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2018

Predictors of adherence to treatment by patients with coronary heart disease after percutaneous coronary intervention

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Wiley-Blackwell

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http://dx.doi.org/10.1111/jocn.14153

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Article type : Original Article

Title page

Descriptive title: Predictors of adherence to treatment by patients with coronary heart disease after percutaneous coronary intervention

Concise title: Adherence to treatment after a PCI

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jocn.14153

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Conflict of interest: No conflict of interest has been declared by the authors.

Acknowledgment: We gratefully acknowledge the members of the PCICARE study group: M-L. Paananen, RN and M. Kivi, RN, Central Finland Central Hospital; P. Jussila, RN and I. Juntunen, RN, North Karelia Central Hospital; M. Lehtovirta, RN and E. Pursiainen, RN, Päijät- Häme Central Hospital; A. Ruotsalainen, RN and R-L. Heikkinen, RN, Kuopio University Hospital; K. Peltomäki, RN and V. Räsänen, Heart Hospital Tampere. We would also acknowledge Docent Matti Estola in the University of Eastern Finland, for his valuable statistical advice, nurses and all the patients who participated in the present study.

Funding statement: The present study was supported by an educational grant from the Finnish Foundation of Cardiovascular Disease (16.4.2012) and Finnish Nursing Associations (6.6.2014).

Ethical approval: Ethical review board of University Hospital of Kuopio: ref 74/2012.

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ABSTRACT

Aim and objectives. To identify the predictors of adherence in patients with coronary heart disease after a percutaneous coronary intervention.

Background. Adherence is a key factor in preventing the progression of coronary heart disease. **Design.** An analytical multi-hospital survey study.

Methods. A survey of 416 post-percutaneous coronary intervention patients was conducted in 2013, using the Adherence of People with Chronic Disease Instrument. The instrument consists of 38 items measuring adherence and 18 items comprising sociodemographic, health behavioural, and disease-specific factors. Adherence consisted of two mean sum variables: adherence to medication and a healthy lifestyle. Based on earlier studies, nine mean sum variables known to explain adherence were responsibility, cooperation, support from next of kin, sense of normality, motivation, results of care, support from nurses and physicians, and fear of complications. Frequencies and percentages were used to describe the data, cross tabulation to find statistically significant background variables, and multivariate logistic regression to confirm standardised predictors of adherence.

Results. Patients reported good adherence. However, there was inconsistency between adherence to a healthy lifestyle and health behaviours. Gender, close personal relationship, length of education, physical activity, vegetable and alcohol consumption, LDL-cholesterol, duration of coronary heart disease without previous percutaneous coronary intervention were predictors of adherence. **Conclusions.** The predictive factors known to explain adherence to treatment were male gender, close personal relationship, longer education, lower LDL-cholesterol and longer duration of coronary heart disease without previous percutaneous coronary intervention.

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Relevance to clinical practice:

Because a healthy lifestyle predicted factors known to explain adherence, these issues should be emphasised particularly for female patients not in a close personal relationship, with low education, and a shorter coronary heart disease duration with previous coronary intervention.

Keywords: Coronary heart disease, percutaneous coronary intervention, adherence

SUMMARY BOX

What does this paper contribute to the wider community?

- Adherence to treatment is a crucial factor in terms of the progression and prognosis of coronary heart disease.
- Patients reported good adherence to a healthy lifestyle, but their health behaviours were not consistent with the Current Care Guidelines of Stable Coronary Artery Disease.
- The predictors of adherence to treatment were: male gender, close personal relationship, longer education, moderate to high physical activity, higher vegetable consumption, LDL-cholesterol and longer duration of coronary heart disease without previous percutaneous coronary intervention.

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INTRODUCTION

Adherence to a healthy lifestyle (Booth et al., 2014, Roffi et al., 2016) and receiving the appropriate medical treatment (Chowdhury et al., 2013, Roffi et al., 2016, Swieczkowski et al., 2016) are crucial elements in the progression and prognosis of CHD. Although preventative measures and therapies have significantly enhanced cardiac patients' prognoses, coronary heart disease (CHD) remains a leading cause of death and disability in adults worldwide (World Health Organization [WHO] 2011, Steg et al., 2012). The main reason for this is that the ageing population is increasing rapidly, causing the prevalence of chronic illnesses to rise (WHO 2011). Coronary heart disease can lead to high levels of physical, emotional, and functional distress for many patients. In addition, there is a significant financial burden related to CHD (Dragomir et al., 2010, Jaarsma et al., 2014).

Background

Coronary heart disease patients' non-adherence to treatment represents a common, significant public health concern (Choudhry et al., 2008, 2013, Dragomir et al., 2010, Mosleh, & Darawad, 2015). Adherence to treatment is challenging, although the effects on long-term outcomes are well documented; the risks of all causes of mortality were reduced by 45–55% (Booth et al., 2014) with smoking cessation, 24–28% when physical activity was increased (Graham et al., 2007), and 11–29% when patients adhered to their recommended diet (Estruch et al., 2013). Good adherence to cardiac medication could be related to a 20% lower risk of cardiovascular diseases and a 35% reduced risk of all-cause mortality (Chowdhury et al., 2013).

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It is estimated that a quarter of patients with CHD have at least two modifiable cardiovascular risk factors after percutaneous coronary intervention (PCI) (Fernandez et al., 2008, Davidson et al., 2011, Booth et al., 2014). However, only about half of CHD patients make lifestyle changes, participate in rehabilitation, or use cardiac medication as recommended (Briffa et al., 2013, Redfern et al., 2014, Perk et al., 2015). In addition, the proportion of patients reaching the target level of physical activity is about 40% (Booth et al., 2014). It was found that almost half of patients with CHD did not know what lifestyle changes were required after PCI, and 38–67% believed that they no longer had CHD (Lauck et al., 2009, Perk et al., 2015). Patients with CHD should know and understand their cardiovascular disease risk factors (Kilonzo, & O'Connell, 2011), because such specific knowledge promotes lifestyle changes and medication adherence (Fernandez et al., 2008, Dullaghan et al., 2014). The information should be presented in an individualised, easily understandable manner and take a salutogenic perspective (Throndson et al., 2016). In nursing practice, this means identifying and working with factors that can contribute to preserving and promoting health (Nilsson et al., 2013, Redfern et al., 2014).

The use of PCI has increased steadily over the past decade. When the treatment is successful, the patient may even be discharged on the same day as the procedure. Shorter hospitalisations are clearly cost-effective (Shroff et al., 2016), but the responsibility for care transfers quickly to the patients (Lauck et al., 2009), who may mistakenly believe that they have fully recovered. This can lead to reduced understanding of the risk factors and diminished understanding of the seriousness of CHD (Fernandez et al., 2008).

This study is based on Kyngäs's (1999) theory of adherence of people with chronic disease. Based on this theory, adherence to treatment is considered to be the patient's active, goal-oriented self-management of health status as required by

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collaboration with healthcare professionals (Kyngäs, 1999). Adherence to treatment comprises adherence to medication and a healthy lifestyle, which have been explained by nine mean sum variables as follows: responsibility, cooperation, support from next of kin, sense of normality, motivation, results of care, support from nurses, support from physicians, and fear of complications (Kääriäinen et al., 2013, XXXX et al., 2015).

Levels of adherence to a healthy lifestyle (Fernandez et al., 2006, Kilonzo, & O'Connell, 2011, Booth et al., 2014) and medication (Choudhry et al., 2008, Dragomir et al., 2010, Chowdhury et al., 2013) have been studied extensively in patients with CHD. Moreover, theory-based knowledge is available concerning the factors related to the adherence of patients with chronic disease (Kyngäs et al., 2000a, Kääriäinen et al., 2013). In this study, this theory of adherence of people with chronic disease is adopted as a framework; it has been tested and found to be suitable for patients with CHD after undergoing PCI. However, there is a lack of evidence on how the sociodemographic, health behavioural, and disease-specific background variables predict those factors related to adherence to treatment after PCI in CHD patients.

Aims of the study

The aim of this study was to identify the predictive factors of adherence to treatment in patients with CHD after PCI. The specific research question is: What are the predictive factors of adherence to treatment in patients with CHD after PCI?

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METHODS

Design

This analytical multi-hospital survey study was conducted in five hospitals in 2013, including two university hospitals and three central hospitals in Finland, with the aim of identifying the predictive factors of adherence to treatment in patients with CHD after an elective or acute PCI procedure (angioplasty or stent).

Participants

Patients were eligible to participate in this study four months after treatment, allowing them time to recover physically and to adapt psychosocially to their situation after a cardiac event. Inclusion criteria were as follows: patients aged 18 years or older with no diagnosed memory disorders.

Convenience sampling means that every patient who was treated with PCI and met the inclusion criteria was invited to participate in the study. The inclusion criteria were met by 572 patients, and they were given information about the study by the nurses working in the medical wards. The nurses sought the informed consent of the patients, and 520 (91%) agreed to participate, with a final response rate of 80% (*n*=418). Two questionnaires were incomplete, giving a sample of 416 completed questionnaires for analysis. According to power analyses, this sample size was large enough to detect statistical significance with relatively small correlations (0.14), a power of 80%, and a significance level of 0.05.

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Data collection

Data were collected using postal questionnaires four months after PCI using the adherence of people with chronic disease instrument (ACDI), which is based on a theory of adherence of chronically ill patients. Originally, it was developed and tested among diabetic adolescents by Kyngäs (1999). Later, the theory and ACDI based on it were used as a theoretical framework to study the adherence of adult patients with chronic disease to health regimens (Kyngäs et al., 2000a, Kääriäinen et al., 2013). The validity (criterion and construct validity) and reliability (internal consistency) were found to be high in earlier studies. Cronbach's α values ranged from 0.69 – 0.91 (e.g Kyngäs et al., 2000b, Kääriäinen et al., 2013).

In this study, the ACDI after modification consisted of 38 items that measured adherence to treatment (Table 1). To verify the validity of the instrument, an exploratory factor analysis (EFA) was conducted. The EFA produced a factor solution with satisfactory statistical values. Based on the results of the EFA, two mean sum variables were formatted, which were named adherence to medication (2 items) and a healthy lifestyle (4 items). These two mean variables were explained by nine mean sum variables (dependent variables) as follows: cooperation (2 items), responsibility (3 items), support from next of kin (5 items), sense of normality (7 items), motivation (2 item), results of care (2 items), support from nurses (4 items), support from physicians (4 items), and fear of complications (2 items). These items of adherence to treatment were rated on a 5-point Likert scale ('definitely disagree' to 'definitely agree').

Sociodemographic, health behavioural, and disease-specific factors (independent variables) were measured by 18 items (Table 2). Sociodemographic factors consisted of gender, age, close personal relationship, length of education, profession, and employment status. Health behaviours included the respondents' estimation of their physical activity,

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vegetable consumption, alcohol consumption, and smoking habits. The recommended amounts of physical activity, vegetable intake, and alcohol consumption were as follows: moderate strenuous physical activity for 90–120 minutes per week, at least five dl of vegetables per day, and a maximum of one to two alcoholic drinks per day (Steg et al., 2012, Current Care Guideline: Stable Coronary Artery Disease, 2015). Disease-specific factors included self-reported blood pressure (systolic and diastolic), cholesterol levels, duration of CHD, and previous acute myocardial infarction (AMI) and invasive treatment (PCI or coronary artery bypass grafting [CABG]). Following the Current Care Guidelines (Stable Coronary Artery Disease, 2015), the target level was ≤ 139 mmHg for systolic blood pressure and ≤ 89 mmHg for diastolic blood pressure. Regarding cholesterol levels, the recommended total cholesterol level was ≤ 4.5 mmol/l and the recommended LDL-cholesterol was ≤1.8 mmol/l, according to the Current Care Guidelines. (Steg et al., 2012, Current Care Guideline: Stable Coronary Artery Disease, 2015.) The final questionnaire consisted of 11 mean sum variables and 18 items to measure sociodemographic, health behavioural, and disease-specific factors.

Data analysis

Data analysis was conducted using the Statistical Package for Social Sciences software for Windows (SPSS 21). Missing values were replaced with each item's mean value. According to Kyngäs's theory (1999), adherence to treatment included two mean sum variables: adherence to a healthy lifestyle and adherence to medication. Furthermore, the dependent mean sum variables related to adherence to treatment were responsibility, cooperation, support from next of kin, sense of normality, motivation, results of care, support from nurses, support from physicians, and fear of complications. (Kyngäs, 1999, Kyngäs et al., 2000, Kääriäinen et al., 2013, xx et al., 2015.)

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According to previous studies (Kääriäinen et al., 2013), the mean sum variables were categorised into two classes that were named good adherence and reduced adherence. Those with a range lower than 3.5 were combined and assigned a value of 1, indicating a reduced level of adherence to treatment. Values ranging from 3.51 to 5.0 were combined and recoded with a value of 2, representing a good adherence to treatment. Descriptive statistics (frequencies, percentages) were used to describe respondents' sociodemographic, health behavioural, and disease-specific factors.

In the first phase, the cross tabulation and chi-square test were used to find a relationship between the independent sociodemographic, health behavioural, and disease-specific factors, and the dependent mean sum variables explaining adherence to treatment (the univariate model). In cases in which a chi-square test was not appropriate (no more than 20% of the cells should have <5), Fisher's exact test was used. In the second phase, multivariate logistic regression was used to find which sociodemographic, health behavioural, and disease-specific factors predicted adherence to treatment.

All statistically significant variables in the univariate model (chi-square test) were entered into multivariate logistic regression using backward stepwise selection. The independent dichotomous variables were recoded as dummy variables (0, 1). Also, the independent variables with more than two categories were recoded into dummy variables (Kellar & Kelvin 2012) as follows: employment status D1: 1 = employed / 0 = unemployed, retired, D2: 1 = retired / 0 = employed, unemployed; profession D1: 1 = clerical workers / 0 = worker, entrepreneur or farmer, uneducated worker, D2: 1 = worker / 0 = clerical worker, entrepreneur or farmer, uneducated worker, D3: 1 = uneducated worker / 0 = clerical worker, worker, entrepreneur or farmer; physical activity D1: 1 = high (≥ 4 times per week 30 minutes) / 0 = moderate (1 – 3 times per week 30 minutes), occasional, D2: 1 = moderate / high,

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occasional. This standardised method facilitated the confirmation of the results of the earlier univariate analysis. P values of < 0.05 were considered statistically significant. In this study, the goodness-of-fit was evaluated using the chi-squared distribution and Nagelkerke R-square values. (Kellar, & Kelvin, 2012, Polit, & Beck, 2012.)

Ethical considerations

Approval for the study was obtained from each research centre and the Ethical Review Board of the University Hospital of Kuopio (Ref. 74/2012). Patients gave their informed consent before discharge. In accordance with the Declaration of Helsinki, participants received verbal and written information about the study, which was provided by a registered nurse, before signing the consent forms. This information included the purpose and procedures of the study, the voluntary nature of participation, and the option to withdraw at any point. Participants were informed in a letter attached to the questionnaire that their identity would not be revealed at any stage and that the researcher would treat their information as confidential.

Validity and reliability

For this study, the face validity of the questionnaire was evaluated by three nurses who had extensive experience in the care of cardiac patients in central hospitals, as well as 15 patients with CHD in a medical ward after an angioplasty treatment. Based on the feedback, some words and sentences in the questionnaire were clarified. In this study, the alpha coefficients ranged from 0.40 to 0.88, indicating sufficient to high internal consistency (Table 1). The construct validity of the instrument was tested using the EFA, which produced a factor solution with satisfactory statistical values. Principal axis factoring yielded an 11-factor solution. These

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factors explained 65.1% of the total variance. One item (Item12: living without restrictions) was not used because it did not load on any factor. Communalities in all items were satisfactory (>0.2), and factor loadings for all variables were 0.26–0.90, meaning that the variables loaded strongly on a particular factor. (DiStefano et al., 2009, Polit, & Beck, 2012.)

RESULTS

Sample characteristics

Of the final sample of 416 respondents (Table 2), most (75.5%) were male. The mean age of the respondents was 63.2 years (range 38–75, standard deviation [SD] 8), and just over three-quarters (77.0%) were in close personal relationship. The mean length of education was 11 years (range 5–24, SD 3.3). In terms of profession, one-third (31.8%) of the respondents were workers; approximately one-quarter (28.4%) were clerical workers, entrepreneurs or farmers (21.6%), and 18% were uneducated workers. Most (70.6%) of the respondents were retired, and just over one-fifth (21.4%) were employed.

An examination of health behaviour in relation to the Current Care Guidelines (Stable Coronary Artery Disease, 2015) revealed that less than half the respondents (42.0%) engaged in at least 120 minutes of sustainable physical exercise per week, and only one-tenth (8.9%) consumed five dl of vegetables per day. Slightly less than half of the respondents (41.1%) were in compliance with the recommendation that consumption of alcohol should be limited to one to two drinks per day, and 15.4% were smokers.

Most of the respondents had an acceptable systolic blood pressure (67.1%), whereas 8.4% did not know their blood pressure values. About one-half (52.4%) had total cholesterol levels as recommended in the Current Care Guidelines (2015), and one-third (33.9%) of the

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respondents did not know their cholesterol values. The average duration of CHD was five years (median 1, range 0.3–45, SD 7). Previous PCI was reported by 23.8% and previous CABG by 12.5% of the respondents.

Prevalence of good adherence to treatment and explanatory factors of adherence among patients with CHD after PCI

Most respondents reported good adherence to medication (95.2%) and a healthy lifestyle (89.9%) (Table 3), and most (93.8%) felt highly responsible for their own care. Somewhat more than 93.3% of the respondents reported a high level of cooperation with healthcare professionals and most (93.2%) received a high level of support from their next of kin. A strong sense of normality was reported by 89.4% of respondents, and 85.3% reported high motivation towards self-care. Good results of the care were important to 83.4% of the respondents. Support from nurses was received by 76.7% of the respondents, and support from physicians by 72.6%. Fear of complications was experienced by 46.2% of the respondents. (Table 4.)

Sociodemographic, health behavioural, and disease-specific factors predicting adherence to treatment

Based on multivariate logistic regression (Table 5), which was carried out to determine whether sociodemographic, health behavioural, and disease-specific factors predicted adherence to treatment, it was found that a higher consumption of vegetables and a higher level of LDL-cholesterol predicted a sense of normality. Respondents with longer education and those who consumed alcohol in excess of the recommended one to two portions per day reported better cooperation with healthcare professionals. Moderate to high physical activity

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and a longer duration of CHD predicted higher motivation towards self-care. Receiving a higher level of support from the next of kin was related to close personal relationship and lower LDL-cholesterol. Respondents consuming more vegetables, and those without previous PCI, perceived good results of care which was more significant than other background variables. Respondents who tended to consume more than the one to two portions of alcohol per day and those with longer duration of CHD were more likely to receive a high level of support from physicians. In addition, women were more fearful of complications.

The binary logistic regression analysis indicated statistically significant models for predictors of adherence to treatment, whereas the indicators of effect size showed low to satisfactory explanatory power with respect to factors predicting adherence to treatment (Nagelkerke R^2 0.07–0.32) (Table 4). Overall, 62.1 – 94.8% of the cases were correctly predicted by the model. (Polit, & Beck, 2012).

DISCUSSION

This study presents for the first time the results of self-reports concerning predicting factors (sociodemographic, disease-specific, health behavioural), and mean sum variables related to adherence to treatment among CHD patients after PCI. The key finding of this study was the good adherence to treatment; 95% of the respondents reported good adherence to medication, similar to the findings of Furuya et al., (2015). This outcome is significant, as adherence to medication is a key factor in determining the success of various therapeutic approaches and minimising the public health impact related to CHD. However, numerous studies have reported contradictory results, observing a substantial level of non-adherence to cardiovascular medications (Choudhry et al., 2008, Dragomir et al., 2010, Chowdhury et al., 2013, Redfern et al., 2014, Mosleh, & Darawad, 2015, Swieczkowski et al., 2016).

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Although respondents reported good adherence to a healthy lifestyle (90%), we found a significant conflict between respondents' perceived adherence to a healthy lifestyle and the health behaviours they reported. These findings are in line with previous studies, which have reported that patients overestimate their adherence to a healthy lifestyle (Lauck et al., 2009, Davidson et al., 2011, Mosleh, & Darawad, 2015, Perk et al., 2015). Of particular concern is the finding that respondents were not aware of their own risk factors regarding CHD. A plausible explanation for this may be a lack of information related to CHD provided by healthcare professionals, or the provision of information that does not meet patients' needs (Kilonzo, & O'Connel, 2011, Redfern et al., 2014). Another possibility is that patients do not understand the information given because they have limited time due to the short period of treatment (Aazami et al., 2016, Fålun et al., 2016). The quality of counselling related to their personal risk factors is evidently linked to patients' participation in their care, better risk factor management and, hence, adherence to treatment (Dullaghan et al., 2014, Redfern et al., 2014, Aazami et al., 2016, Fålun et al., 2016, Throndson et al., 2016). Post-PCI patients should understand their CHD as a chronic, long-term condition (Fernandez et al., 2009); consequently, the continuum of care and adequate secondary prevention are undoubtedly key issues in this respect (Kotowycz et al., 2010, Shroff et al., 2016).

The high consumption of vegetables predicted a sense of normality, meaning that the respondents felt able to live a normal life that would not be limited by the disease or its treatment. Furthermore, they had adapted to their diet with vegetables as a normal part of life. Our results verified that higher LDL-cholesterol was related to higher sense of normality. A plausible explanation for this might be, for example, that the cholesterol medication was abandoned if it caused side effects that somehow restricted the patient's normal life. The relationship between the higher LDL-cholesterol and a higher sense of normality may also be explained by risk compensation; people receiving a cholesterol medication might be more

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likely to engage in risky behaviours, such as consuming an unhealthy diet, as reported by Sugiyama et al. (2014). This finding is noteworthy, because there is strong evidence that cholesterol medication has a beneficial effect on CHD patients' prognosis, and is therefore a cornerstone of post-PCI patients' secondary preventative treatment. (Rockberg et al., 2017.)

Our results showed that respondents with more education reported better cooperation with healthcare professionals. Additionally, an interesting finding was that respondents who were not in compliance with the recommendation that consumption of alcohol should be limited to one to two drinks per day reported better cooperation with healthcare professionals and higher support from physicians. Use of abundant alcohol is a costly health care problem and an indisputable risk factor for many chronic diseases (Reiff-Hekking et al., 2005), and also to the progression for risk factors of coronary heart disease (Tang et al., 2013). Based on this result, it can be deduced that health care professionals pay special attention to the patient group whose alcohol consumption is at risk level. This is of paramount importance, because evidently, healthcare professionals can effectively help their patients to reduce high-risk drinking while briefly addressing these issues within a visit that may have been scheduled to focus on another health issues. (Reiff-Hekking et al., 2005, Nilssen et al., 2006). Previous evidence also confirms that good cooperation between patients and healthcare professionals is related to better adherence to treatment by chronically ill patients (Kyngäs et al., 2000b, Lauck et al., 2009, Kääriäinen et al., 2013).

Lower socioeconomic status is known to be related to a greater need for support and knowledge (Nilsson et al., 2013, Seyedehtanaz et al., 2016). Educationally or economically disadvantaged patients may encounter inequities in healthcare, and financial restrictions may limit the use of health services (Artinian et al., 2010).

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The important forms of health behaviour regarding the prevention of CHD — such as high to moderate physical activity and high vegetable consumption — predicted the motivation towards self-care, sense of normality, and perceived results of care, which were found to be crucial factors influencing adherence to treatment in many studies (Kääriäinen et al., 2013, Oikarinen et al., 2015, XX et al., 2015). The health benefits of physical activity are undeniably important when it comes to mitigating modifiable CHD risk factors, such as hypercholesterolaemia, hypertension, overweight, and stress (Current Care Guideline: Stable Coronary Artery Disease, 2015).

The results of the present study indicated a lower motivation towards self-care among respondents with a shorter duration of CHD, in contrast to the results of Fålun et al. (2016), who reported that patients may be highly motivated towards lifestyle changes after a cardiac event. Our result is interesting, because a short hospitalisation restricts time for counselling. In addition, a patient's ability to absorb information may be confined in an acute situation. According to Fernandez et al. (2008) and Lauck et al. (2009), insufficient counselling can lead to reduced understanding about the risk factors to, and seriousness of CHD, hence reducing motivation towards self-care. Special attention should be paid to strengthening patients' motivation instead of merely passing on information (Artinian et al., 2010, Aazami et al. 2016). Healthcare professionals' skills are the key to motivation, changing health behaviour, and encouraging patients to adhere to a healthy lifestyle (Smith et al., 2007, Aazami et al., 2016). Patients may need different forms of counselling to enhance their motivation and bring about favourable health behaviour changes. Self-setting goals, self-monitoring, and scheduled follow-up sessions, including face-to-face meetings, group-based interventions, or peer support groups, may provide several advantages to achieve the desired behaviour change. (Artinian et al., 2010.) In addition, innovative strategies that are simply geared to adapting to busy lifestyles, such as home and community-based counselling programmes and smartphones,

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email, and internet-based applications, are increasingly needed to optimise adherence to treatment (Varghese et al., 2016).

Being in a close personal relationship predicted higher support from next of kin in this study. Patients recognised their support from family, colleagues and friends as being an important resource for future change (Fålun et al., 2016). Previous evidence has shown that marriage may have a protective effect in maintaining a healthy lifestyle, possibly resulting in better overall health (Lammintausta et al., 2014, Seyedehtanaz et al., 2016). Lacking a close personal relationship increases the risk of having an acute cardiac event in both men and women, regardless of age and living as single or unmarried; moreover, it worsens the prognosis for acute coronary events (Lammintausta et al., 2014). This patient group should receive special attention, and enhanced interventions should be allocated to different high-risk populations.

Our results indicated that female gender predicted a higher fear of complications. Numasawa et al. (2017) have indicated that women experienced more complications during and after PCI than men. Fear of complications may lead to anxiety, which is, according to Delewi et al. (2017), related to female gender after PCI. Anxiety is understood as a condition in which a person experiences a fear, along with activation of the autonomous nervous system. These symptoms are possibly related to lowered immune response, impaired heart rate variety, endothelial dysfunction and vascular inflammation, which might result in worse clinical outcomes. (Munk et al., 2012.) This is clinically important, and should be taken into account as a part of pre- and post-operative counselling to minimise redundant fear, as well as to identify possible complications as early as possible.

The statistically significant sociodemographic, health behavioural, and disease-specific factors that predicted adherence to treatment in this study were male gender, close personal

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relationship, length of education, physical activity, vegetable consumption, LDL-cholesterol, and duration of CHD with a previous PCI. Additionally, respondents whose consumption of alcohol was not compliant with the recommendation were paid special attention in healthcare. However, age, profession, employment status, smoking habits, blood pressure, previous AMI, and previous CABG were not statistically significant background variables predicting adherence to treatment.

A comparison of the results of this research with those of previous studies using the same instrument is challenging because this is the first study to explain the predictors of good adherence to treatment in CHD patients, in which selected health behavioural and disease-specific background variables were linked to the investigated patient group or disease. However, the results of the present study are partly supported by earlier studies based on Kyngäs's theory of adherence of people with chronic disease, focusing on other chronically ill patient groups. In line with our study, Oikarinen et al. (2015) found adherence to be associated with healthy lifestyle habits, such as engaging in physical activity and high vegetable consumption, among stroke patients. In contrast to previous studies, age (e.g.Kääriäinen et al., 2013) was not predictor of factors related to adherence to treatment in our study.

Limitations and strengths of the study

The present study has some limitations. First, the background variables should have included information on co-morbidity; in particular, questions should have been included in the survey regarding diabetes, metabolic syndrome and stress. In addition, in studies involving self-reported data collection methods, there is always a risk of social desirability bias, where patients provide answers that they think are supposed to be good

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rather than responding according to what they actually do or how they feel (Abma, & Broerse, 2010). However, it is impossible to study adherence to treatment without the patients' assessment of their situation. To minimise the risk of social desirability bias, the voluntary nature of participation in this study was highlighted. Additionally, this study was conducted four months after the procedure. In the future, longitudinal studies are needed to identify how adherence to treatment changes over time.

The main strength of this study was its adequate sample size. Of the 572 patients asked to participate, 91% (n=520) gave their informed consent. Ultimately, 418 patients (80%) returned their questionnaires, reflecting a high response rate. Generally, the questionnaires were well completed, and only two were rejected due to insufficient data. Another strength of the present study was that the research took a broader perspective than other studies regarding adherence to treatment; these earlier studies mainly focused on adherence to medication and a healthy lifestyle. In addition, adherence to treatment and its related factors were studied using both univariate and multivariate methods. This provided information about the strength of the explanatory factors relating to adherence to treatment. This can be considered as another strength of the study. Finally, the ACDI used in this study has been employed in different patient groups in different countries, and its validity and reliability are high (Kyngäs et al., 2000b, Kääriäinen et al., 2013).

CONCLUSIONS

The predictive factors known to explain adherence to treatment were male gender, close personal relationship, longer education, lower LDL-cholesterol and longer duration of CHD without previous PCI.

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RELEVANCE TO CLINICAL PRACTICE

Adherence to treatment is a key factor in preventing the progression of CHD, but adherence to a healthy lifestyle is not a target for patients with CHD after PCI. There was a significant conflict between perceived adherence to a healthy lifestyle and the reported health behaviours in post-PCI patients. Post-PCI patients should be encouraged to perform physical activity and include high vegetable consumption in their diets. Healthcare professionals should pay special attention to patients' involvement in their own care and counselling to strengthen patients' motivation. In particular, patients not in a close personal relationship or less educated patients should be afforded special attention, as well as those who do not engage in sufficient physical activity, or consume inadequate amounts of vegetables.

Shortened hospitalisation causes additional challenges to secondary prevention, and current nursing practice needs to be critically reviewed and reformed to meet these challenges. In the future, it will not be possible to continue to provide guidance to all patients using the same formula. Instead, it is important to identify patients at risk for low adherence to treatment and allocate enhanced patient counselling to strengthen their adherence to treatment. The counselling should be more individually tailored than it is at present, and it should be based more on patients' need for knowledge. Nursing guidelines and recommendations to arrange systematic, evidence-based follow-up treatment will be necessary. High-quality current care guidelines for treatment for coronary disease have been published, but special attention should be paid to strengthening and combining them with this aspect of nursing.

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Contributions

All authors meet conditions 1, 2, and 3 in the definition of authorship set up by The International Committee of Medical Journal Editors (ICMJE).

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Table 1 Factors, factor loadings and Cronbach's alphas related to mean sum variables of adherence

Mean sum variables and factor loadings	Factor loading	Cronbach's alpha
Mean sum variables related to		0.84
adherence to treatment		
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 patients' 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 patient's possibility of discussion with physician	0.87	
Item 9: Related to patient's possibility of discussion 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 good self-care	0.40	
Support from next of kin		0.60
Item16: 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 how next of kin are interested in patient's life	0.76	
Item 27: Related how the next of kin reminds patient of treatment	0.54	
Item 28: Related to how next of kin motivates patient to self-care	0.86	
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	0.66	

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of illness		
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: Relatedto how self-care causes dependence of next of kin	0.58	
Motivation		0.65
Item13: Related to fatique	0.47	
Item15: Related to lack of motivation	0.47	
Results of care		0.40
Item17: 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		
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

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Table 2 Sociodemographic, health behavioural, and disease-specific background information of patients with CHD after PCI: % (n), mean, median, range, standard deviation (SD), missing data %(n) (n = 416)

Factors	%(n)	Mean	Median	Range	SD	Missing %(n)
Sociodemographic						
Gender						0.2(1)
Male	75.5(314)					
Female	24.3(101)					
Age (years)		63.2	64.0	38 – 75	8.0	1.0(4)
Marital status						0.2(1)
Relationship	77.0(320)					
No relationship	22.8(95)					
Length of education (years)		11.0	10.0	5 – 24	3.3	3.6(15)
Profession						0.2(1)
Worker	31.8(132)					
Clerical worker	28.4(118)					
Entrepreneur or farmer	21.6(90)					
Uneducated worker	18.0(75)					
Employment status						0.5(2)
Retired	70.6(294)					
Employed	21.4(89)					
Unemployed	7.5(31)					
Health behavioural						
Physical activity (30 min per day)						1.0(4)
High (≥4 times per week)	42.0(175)					
Moderate (1–3 per week)	44.5(185)					
Occasionally	12.5(52)					
Vegetable consumption		2.4	2.0	0 – 5	1.2	2.2(9)
<2 dl per day	55.2(230)					
2–4 dl per day	33.7(140)					
≥ 5 dl per day	8.9(37)					
Alcohol consumption						15.9(66)
≤2 portions per day	41.1(171)					
>2 portions per day	43.0(179)					
Smoking						0.2(1)
No	84.4(351)					
Yes	15.4(64)					
Disease-specific						

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Systolic blood pressure		130.0	130.0	90 – 192	14.5	8.4(35)
≤ 139 mmHg	67.1(279)					
Hypertension	24.5(102)					
Diastolic blood pressure		75.7	76.0	50 – 97	10.0	8.7(36)
≤ 89 mmHg	86.5(360)					
Hypertension	4.8(290)					
Total cholesterol		4.0	3.8	2.2 – 7.5	0.9	33.9(141)
≤ 4.5 mmo1/l	52.4(218)					
Hypercholesterolaemia	13.7(57)					
LDL-cholesterol		2.18	2.0	0.7 – 5.1	0.8	39.2(163)
≤ 1.8 mmol/l	23.1(96)					
Hypercholesterolaemia	37.7(157)					
Duration of CHD		4.7	1.0	0.3 – 45	7.4	10.3(43)
Previous AMI						1.2(5)
No	61.8(257)					
Yes	37.0(154)					
Previous PCI						0.7(3)
No	75.5(314)					
Yes	23.8(99)					
Previous CABG						1.0(4)
No	86.5(359)					
Yes	12.5(52)					

Abbreviations: CHD = coronary heart disease; AMI = acute myocardial infarction; PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting

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Table3 Prevalence of good adherence to treatment and factors known to explain adherence among patients with CHD after PCI (n = 416)

Mean sum variables	Good adherence %(n)	Mean	Median	Standard deviation
The mean sum variables related to adherence to treatment				
Adherence to medication	95.2(396)	1.95	2.0	0.21
Adherence to healthy lifestyle	89.9(374)	1.90	2.0	0.30
The mean sum variables related to adherence to treatment				
Responsibility	93.8(390)	1.94	2.0	0.24
Cooperation	93.3(388)	1.95	2.0	0.21
Support from next of kin	93.2(388)	1.95	2.0	0.21
Sense of normality	89.4(372)	1.89	2.0	0.31
Motivation	85.3(355)	1.85	2.0	0.35
Results of care	83.4(347)	1.83	2.0	0.37
Support from nurses	76.7(319)	1.77	2.0	0.42
Support from physicians	72.6(302)	1.77	2.0	0.42
Fear of complications	46.2(192)	1.46	1.0	0.50

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Table 4 Percentages and numbers of patients in different factors by background variables, related to good adherence to treatment of patients with CHD after PCI in univariate model (n = 416) (electronic background material)

Factor	**Responsi-bility**	**Cooperation**	**Support from next of kin**	**Sense of normality**	**Motivation**	**Results of care**	**Support from nurses**	**Support from physicians**	**Fear of complications**
%(n)	**93.8(390)**	**93.3(388)**	**93.2(387)**	**89.4(372)**	**85.3(355)**	**83.4(347)**	**76.7(319)**	**72.6(302)**	**46.2(192)**
	p [1)]	**p[1)]**	**p[1)]**	**p[1)]**	**p[1)]**	**p[1)]**	**p[1)]**	**p[1)]**	**p[1)]**
	%(n)	**%(n)**	**%(n)**	**%(n)**	**%(n)**	**%(n)**	**%(n)**	**%(n)**	**%(n)**
Gender	**0.04**								**0.03**
Female	98.0(99)								55.4(56)
Male	92.3(288)								42.9(134)
Marital Status		**0.01**	**<0.001**		**0.05**		**0.03**		
Relationship		96.8(304)	95.9(306)		87.2(279)		79.1(253)		
No relationship		90.3(84)	84.2(80)		78.9(75)		68.4(65)		
Length of education		**0.02**		**0.02**	**0.02**	**0.05**			
< 9 years		97.5(158)		85.4(140)	81.7(134)	78.0(128)			
9–12 years		97.6(83)		88.4(76)	83.7(72)	84.9(73)			
> 12 years		91.2(134)		94.7(143)	92.1(139)	88.1(133)			
Profession		0.03							
Worker		97.7(127)							
Entrepreneur or farmer		97.7(84)							
Uneducated worker		95.9(71)							
Clerical worker		90.6(106)							
Employment status				**0.02**				**0.01**	
Employed				**97.8(87)**				76.4(68)	
Retired				**87.1(256)**				73.8(217)	
Unemployed				**87.1(27)**				48.4(15)	
Physical activity 30 min per day					**<0.001**				
High (≥4 times per week)				92(161)	93.7(164)				
Moderate (1–3 times per week)				89.7(166)	83.2(154)				
Occasionally				78.8(41)	63.5(33)				

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Vegetable consumption			**0.02**	**0.03**	**0.03**		
> 5 dl per day			97.3(36)	91.9(34)	91.9(34)		
2–4 dl per day			93.6(131)	90.0(126)	87.9(123)		
<2 dl per day			86.1(198)	80.9(186)	79.1(182)		
Alcohol consumption						**0.004**	
1–2 portions per day						80.1(137)	
>2 portions per day						66.5(119)	
Smoking				**0.01**	**0.05**		
No				87.2(306)	84.9(298)		
Yes				75.0(48)	75.0(48)		
Duration of CHD			**0.02**				
< 1 year			92.7(204)				
1–10 years			82.1(64)				
> 10 years			86.7(65)				
Systolic blood pressure				**0.02**			
≤ 139 mmHg				88.2(246)			
Hypertension				78.4(80)			
Diastolic blood pressure	**<0.01**	**0.002**		0.01			
≤89 mmHg	94.7(341)	95.7(337)		86.7(312)			
Hypertension	75%(15)	80.0(16)		65.0(13)			
LDL-cholesterol			**0.04**				**0.03**
≤ 1.8 mmol/l			86.5(83)				52.1(50)
Hypercholesterolemia			96.2(151)				38.2(60)
Previous PCI					**0.02**		
No					**85.7(269)**		
Yes					**75.8(75)**		
Previous CABG					**0.01**		
No					**85(305)**		
Yes					**73.1(38)**		

[1)]Cross tabulation and chi-square test were used; Abbreviations: CHD = coronary heart disease; Age and total cholesterol were not statistically significant background variables in univariate model

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Table 5 Multivariate logistic regression describing the relationship between background variables and mean sum variables known to explain adherence to treatment of patients with CHD after PCI (n=416)

Predicting factors	**Odds ratio (95% CI)**	**p**	**χ^2 (df) p**
SENSE OF NORMALITY (R^2=0.32)*			**23.74 (3) <0.001**
Consumption of vegetables (dl per day)	5.03(1.79/14.21)	0.002	
LDL-cholesterol (mmol/l)	5.70(1.45/22.46)	0.01	
COOPERATION (R^2=0.29)*			**17.88 (3) <0.001**
Length of education	0.67(0.53/0.84)	0.01	
Alcohol consumption: 1–2 portions per day / >2 portions per day	5.57(1.03/30.00)	0.05	
MOTIVATION (R^2=0.28)*			**25.55 (5) <0.001**
[1)]Physical activity: moderate and occasional / high	9.29(2.12/39.90)	0.002	
[2)]Physical activity: high and occasional / moderate	8.92(2.30/34.56)	0.01	
Duration of CHD	0.94(0.89/0.99)	0.02	
SUPPORT FROM NEXT OF KIN (R^2=0.27)*		0.01	**16.53 (3) 0.001**
No relationship / relationship	14.79(2.99/73.20	0.01	
LDL-cholesterol (mmol/l)	0.36(0.16/0.82)	0.02	
RESULTS OF CARE (R^2=0.14)*			**13.64 (2) 0.001**
Consumption of vegetables (dl per day)	2.02(1.23/3.3)	0.01	
Previous PCI: yes / no	2.79(1.05/7.39)	0.04	
SUPPORT FROM PHYSICIANS (R^2=0.12)*			
Alcohol consumption: 1–2 portions per day / >2 portions per day	2.35(1.12/4.89)	0.02	
Duration of CHD	1.11(1.01/1.22)	0.03	
FEAR OF COMPLICATIONS (R^2=0.07)*			**12.01 (3) 0.007**
Gender: male / female	2.49(1.23/5.05)	0.02	

Dummy coding: 1)Physical activity 30 minutes per day: 0 = moderate (1–3 times per week) and occasional, 1= high (≥4 times per week); 2)Physical activity 30 minutes per day 0 = high (≥4 times per week) and occasional, 1 = moderate (1–3 times per week); * Nagelkerke R^2 was used

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