1093/eurheartj/ehz425

32. Thórarinsdóttir K, Kristjánsson K. Patients' perspectives on person-centred participation in healthcare: a framework analysis. *Nurs Ethics.* 2014;21(2):129-147. doi:10.1177/0969733013490593

33. Kähkönen O, Saaranen T, Kankkunen P, Lamidi ML, Kyngäs H, Miettinen H. Predictors of adherence to treatment by patients with coronary heart disease after percutaneous coronary intervention. *J Clin Nurs.* 2018;27(5-6):989-1003. doi:10.1111/jocn.14153

34. Palmerini T, Serruys P, Kappetein AP, et al. Clinical outcomes with percutaneous coronary revascularization vs coronary artery bypass grafting surgery in patients with unprotected left main coronary artery disease: a meta-analysis of 6 randomized trials and 4,686 patients. *Am Heart J.* 2017;190:54-63.

35. Matysek M, Wójcicki K, Tokarek T, et al. Knowledge and prevalence of risk factors for coronary artery disease in patients after percutaneous coronary intervention and coronary artery bypass grafting. *Healthcare.* 2022;10(6):1142.

36. Perk J, Hambraeus K, Burell G, Carlsson R, Johansson P, Lisspers J. Study of patient information after percutaneous coronary intervention (SPICI): should prevention programmes

become more effective? *EuroIntervention.* 2015;10(11):e1-e7. doi:10.4244/EIJV10I11A223

37. Kotseva K, Wood D, De Bacquer D, et al. EUROASPIRE IV: a European Society of Cardiology survey on the lifestyle, risk factor and therapeutic management of coronary patients from 24 European countries. *Eur J Prev Cardiol.* 2016;23(6):636-648. doi:10.1177/2047487315569401

38. Delewi R, Vlastra W, Rohling WJ, et al. Anxiety levels of patients undergoing coronary procedures in the catheterization laboratory. *Int J Cardiol.* 2017;228:926-930. doi:10.1016/j.ijcard.2016.11.043

39. Saini R, Chaudhury S, Singh N, Chadha D, Kapoor R. Depression, anxiety, and quality of life after percuataneous coronary interventions. *Ind Psychiatry J.* 2022;31(1):6-18. doi:10.4103/ipj.ipj_126_21

40. Munk PS, Isaksen K, Brønnick K, Kurz MW, Butt N, Larsen AI. Symptoms of anxiety and depression after percutaneous coronary intervention are associated with decreased heart rate variability, impaired endothelial function and increased inflammation. *Int J Cardiol.* 2012;158(1):173-176. doi:10.1016/j.ijcard.2012.04.085

41. Kattainen E, Meriläinen P, Jokela V. CABG and PTCA patients' expectations of informational support in health-related quality of life themes and adequacy of information in 1-year follow-up. *Eur J Cardiovasc Nurs.* 2004;3:149-163. doi:10.3390/healthcare10061142

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.