

Adherence to self-management in patients with multimorbidity and associated factors: A cross-sectional study in primary healthcare

short running title: Adherence in multimorbid patients

ABSTRACT

Aim

The aim of the study was to explore the adherence to self-management of patients with multimorbidity, identify associated factors, and determine explanatory factors of their adherence to self-management in terms of the Theory of Adherence of People with Chronic Disease.

Background

Adherence to self-management is essential for successful care of multimorbid patients, but multimorbidity poses challenges for both patients and practitioners due its care complexity and broad impact on patients' lives.

Design

A cross-sectional, descriptive exploratory design with the STROBE reporting checklist was applied.

Methods

Adult multimorbid patients who attended primary healthcare consultations in Finland were surveyed using self-administered questionnaires with several instruments including the Adherence of People with Chronic Disease Instrument, Kasari's FIT Index, and Alcohol Use Disorders Identification test. Responses of 124 patients were analysed using descriptive statistics, Spearman correlations, binary logistic regression analysis, and Chi-squared, or corresponding, tests.

Results

Most patients' responses indicated good or adequate adherence to care regimens and medications. However, adherence to self-management for a healthy lifestyle was more frequently inadequate. Adherence was significantly associated with several patient-related factors, including demographic and health-related factors, perceived adequacy of loved ones, and patient activation. Significant explanatory factors for adherence included energy and will-power, motivation, results of care, sense of normality, fear of complications and additional diseases, and support from nurses, from physicians, and from family and friends. Various factors were relevant for specific aspects of self-management.

Conclusions

Multimorbid patients' adherence to self-management is not an 'all or none phenomenon, but a multifaceted process with numerous associated and explanatory factors.

Relevance to clinical practice

The findings highlight needs for an individualised whole-person approach in multimorbid patients' care to provide the required support for good adherence to self-management. Healthcare professionals, especially nurses working in primary healthcare, are well-positioned to meet this need.

Keywords:

Adherence; Healthy lifestyle; Multimorbidity; Primary healthcare; Self-management

What does this paper contribute to the wider global clinical community?

Multimorbidity demands adherence to self-management in individuals' daily life.

Respondents' adherence to care regimens was generally good, but adherence to self-management for healthy lifestyle was more frequently inadequate.

Adherence to self-management was found to be complex, multifaceted process with numerous associated and explanatory factors for patients with multimorbidity.

1 INTRODUCTION

Adherence to care is a major global public health issue. It is particularly important in the care of chronic conditions, i.e., ongoing, often lifelong, health conditions that can be controlled but not cured, at least not yet generally, including mental and physical conditions and prolonged infectious diseases (World Health Organization, 2003, 2016). Adherence positively affects care efficacy and outcomes, and poor adherence has numerous negative consequences (which could be largely avoided by good adherence) for both individuals and societies by increasing morbidity, mortality and both healthcare visits and costs (World Health Organization, 2003).

Multimorbidity, commonly defined as the simultaneous presence of two or more chronic conditions in a single individual, poses major global healthcare challenges due to high prevalence, care complexity, and impact on patients' lives (Academy of Medical Sciences, 2018). The prevalence of multimorbidity varies according to population and methods used to measure it, but regardless of such variations it is indisputably very common globally (Garin et al., 2016). Approximately a quarter of the total population and most of those aged 65 years or more have multimorbidity. However, although the likelihood of multimorbidity is associated with aging, it is not solely a health problem of the elderly, as even more than half of multimorbid people are younger than 65 years old (Barnett et al., 2012; Cassell et al., 2018). Especially in younger age groups, increases in multimorbidity also appear to be related to socioeconomic disadvantage (Barnett et al., 2012; Cassell et al., 2018) and poor health behaviours. The latter include the same risk factors that increase individual chronic conditions, *inter alia* tobacco use, excess alcohol use, physical inactivity, and unhealthy diet (Dhalwani et al., 2017; Freisling et al., 2020). Multimorbidity is projected to increase in the future, both

in absolute terms and relative to single diseases, and particularly severe multimorbidity (presence of four diseases or more simultaneously), is predicted to double by 2035 (Kingston, Robinson, Booth, Knapp, & Jagger, 2018). Multimorbidity is associated with negative health consequences including (*inter alia*) deterioration of health outcomes, functional status, quality of life, accompanied by increases in polypharmacy and treatment-burden, and premature mortality (Stafford et al., 2018; Wallace et al., 2015). It is also associated with higher rates of healthcare utilization, especially primary care but also secondary care including emergency admissions and hospitalization (Palladino, Lee, Ashworth, Triassi, & Millett, 2016; Stafford et al., 2018; Wallace et al., 2015). Multimorbidity management also has considerable financial implications for health systems and individuals, with costs increasing with the number of chronic conditions (McPhail, 2016; Stafford et al., 2018).

2 BACKGROUND

The care of chronic conditions is mainly based on self-management, i.e., the day-to-day management of chronic conditions by individuals themselves. Thus, adherence to self-management is an integral element of the care of multimorbidity patients. It is essential for maintaining optimal health, avoiding troublesome symptoms and even life-threatening complications, slowing progression of diseases, and preventing the onset of additional diseases. Self-management typically involves a range of daily behaviours, such as following care regimens, *inter alia* taking medications as prescribed, attending healthcare appointments, self-monitoring, choosing appropriate treatment options, and implementing health-related lifestyle changes and/or maintaining a healthy lifestyle (Bayliss et al., 2007; Bodenheimer, Lorig, Holman, & Grumbach, 2002). Four behavioural lifestyle risk factors that are the most important for patients with chronic diseases as well as those with multimorbidity, and should be avoided, are tobacco use, an unhealthy diet, physical inactivity and harmful use of alcohol (World Health Organization, 2013). Self-management for even a single condition can be challenging, and the presence of two or more conditions makes it more burdensome and complicated, but even more imperative, as it necessitates prioritization of multiple needs and both consideration and balancing of potential interactions between treatments and diseases (Gobeil-Lavoie, Chouinard, Danish, & Hudon, 2019).

Adherence to self-management can be defined by the extent to which the patient follows agreed recommendations regarding treatment. The concept of compliance is related to adherence, but compliance typically reflects the extent that a patient follows instructions of healthcare providers (Gardner, 2015; World Health Organization, 2003). Thus, here the term 'adherence' is used to emphasize the patient's active role in the care process and importance of the patient-professional relationship. Hence, adherence is defined as an active, intentional and responsible process of care, in which the individual works to maintain his or her health in close collaboration with her/his healthcare providers (Kyngäs, 1999).

Adherence to self-management is a complex process that is influenced by multiple interactive factors. In addition to patient-related factors (such as their resources, knowledge, beliefs, perceptions) and patients' social and economic factors (education or employment status, age etc.), these include health system-related factors (patient-provider partnership, systems' ability to establish self-management capacity etc.), condition-related factors (level of disability, co-morbidities etc.) and therapy-related factors (complexity, duration etc.) (World Health Organization, 2003). The multitude of factors highlight risks that features of the burden and complexity of both multimorbidity and its care may impair patients' adherence to care. Multimorbid patients typically have needs to adhere simultaneously to many ongoing medication and self-management regimens. Thus, their self-management may be very onerous. For example, an analysis of the potential workload for patients with multimorbidity applying the most recent clinical guidelines for adults with prevalent chronic conditions in primary care found that (depending on the concomitant chronic conditions) patients with three chronic conditions would have to: take 6-13 medications per day, visit a health caregiver 1.2-5.9 times per month and spend 49.6-71.0 hours per month on average on health-related activities. Moreover, the potential workload increased greatly with increasing number of concomitant conditions, rising to 18 medications per day, 6.6 visits per month and 80.7 hours per month spent on health-related activities for patients with six chronic conditions. Thus, clinical guidelines that are commonly used to make appropriate care decisions and largely created for single conditions rarely address needs of multimorbid patients, making their potential workloads onerous and likely decreasing adherence (Du Vaure et al., 2016). In addition, several healthcare professionals are typically involved in their care, and services are usually provided by multiple specialty healthcare providers working for various healthcare organisations and in various settings, so the care tends to

be fragmented, with risks of communication problems, confusing information and obstacles hindering coordination and continuity of care (Wallace et al., 2015). Due to the prevailing single-condition approach, and both the heterogeneity and complexity of multimorbid patients' conditions, both the patients themselves and healthcare professionals reportedly find that management of multimorbidity poses substantial challenges, including difficulties in provision of self-management support (Bower et al., 2011; Wallace et al., 2015). On the other hand, multimorbid patients' tendency to have frequent and intensive contacts with the local healthcare system may facilitate provision of high-quality care (Zulman et al., 2014). However, the features and challenges posed by multimorbidity highlight the need for person-centred and individualized care (Academy of Medical Sciences, 2018; World Health Organization, 2016).

The Theory of Adherence of People with Chronic Disease developed by Kyngäs (1999) presented factors that associate with adherence from the patient's point of view. These are energy and will-power, motivation, results of care, sense of normality, fear of complications and additional diseases, and support from physicians, from nurses and from friends and relatives. The theory originally addressed young people with diabetes, but it has been subsequently modified and applied to different patient groups with various ages and in various healthcare settings. Previous studies focused on adult patients with certain chronic conditions have found that factors explaining adherence to care include: motivation (Kääriäinen, Paukama, & Kyngäs, 2013; Kähkönen et al., 2015); results of care (Lunnela, Kääriäinen, & Kyngäs, 2011); sense of normality (Kääriäinen et al., 2013), and support from physicians (Lunnela et al., 2011), from nurses (Kähkönen et al., 2020; Lunnela et al., 2011) and from next of kin (Kähkönen et al., 2020). However, previous studies have not focused on patients with multimorbidity.

As multimorbidity poses severe global healthcare challenges, and adherence to self-management of care is crucial for multimorbid patients, there are clear needs for research on the subject. The level of adherence may vary between different elements of self-management and in different times and contexts, thus it is important to study adherence to self-management holistically, rather than focusing solely on either medication adherence or healthy lifestyles. To the best of our knowledge, multimorbid patients' adherence has received limited attention. However, identifying patients at risk of poor adherence to self-management may facilitate effective targeting of support and counselling to strengthen their adherence. Better

understanding of factors associated with adherence to self-management is also likely to help efforts to find ways to improve support for patients in managing their care. Thus, further information on multimorbid patients' perceptions of their adherence to specific aspects of self-management is clearly needed.

Hence, the aim of the study presented here was to explore the adherence to self-management of patients with multimorbidity, identify associated factors, and determine explanatory factors of their adherence to self-management in terms of the Theory of Adherence of People with Chronic Disease.

The following research questions were specifically addressed:

1. What are the main characteristics of the adherence to self-management of Finnish adult primary healthcare outpatients with multimorbidity?
2. What patient-related factors are associated with good adherence to self-management among adult primary healthcare outpatients with multimorbidity?
3. What factors explain adherence to self-management among adult primary healthcare outpatients with multimorbidity in terms of the Theory of Adherence of People with Chronic Disease?

3 METHODS

3.1 Study design

A cross-sectional, descriptive exploratory design was applied, following the STROBE statement reporting guidelines for cross-sectional studies (Supplementary File 1; Von Elm et al., 2007).

3.2 Setting and participants

Participants in the study were adult outpatients with multimorbidity who attended primary healthcare consultations during the data collection period (November 2019 to May 2020). Eligibility criteria for participation were co-existence of two or more chronic conditions. These could include one or more physical non-communicable diseases of long duration (such as cardiovascular disease, diabetes, asthma or cancer), mental health conditions of long duration (such as a mood disorder) and/or infectious diseases of long duration, such as HIV or hepatitis C (Academy of Medical Sciences, 2018). Participants were also required to be at least 18 years old and have sufficient Finnish language skills to complete the questionnaire described

in section 3.4. The minimum required sample size was based on previous information regarding the ACIDI-measurement when comparing patients with good and poor adherence according to factors influencing adherence (sense of normality, motivation) in the Chi-squared test (Kääriäinen et al., 2013) for a probability of type I error (α) < 0.05 and power > 0.80 for the considered variables ranged from 116 to 132 participants.

3.3 Data collection

Eligible study participants were recruited during appointments for management of a chronic condition with a nurse or a doctor in all primary healthcare centres in one Finnish municipality, by health personnel, mainly nurses, who were responsible for chronic care of patients. They were instructed to distribute questionnaires to all patients satisfying the eligibility criteria. Questionnaires (including items described in section 3.4) were delivered with a stamped addressed envelope for return and detailed written information about the study's purpose and objectives as well as contact information for the researcher so that prospective participants could ask additional questions.

3.4 Measurements

3.4.1 Adherence to self-management

Adherence to care regimens was measured using the self-report Adherence of people with Chronic Disease Instrument (ACDI), which was originally developed by Kyngäs (1999). It has been subsequently used, modified and validated in several studies for use with patients with various chronic diseases (Kääriäinen et al., 2013; Kähkönen et al., 2015, 2018, 2020; Lunnela et al., 2011; Oikarinen, Engblom, Kyngäs, & Kääriäinen, 2018) and frequent healthcare attenders (Hirsikangas, Kanste, Korpelainen, & Kyngäs, 2016; Kivelä, Elo, Kyngäs, & Kääriäinen, 2020). The instrument includes 11 items intended to measure adherence to care in terms of adherence to: medications, general care regimens, agreed diet, monitoring, co-operation, responsibility, and willingness to care for oneself. It also includes 27 items intended to measure factors affecting adherence: energy and will-power, motivation, results of care, sense of normality, fear of complications and additional diseases, support from physicians, support from nurses, and support from friends and relatives. All these items invite Likert-type responses on a 1-4 scale ranging from strongly

disagree to strongly agree. Mean scores for the adherence to care regimens (treated as mean sum variables) were categorised into three classes: poor (< 3), adequate ($3 \leq \text{mean} < 3.5$) and good (≥ 3.5). In terms of factors affecting adherence values ≥ 3 (agree or strongly agree) and < 3 (disagree or strongly disagree) indicate positive and negative responses, respectively. In this study the Cronbach's α values were satisfactory for the 11 adherence to care regimens items (0.75), three adherence to medication items (0.71), and total instrument (38 items, 0.90).

Physical Activity was measured with the FIT Index developed by Kasari (1976), which is used to assess general physical activity by inviting Likert-type responses to three questions regarding frequency of exercise ("How often do you exercise?"), intensity of exercise ("With what intensity do you usually exercise?"), and time spent exercising ("How long do you usually work out?"). For frequency, there is a 5-point scale (once per month or less to at least 6 times per week). For intensity, there is also a 5-point scale (from light aerobic activity to high intensity), and for time spent exercising there is a 4-point scale (less than 10 minutes to >30 minutes). The overall FIT index is scored by simply multiplying scores obtained for each of these three parameters, and ranges from 1 to 100, with scores of ≤ 36 , 37–63 and > 64 indicating low, moderate, and high physical activity levels, respectively. 12 points or below is considered sedentary (Uutela, Kautiainen, & Häkkinen, 2018). The Cronbach's alpha value for the FIT index was 0.78 in this study.

Alcohol use was assessed using AUDIT-C, the first three of 10 questions in the Alcohol Use Disorders Identification Test (AUDIT) instrument developed by the World Health Organization (2001). Each question has five possible answers, scoring 0 to 4 points, which are summed. Thus, the resulting scale ranges from 0 (no alcohol use) to 12. Scores of 3 or less for men and 2 or less for women are considered to indicate low-risk consumption. (Bradley, Kivlahan, & Williams, 2009) According to Finnish Current Care Guidelines commonly used screening limits for problem use are ≥ 6 for men and ≥ 5 for women, and which were used in this study to allow comparison. (In international studies these thresholds for risky use have varied slightly). In this study the Cronbach's alpha for AUDIT-C was 0,91.

Tobacco-use was assessed with two questions: "At the present time, do you smoke cigarettes?" and "Do you use other tobacco products (snuff, chewing tobacco etc)?" Possible answers were not at all, occasionally, and daily.

Variety of diet was assessed using a single question, “How varied is your diet?”, inviting Likert-type responses with a 5-point scale (very varied to very uniform).

3.4.2 Secondary outcome measures and variables

Patient activation was measured using the Patient Activation Measurement (PAM[®]) instrument (Hibbard, Mahoney, Stockard, & Tusler, 2005), which is widely used in assessments of patients with various chronic conditions and in various settings. PAM is available under license from Insignia Health in several languages, including Finnish, which was used in this study. PAM includes 13 items on the respondents’ knowledge, skills and confidence in managing their own health and healthcare, as well as belief in the importance of their own role. The items invite Likert-type responses with scales ranging from strongly disagree (1) to strongly agree (4), with an additional “not applicable” option. The raw scores are summed (range 13-52) and used to generate a PAM-score (range 0-100, with higher scores indicating higher activation), which can be categorized as one of four levels of activation designated 1, 2, 3, and 4 (for scores of <47.1, 47.1-55.1, 55.2-67.0, and >67.1, respectively). According to measurement guidelines, respondents must answer at least 10 of the 13 questions (N/A responses are considered missing) to obtain a valid PAM-score. In addition, uniform response patterns with no variation are usually considered unreliable and invalid, so they are excluded (Hibbard & Gilbert, 2014; Hibbard et al., 2005). In this study, the activation levels were dichotomised into low (levels 1 and 2) and high (levels 3 and 4) activation levels, in accordance with previous studies (Zimbudzi et al., 2017), and the Cronbach’s alpha value for this instrument was 0.84.

Perceived health was measured with a single question that is often applied internationally, “How is your current health in general?” (Palladino et al., 2016; OECD, 2017), with the response options good, quite good, moderate, quite poor and poor, in accordance with a study by the Finnish Institute for Health and Welfare (Koponen, Borodulin & Lundqvist, 2018), these responses were further classified as good (good or very good), moderate, and poor (quite poor or poor).

Perceived functional ability, i.e., respondents’ subjective experience of their ability to cope with meaningful and necessary daily life activities in their environment was assessed by one question, “How is your current functional ability in general?”, with response options good, quite good, moderate, quite poor and poor

(Halonen, Enroth, Jylhä, & Tiainen, 2017) that were classified in the same manner as the perceived health responses.

Perceived sufficiency of number of close people was also measured with a single question: “Do you think you have enough close people?” with three possible answers: sufficient, not sufficient, and none at all.

Number of chronic conditions constituting multimorbidity was assessed using a form listing 26 conditions: diabetes, hypertension, coronary heart disease, heart failure, arrhythmia, stroke, rheumatoid arthritis, ankylosing spondylitis, osteoarthritis, cancer, chronic obstructive pulmonary disease (COPD), asthma, hypo- or hyperthyroidism, inflammatory bowel disease (Crohn’s Disease, ulcerative colitis etc.), chronic kidney disease, memory disorder (like Alzheimer's disease), allergy, celiac disease, depression, bipolar disorder, schizophrenia, Parkinson’s disease, epilepsy, multiple sclerosis, glaucoma, and hepatitis C. Respondents could select any combination of chronic conditions from the list and add other long-term diseases not mentioned in the list in a text box. The suitability of freely listed conditions for constituting multimorbidity was checked before inclusion in a respondent’s total number of conditions.

Height and weight: respondents were also asked to state their height and weight to allow calculation of respondents’ Body Mass Index (BMI). Obesity, overweight and normal weight was defined as BMI of ≥ 30 , 29.9-25, <24,9 kg/m², respectively. Obesity was not included in a respondent’s total number of conditions constituting multimorbidity.

Demographic variables: respondents were also asked to list their year of birth (subsequently used to form 38-64, 65-74, 75–93-year-old age groups), gender, marital status, highest education level, employment status, and living situation (alone, with spouse/children, etc.).

3.5 Data analysis

Descriptive statistics were calculated for all of the variables and respondents’ characteristics: means, standard deviations (SD) and ranges for continuous variables, and frequencies, percentages and indications of their distributions for categorical variables. Scores and levels for each considered variable were

calculated, and classified for some analyses, according to guidelines of the instruments used (see above). The missing values were not imputed.

Relations between all scores for the elements of self-management (adherence to care regimens, physical activity, varied diet, alcohol use, and tobacco use) were assessed by calculating Spearman correlation coefficients between them. Cross-tabulation with the Chi-squared, Fisher's exact, or Fisher-Freeman-Halton Exact test was used, as appropriate, to test the significance of associations between patient-related factors and adherence. This was applied to identify sociodemographic and health-related factors associated with good adherence in this population in terms of the considered self-management behaviours (adherence to care regimens, engagement in physical activity, varied diet, avoidance of excessive alcohol and tobacco consumption). In addition, binary logistic regression analysis was used to identify potential explanatory factors for the respondents' adherence in terms of the Theory of Adherence of People with Chronic Disease with the calculation of Odds Ratios between explanatory factors and elements of adherence to self-management.

For all analyses, differences were considered significant if $p < 0.05$. All of the statistical analyses were performed using IBM SPSS for Windows (version 27.0, IBM Corporation, Armonk, NY).

3.6 Ethical considerations

The study was conducted in accordance with relevant ethical standards (World Medical Association, 2013) and responsible research practice guidelines (Finnish Advisory Board on Research Integrity, 2012). The study was approved by the Institutional Review Board (OUKA/8626/07.01.04.02/2019). Any necessary permits, registrations, or licenses for using the applied instruments were obtained. All prospective participants were given detailed written information about the study's purpose and objectives, as well as assurances regarding anonymity, confidentiality, and the voluntary nature of participation. Contact information for the researcher was also provided so prospective participants could ask additional questions if they wished. Completion and return of the anonymous questionnaire was considered to constitute informed consent for participation in the study. The data were collected, processed, and stored without any identifying

information. The study complied with the European Union's General Data Protection Regulation (EU 2016/679). Thus, no further ethical approval was required.

4 RESULTS

4.1 Sample characteristics

The study sample consisted of 124 patients. The participants' age ranged from 38 to 93 years (mean 68.6, SD 10.7). Well over half (59.7%) of the respondents were women and 40.3% were men. Most (87.9%) participants were retired and just over half (51.6%) had tertiary education. All recorded characteristics of the sample are summarized in Table 1.

Participants had 2-13 chronic conditions (mean 4.19, SD 2.0) and well over half (55.6%) had severe multimorbidity (i.e., four simultaneous conditions or more). The conditions were diverse, but the most common types of physical chronic conditions were hypertension, diabetes, coronary artery disease, asthma and arrhythmia (reported by 74.2, 60.5, 27.4, 27.4 and 24.2% of the respondents, respectively). The most common mental illness was depression (reported by 9.7% of respondents). In addition to the mentioned conditions 45.3% of respondents were obese and 36.8% were overweight.

4.2 Adherence to self-management

In terms of *adherence to care regimens* as measured by the ACIDI, about three quarters (73.4%) reported good adherence (mean ≥ 3.5), 17.7% reported adequate ($3 \leq \text{mean} < 3.5$), and 8.9% poor adherence (mean < 3), however the lowest mean was 2.6 on a scale of 1-4. Most patients (81.5%) reported good *adherence to medication*, while 14.5% and 4% respectively reported adequate and poor adherence. The highest adherence emerged in relation to medication use following agreed instructions (mean 3.88, SD 0.37) and related to healthcare follow-up visits (mean 3.83, SD 0.47) (Table 2).

The FIT index values of *Physical activity* indicated that 59.7% of participants had low activity (20.9 and 38.8%, respectively, being classified as sedentary and having some activity), 27.4% had moderate activity and 8.9% high activity. For five respondents the value could not be calculated due to missing answer(s). Half (50.8%) of the participants engaged in physical activity for at least 10 minutes at least three times a week,

and the rest rarely. Regarding *variety of diet* 58% rated their diet as very or quite varied, and 41.5% rated their diet as moderately varied or uniform.

The AUDIT-C scores of *Alcohol use* indicated that two thirds (67.7%) of the respondents had low alcohol consumption, almost half (46%) did not consume alcohol at all, and 15% were self-reportedly in the risky alcohol use category. In addition, 12.9% of respondents reported *use of tobacco* (smoke or smokeless), 10.5% daily.

Several significant *correlations between examined behaviours* were detected: adherence to care regimens was positively correlated with physical activity ($r=.254$, $p<0.01$) and varied diet ($r=.351$, $p<0.01$). In addition, physical activity correlated negatively with use of tobacco ($r=-.212$, $p<0.05$), which was positively correlated with alcohol use ($r=.210$, $p<0.05$) (Table 3).

4.3 Associations of patient-related factors with specific elements of self-management

Factors found to be significantly associated with adherence to care regimens were marital status, perceived adequacy of close friends and relatives, and patient activation level: good adherence in this respect was less frequent among respondents who were single ($p=.012$), reportedly had insufficient close friends and relatives ($p=.026$), and a low level of patient activation ($p=.004$). Factors associated with medication adherence (in the same direction as in the overall adherence to care regimens) were marital status ($p=.020$) and adequacy of close friends and relatives ($p=.023$). For more details see table 4 and 5.

Physical activity was found to be significantly associated with living situation, and levels of adequate (moderate or high) activity were highest for the group living with a spouse or partner ($p=.041$) (Table 4). The number of patients' chronic conditions was also significant: participants with 2 or 3 conditions were more frequently adequately active than those with 4 or more conditions ($p=.014$). High patient activation level ($p=.005$) and good perceived health and functional ability ($p<0.0001$ and 0.001 , respectively) were also positively associated with adherence to physical activity, and frequency of physical activity (i.e., scores were higher for respondents who engaged in physical activity at least three times a week than for those who exercised rarely). (Table 5).

Adherence to a varied diet was significantly associated with age, being more common among patients aged 65-74 years than both younger and older age groups ($p=.018$). It was also significantly associated with education level, being more common among participants with tertiary education than those with lower education ($p=.017$) (Table 4). Similarly, patients with enough close friends and relatives ($p=.012$), with good perceived health and functional ability ($p<0.0001$ in both cases) and high patient activation ($p=.002$) reported eating a variety of foods more frequently than those without sufficiently close friends and relatives, poorer perceived health and functional ability, and low patient activation (Table 5).

Alcohol consumption was significantly related to age, gender, and number of chronic conditions. The proportion of participants with low consumption of alcohol increased with increases in age ($p=.003$) and number of conditions ($p=.014$). The women were also more likely to report low alcohol consumption than the men ($p=.003$). All of these variables remained significant factors for low alcohol consumption even when they were adjusted with each other in multivariable binary regression analysis. Age and gender were also associated with risky use of alcohol, which was found to be inversely related to age ($p=.042$) and higher among the men than the women (30% and 5.4%, respectively, $p<0.001$). For more details see table 4 and 5.

Use of tobacco was also significantly associated with age: adherence to non-use of tobacco increased with age of the stratified groups ($p<0.001$). It was also slightly more common among men (14.0%, 12% daily) than among women (12.2%, 9.5% daily), but the differences were not significant. The results also showed that employment status was associated with use of tobacco, but this was due to the employed respondents being younger on average than the others, as demonstrated by loss of significance for employment status in multivariable binary regression analysis with adjustment for age. (Table 4). Use of tobacco was also more common among those reporting a lack of sufficiently close friends and relatives than among those who reported having enough close people ($p=.026$) (Table 5).

4.4. Explanatory factors for adherence to self-management

According to the Theory of Adherence of People with Chronic Disease, potential explanatory factors for adherence are energy and will-power, motivation, results of care, sense of normality, fear of complications and additional diseases, support from family and friends, support from physicians, and support from nurses.

Most participants in this study felt that they had enough energy and willpower (78.2%) and motivation (84.7%) to care for themselves. Most (91.9%) also perceived positive results of care and that caring for oneself is related to positive feelings (83.1%, corroborating the sense of normality in care). In addition, 79.8, 69.4 and 87% felt that they obtained sufficient support from family and friends, physicians and nurses, respectively. However, most (69.4%) also had fears of complications and additional diseases.

Significant factors for good total *adherence to care regimens* detected in this study were: motivation (OR 3.96, $p=.008$), results of care (OR 7.90, $p=.004$), sense of normality in care (OR 3.16, $p=.021$), support from family and friends (OR 2.75, $p=.031$), support from physicians (OR 5.14, $p<.001$) and support from nurses (OR 4.70, $p=.005$). Significant factors for good *Adherence to medication* detected were motivation (OR 4.36, $p=.007$), not having fears of complications and additional diseases (OR 5.82, $p=.022$) and support from physicians (OR 4.99, $p=.001$) (Table 6).

Regarding physical activity, significant explanatory factors for its frequency were support from physicians (OR 2.35, $p=.038$) and support from nurses (OR 4.10, $p=.040$). Significant explanatory factors for a varied diet were having energy and willpower to care for oneself (OR 3.71, $p=.004$), motivation (OR 4.97, $p=.004$), sense of normality in care (OR 4.46, $p=.004$), support from family and friends (OR 3.89, $p=.004$) and support from physicians (OR 3.01, $p=.006$) (Table 6).

5 DISCUSSION

This study has provided new knowledge about multimorbid patients' adherence to self-management and factors influencing adherence in Finnish primary healthcare settings. It has also provided the first indications of specific explanatory factors, in terms of the Theory of Adherence of people with Chronic Disease, for good adherence in this population.

The findings reveal that adherence to care regimens was generally moderately good among the multimorbid patients. Adherence to medication and attendance of healthcare follow-up appointments was particularly high, in accordance with previous findings regarding multimorbid patients' adherence in Israel (Cohen-Stavi et al., 2020). In this study, good, adequate and poor adherence to medications was reported by 82, 14.5 and just 4% of the participants, respectively. This is important, as most multimorbid patients usually use a lot of

medications, often receiving polypharmacy, and co-occurrence of many conditions is considered a risk for good adherence to medications. On the other hand, it is also possible that as multimorbid patients have numerous healthcare contacts they may receive overlapping care, especially in cases where their conditions are interrelated and share similar management strategies (Zulman et al., 2014), which may help them to adhere to medications and other care regimens. This notion is corroborated by a previous study of Finnish frequent healthcare attenders, most of whom had at least one chronic disease, which found a similarly high rate of adherence (Hirsikangas et al., 2016). However, a previous study of older multimorbid patients observed somewhat higher rates of non-adherence, with on average 20-40% of patients being non-adherent to medications, with rates varying for certain combinations of chronic conditions (Kim, Bennett, Wallace, Fahey, & Cahir, 2018). We did not examine potential differences in adherence associated with variations in combinations of our multimorbid participants' conditions. It is also worth noting that there are many current methods for assessing medication adherence, which complicates attempts to compare results of studies.

Results of this study also show that several factors were associated with adherence to care regimens. Good adherence to care regimens and medications was less frequent among participants who expressed a lack of sufficient close friends and relatives, and single respondents. Support from family and friends, from nurses and from physicians were all also significant explanatory factors for adherence to care regimens, while support from physicians was a significant explanator of medication adherence. Previous studies, using the same theory of adherence, have also found that significant explanatory factors for adherence of chronically ill patients included support and results of care (Lunnela et al., 2011), sense of normality (Kääriäinen et al., 2013) and motivation (Kääriäinen et al., 2013; Kähkönen et al., 2015), all of which proved to be explanatory factors for care regimens in this study. This study also revealed that patient activation was significantly associated with adherence to care regimens, but not adherence to medications. Previously mixed results have been obtained on associations between patient activation and medication adherence among patients with chronic diseases (Kinney, Lemon, Person, Pagoto, & Saczynski, 2015). We also found that poor adherence to use of medications as agreed with professionals was more common among patients who had fears of complications and additional diseases. The converse finding, that lack of such fear promotes good adherence to medications, warrants further attention, both theoretical and practical. Moreover, fears were very common

in the focal population; about 70% of respondents reported having fears compared to 46 % of coronary heart disease patients treated with percutaneous coronary intervention previously surveyed by Kähkönen et al. (2018).

The level of engagement in physical activity varied among the multimorbid patients, four out of ten reported moderate or high activity while the rest reported low activity, and a fifth were sedentary. Physical activity was negatively correlated to number of conditions, perceived health and functional ability, but positively related to patient activation i.e., knowledge, skills and confidence in managing their own health.

Multimorbidity can restrict physical activity and exercise, and adaptation of exercise to chronic conditions may be needed, but finding appropriate individual ways to engage in physical activity and understanding its importance for health, are very important. Results of this study indicate that patients' own knowledge and understanding of the importance of their role in their own care can promote physical activity. This result is supported by another finding, that frequent activity (at least three times per week) was associated with support from nurses and physicians. Physical activity is a key form of prevention and care of many chronic conditions and multimorbidity (Pareja-Galeano, Garatachea, & Lucia, 2015). For example, a recent study found an inverse dose-response association between physical activity and mortality, and that for multimorbid individuals even moderate exercise was associated with longer life expectancy (Chudasama et al., 2019). For multimorbid patients physical activity also reportedly contributes to improvements in their self-rated health and life satisfaction, the factors known to be associated with living with multimorbidity (Marques, Peralta, Gouveia, Chávez, & Valeiro, 2018). Thus, healthcare professionals should clearly encourage patients to engage in physical activity.

Regarding variety of diet, 58% of respondents reported that their diet was very or quite varied. This was significantly associated with several patient-related factors. First, it was more common among patients with tertiary education, in accordance with findings of a Finnish national health survey that highly educated citizens had better eating habits than the less educated (Koponen et al., 2018). It was also more common among patients with high patient activation, in accordance with previous findings regarding cancer patients (Hibbard, Mahoney, & Sonet, 2017). In contrast, experience of insufficient loved ones, and poor perceived health and functional ability were negatively associated with a varied diet. This may have been at least partly

because patients with poor perceived health and functional ability may be more frequently too overwhelmed by their situation or circumstances to take care of healthy eating on a daily basis. The results also show that energy and willpower, motivation to care for oneself, feeling normality in care, and support from physicians, family and friends are explanatory factors for a varied diet. Thus, targeted support and guidance to make maintenance of a balanced diet as natural and easy as possible in everyday life, considering possible limitations of patients' health and living conditions, could be extremely helpful.

Poor eating habits, combined with low levels of physical activity, are the main risk factors for being overweight or obese, and obesity is a major risk factor for noncommunicable chronic conditions and strongly associated with multimorbidity (Booth, Prevost, & Gulliford, 2014; Freisling et al., 2020). In this study less than a fifth of participants were of normal weight. According to a recent birth cohort study, more obese individuals, especially in younger age groups, develop multimorbidity at an earlier age than those of normal weight (Canizares, Hogg-Johnson, Gignac, Glazier, & Badley, 2018). Obesity also increases risks of multimorbid people developing a new disease (Freisling et al., 2020). These results confirm the importance of weight monitoring, along with required weight management support, in primary care.

Alcohol consumption was found to be quite dichotomous; while almost half of the respondents did not consume it at all, a third consumed more than recommended limits, and 15% were assigned to the risky use category. Alcohol consumption was significantly associated with age and gender, being lower among women and older age groups, in accordance with findings of a comprehensive Finnish national health survey (Koponen et al., 2018). Men and younger participants were also more likely to be risky users of alcohol; 30% of men were in this category (slightly more than the proportion in the national sample), but just 5.4% of women. In addition, 12.9% of respondents used tobacco (smoke or smokeless) and its use was significantly associated with younger age and perceived inadequacy of close friends and relatives. Adherence to recommended use of alcohol and avoidance of tobacco was therefore far from ideal. Thus, finding ways to reduce their rates of risky alcohol consumption and tobacco use would be very beneficial. Recent studies have found that an overall healthy lifestyle largely counterbalances the negative association between multimorbidity and life expectancy, and engaging in a healthier lifestyle, in particular abstinence from smoking, can increase life expectancy by up to 7 years (Chudasama, Khunti, Gillies, Dhalwani, Davies,

2020). For multimorbid patients adherence to self-management is important not only for managing current conditions, but also for prevention of secondary conditions. There are also promising indications that multidomain intervention could reduce the risk of development of multimorbid individuals (and others) developing new chronic disease(s) (Marengoni et al., 2018).

Limitations and strengths of the study

This study has several limitations that should be noted. First, the number of participants was quite small. However, abundant data were collected, providing information on the adherence of multimorbid patients from a broad perspective. In addition, the participants (recruited from several healthcare centres and units) included patients of various age- and other sociodemographic groups with diverse diseases and conditions. The participants had an average four conditions ranging from 2 to 13 conditions, and the most common conditions in this study population (hypertension, diabetes, asthma, coronary artery diseases etc.) are considered important national public health issues in Finland and worldwide. However, it is possible that healthier patients participated more frequently in the study than patients with more illnesses and higher treatment burdens, who may have lacked the energy to participate. It is also possible that patients who adhered well to care were more likely to respond to the questionnaire. However, in efforts to ensure honesty questionnaires were returned anonymously directly to the researcher. It was not possible to determine nonresponse rates or perform nonresponse analysis, as healthcare professionals distributed the questionnaires during healthcare appointments. This, together with the fact that all the instruments used were self-reporting, inevitably introduced some risk of bias. However, the study focused on the patients' adherence in their daily lives, and validated instruments were used to collect data. In addition, the Covid-19 epidemic hindered the data collection as it affected the functioning of healthcare organizations and reduced numbers of non-urgent appointments, including appointments for the focal group of chronically ill patients, and may have decreased their willingness to attend appointments. These factors also contributed to the sample size remaining quite small despite a substantial collection time. As a cross-sectional design was applied, findings demonstrate associations between studied factors, but no assumptions of causation can be made.

6 CONCLUSIONS

The participants' adherence to care regimens was good generally, but there was clear scope for improvement in their adherence to self-management in terms of healthy lifestyles. In addition, although there were weak correlations between adherence and some elements of self-management, multimorbid patients' adherence to self-management is clearly not an 'all or none' phenomenon.' Adherence was found to be associated with several patient-related factors: age, gender, education level, marital status, living situation, sufficiency of close friends and relatives, number of chronic conditions, perceived health and functional ability and patient activation, with various factors being particularly associated with specific elements of self-management. Factors explaining adherence, in accordance with the Theory of Adherence of People with Chronic Disease, were energy and willpower, motivation, results of care, sense of normality in care, fear of complications and additional diseases, support from family and friends, support from physicians, and support from nurses, while varying factors were significantly explanatory for specific elements of self-management.

7 RELEVANCE TO CLINICAL PRACTICE

For multimorbid patients, adherence to self-management is not only essential for managing their conditions, but also important for prevention of secondary diseases. Their adherence to self-management was found to be a multifaceted and complex process with numerous associated and explanatory factors. The findings underscore the need for individualised and holistic patient encounters in healthcare, i.e. a whole-person approach in the care of multimorbid patients. Identified gaps in good adherence, as well as the associated and explanatory factors, together with the modifiability of behaviours related to adherence to self-management, may help efforts to facilitate development and targeting of support and interventions that enable multimorbid patients to improve their adherence to self-management. The results reinforce the view of adherence as a process in which both patients' active role and collaboration with healthcare providers are crucial. Patients' adherence must be supported, while respecting their autonomy. Healthcare professionals working with chronically ill and multimorbid patients in primary healthcare settings are well positioned to provide support to enhance adherence to self-management and enhance these patients' health outcomes.

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Table 1. Sociodemographic characteristics of the study participants with multimorbidity (n, %)

Total (n=124)	n (%)
Age	
38–64 years	38 (30.6)
65–74 years	49 (39.5)
75–93 years	35 (28.2)
missing information	2 (1.6)
Gender	
Female	74 (59.7)
Male	50 (40.3)
Education	
Primary education	36 (29.0)
Secondary education	24 (19.4)
Tertiary education	64 (51.6)
Employment status	
Employed	11 (8.9)
Unemployed/ long-term sick leave	4 (3.2)
Retired (for various reasons)	109 (87.9)
Marital status	
Single	12 (9.7)
Married / in registered partnership	79 (63.7)
Divorced	20 (16.1)
Widowed	13 (10.5)
Living situation	
alone	35 (28.2)
with spouse/partner	63 (50.8)
with spouse/partner and child/children	22 (17.7)
something other	4 (3.2)

Table 2. Adherence to care regimens as measured by Adherence of people with Chronic Disease Instrument (ACDI) (mean, SD, observed range)

	mean (SD)	observed range
Adherence to care regimens (considering all 11 items)	3.60 (.35)	2.64-4.00
Adherence to medication (Considering all 3 items)	3.78 (.40)	2.00-4.00
related to medication use as agreed instructions	3.88 (.37)	2.00-4.00
related to changes of medication doses	3.82 (.43)	1.00-4.00
related to changes of medication times	3.65 (.65)	1.00-4.00
Adherence to monitoring		
related to healthcare follow-up visits	3.83 (.47)	1.00-4.00
related to home-monitoring	3.57 (.62)	1.00-4.00
Adherence to general regimens (use of assistive devices, physiotherapy etc.)	3.40 (.87)	1.00-4.00
Adherence to agreed diet	3.14 (.78)	1.00-4.00
Adherence to cooperation with professionals		
related to care planning with physicians	3.46 (.76)	1.00-4.00
related to care planning with nurses	3.50 (.70)	1.00-4.00
Responsibility for own care	3.50 (.73)	1.00-4.00
Willingness for own care	3.76 (.56)	1.00-4.00

Response Options in Likert scale (1–4) was from strongly disagree to strongly agree.

Table 3. Correlations of parts of self-management

	Adherence to care regimens	Physical activity	Varied diet	Alcohol Use	Tobacco use
	Coefficient (95 % CI)[†]	Coefficient (95 % CI)[†]	Coefficient (95 % CI)[†]	Coefficient (95 % CI)[†]	Coefficient (95 % CI)[†]
Adherence to care regimens	1.00	.254 ** (.063–.407)	.351 ** (.193–.510)	-.007 (-.214–.155)	.033 (-.169–.202)
Physical activity	.254 ** (.063–.407)	1.00	.374 ** (.231–.546)	.058 (-.125–.255)	-.212 * (-.367– -.072)
Varied diet	.351** (.193–.510)	.374 ** (.231–.546)	1.00	.092 (-.081–.289)	-.133 (-.306–.027)
Alcohol use	-.007 (-.214–.155)	.058 (-.125–.255)	.092 (-.081–.289)	1.00	.210 * (-.018–408)
Tobacco use	.033 (-.169–202)	-.212 * (-.367– -.072)	-.133 (-.306–.027)	.210 * (-.018–408)	1.00

Spearman correlation coefficient

CI = Confidence interval

[†] Bootstrap result based on 1000 bootstrap sample.

** Correlation is significant at the level 0,01 (2-tailed).

* Correlation is significant at the level 0,05 (2-tailed).

Table 4. Patient Demographics connected with self-management (n,%, p)

Factor	Adherence to care regimens (n=124)		Physical activity		Varied diet (n=124) Yes; no	Alcohol use (n=121)		Tobacco use (n=124) No; yes
	Total good; poor	Medication good; poor	by FIT-index (n=119) high or moderate; low or sedentary	Frequency (n=121) at least 3 times per week; rarely		Consumption Low; others	Risk use No; yes	
Age	NS (.620)	NS (.310)	NS (.308)	NS (.328)	.018	.003	.042	<0.001 ‡
38–64 year	29(76.3); 9(23.7)	29(76.3); 9(23.7)	12(32.4); 25(67.6)	19(51.4); 18(46.8)	20(50); 19(50)	21(55.3); 17(44.7)	29(76.3); 9(23.7)	26(68.4); 12(31.6)
65–74 years	38 (77.6); 11(22.4)	43(87.8); 6(12.2)	22(45.8); 26(54.2)	29(59.2); 20(40.8)	36(73.5); 13(26.5)	31(66.0); 16(34.0)	38(80.9); 9(19.1)	45(91.8); 4(8.2)
75–93 years	24(68.6); 11(31.4)	27(77.1); 8(22.9)	10(31.3); 22(68.8)	14(42.4); 19(57.6)	16(45.7); 19 (54.3)	31(91.2); 3(8.8)	33(97.1); 1(2.9)	35(100); 0(0.0)
Gender	NS (.588)	NS (.284)	NS (.657)	NS (.849)	NS (.702)	.003	<0.001	NS (.765)
Female	53(71.6); 21(28.4)	58(78.4); 16(21.6)	28(39.4); 43(60.6)	38(52.8); 34(47.2)	44(59.5); 30(40.5)	58(79.5); 15(20.5)	69(94.5); 4(5.5)	65(87.8); 9(12.2)
Male	38(76.0); 12(24.0)	43(86.0); 7(14.0)	17(35.4); 31(64.6)	25(51.0); 24(49.0)	28(56.0); 22(44.0)	26(54.2); 22(45.8)	33(68.8); 15(31.3)	43(86.0); 7(14.0)
Education	NS (.515)	NS (.225) ‡	NS (.574)	NS (.425)	.017	NS (.058)	NS (1.000)	NS (.486)
Primary education	24(66.7); 12(33.3)	26(72.2); 10(27.8)	10(30.3); 23(69.7)	15(42.9); 20(57.1)	16(44.4); 20 (55.6)	28(80.0); 7(20.0)	30(85.7); 5(14.3)	30(83.3); 6(16.7)
Secondary education	19(79.2); 5(20.8)	20(83.3); 4(16.7)	10(41.7); 14(58.3)	13(54.2); 11(45.8)	11(45.8); 13(54.2)	19(79.2); 5(20.8)	20(83.3); 4(16.7)	20(83.3); 4(16.7)
Tertiary education	48(75.0); 16(25.0)	55(85.9); 9(14.1)	25(40.3); 37(59.7)	35(56.6); 27(43.5)	45(70.3); 19(29.7)	37(59.7); 25(40.3)	52(83.9); 10(16.1)	58(90.6); 6(9.4)
Employment status	NS (.486) ‡	NS (.864)	NS (.517) ‡	NS (1.000) ‡	NS (.405) ‡	NS (.075)	NS (.298)	.003 ‡ §
Employed	9(81.8); 2(18.2)	9(81.8); 2(18.2)	5(45.5); 6(54.5)	6(54.5); 5(45.5)	6(54.5); 5(45.5)	5 (45.5); 6(54.5)	8(72.7); 3(27.3)	6(54.5); 5(45.5)
Unemployed; long-term sick leave	2(50.0); 2(50.0)	3(75.0); 1(25.0)	2(66.7); 1(33.3)	2(66.7); 1(33.3)	1(25.0); 3(75.0)	2(50.0); 2(50.0)	3(75.0); 1(25.0)	3(75.0); 1(25.0)
Retired	80(73.4); 29(26.6)	89(81.7); 20(18.3)	38(36.3); 67(63.8)	55(51.4); 52(48.6)	65(59.6); 44(40.4)	77(72.6); 29(27.4)	91(85.8); 15(14.2)	99(90.8); 10(9.2)
Marital status	.012 ‡	.020 ‡	NS (.292) ‡	NS (.937)	NS (.157)	NS (.295)	NS (.530)	NS (.075)
Single	4(33.3); 8(66.7)	6(50.0); 6(50.0)	4(33.3); 8(66.7)	7(58.3); 5(41.7)	4(33.3); 8(66.7)	7(58.3); 5(41.7)	10(83.3); 2(16.7)	8(66.7); 4(33.3)
Married;registered partnership	63(79.7); 16(20.3)	68(86.1); 11(13.9)	32(43.2); 42(56.8)	40(52.6); 36(47.4)	51(64.6); 28(35.4)	52(67.5); 25(32.5)	63(81.8); 14(18.2)	72(91.1); 7(8.9)
Divorced	15(75.9); 5(25.5)	15(75.0); 5(25.5)	4(20.0); 16(80.0)	10(50.0); 10(50.0)	11(55.0); 9(45.0)	14(70.0); 6(30.0)	17(85.0); 3(15.0)	16(80.0); 4(20.0)
Widowed	9(69.2); 4(30.8)	12(92.3); 1(7.7)	5(38.5); 8(61.5)	6(46.2); 7(53.8)	6(46.2); 7(53.8)	11(91.7); 1(8.3)	12(100.0); 0(0.0)	12(92.3); 1(7.7)
Living situation	NS (.322) ‡	NS (.122) ‡	.041 ‡	NS (.461)	NS (.162)	NS (.393)	NS (.401)	NS (.073)
Alone	22(62.9); 13(37.1)	26(74.3); 9(25.7)	10(28.6); 25(71.4)	17(48.6); 18(51.4)	17(48.6); 18(51.4)	26 (76.5); 8(23.5)	31(91.2); 3(8.8)	27(77.1); 8(22.9)
With spouse; partner	50(79.4); 13(20.6)	56(88.9); 7(11.1)	30(50.5); 30(50.0)	36(58.1); 26(41.9)	42(66.7); 21(33.3)	40 (65.6); 21(34.4)	48(78.7); 13(21.3)	59(93.7); 4(6.3)
With spouse; partner and child;children	16(72.9); 6(27.3)	16(72.7); 6(27.3)	4(20.0); 16(80.0)	9(45.0); 11(55.0)	12(54.5); 10(45.5)	14(63.6); 8(36.4)	19(86.4); 3(13.6)	18(81.8); 4(18.2)
Something other	3(75.0); 1(25.0)	3(75.0); 1(25.0)	1(25.5); 3(75.0)	1(25.5); 3(75.0)	1(25.5); 3(75.0)	4(100.0); 0(0.0)	4(100.0); 0(0.0)	4(100.0); 0(0.0)

Used test Chi-squared test, or Fisher's exact test (†) or Fisher-Freeman-Halton Exact Test (‡), as appropriate

NS= non-significant (P > .05)

§ employment status was not significant for smoking when age was adjusted in the same model by linear modelling

Table 5. Studied patient-related factors connected with self-management (n,%, p)

Factor	Adherence to care regimens (n=124)		Physical activity		Varied diet (n=124) Yes; no	Alcohol use (n=121)		Tobacco use (n=124) No; yes
	Total good; poor	Medication good; poor	by FIT-index (n=119) high or moderate; low or sedentary	Frequency (n=121) at least 3 times per week; rarely		Consumption Low; others	Risk use No; yes	
Number of chronic conditions 2 or 3 4 or 5 6 or more	NS (.141) 44(80.0); 11(20.0) 23(62.2); 14(37.8) 21(77.8); 6(22.2)	NS (.328) ‡ 48(87.3); 7(12.7) 28(75.7); 9(24.4) 21(77.8); 6(22.2)	.014 28(52.8); 25(47.2) 9(25.0); 27(75.0) 7(28.0); 18(72.0)	.041 35(63.6); 20(36.4) 16(44.4); 20(55.6) 9(36.6); 16(64.0)	NS (.158) 37(67.3); 18(32.7) 18(48.6); 19(51.4) 14(51.9); 13(48.1)	.014 § 31(57.4); 23(42.6) 25(71.4); 10(28.6) 24(88.9); 3(11.1)	NS (.137) 41(75.9); 13(24.1) 31(88.6); 4(11.4) 25(92.6); 2(7.4)	NS (.525) 46(83.6); 9(16.4) 34(91.9); 3(8.1) 24(88.9); 3(11.1)
Perceived health Good Moderate Poor	NS (.265) 47(79.7); 12(20.3) 31(72.1); 12(27.9) 13(61.9); 8(38.1)	NS (.144) ‡ 51(86.4); 9(13.6) 35(81.4); 8(18.6) 14(66.7); 7(33.3)	<0.0001 33(55.9); 26(44.1) 11(26.8); 30(73.2) 1(5.3); 18(94.7)	<0.001 41(69.5); 18(30.5) 19(44.2); 24(55.8) 3(15.8); 16(84.2)	<0.0001 47(79.7); 12(20.3) 21(48.8); 22(51.2) 4(19.9); 17(81.0)	NS (.296) 36(63.2); 21(36.8) 30(71.4); 12(28.6) 17(81.0); 4(19.0)	NS (.637) 46(80.7); 11(19.6) 37(88.1); 5(11.6) 18(85.7); 3(14.3)	NS (.676) 52(88.1); 7(11.9) 38(88.4); 5(11.6) 17(81.0); 4(19.0)
Perceived Functional ability Good Moderate Poor	NS (.141) 55(80.9); 13(19.1) 19(63.3); 11(36.7) 17(68.0); 8(32.0)	NS (.167) ‡ 58(85.3); 10(14.7) 25(83.3); 5(16.7) 17(68.0); 8(32.0)	.001 35(51.5); 33(48.5) 8(27.6); 21(72.4) 2(9.1); 20(90.9)	<0.001 46(67.6); 22(32.4) 12(40.0); 18(60.0) 5(21.7); 18(78.3)	<0.0001 53(77.9); 15(22.1) 13(43.3); 17(56.7) 6(24.0); 19(76.0)	NS (.291) 42(63.6); 24(36.4) 21(72.4); 8(27.6) 20(80.0); 5(20.0)	NS (.840) 54(81.8); 12(18.2) 25(86.2); 4(13.8) 22(88.0); 3(12.0)	NS (.547) 58(85.3); 10(14.7) 28(93.3); 2(6.7) 21(84.0); 4(16.0)
Adequacy of close people Yes sufficiently Not sufficiently	.026 73(78.5); 20(21.5) 18(58.1); 13(41.9)	.023 80(86.0); 13(14.0) 21(67.7); 10(32.3)	NS (.145) 37(41.6); 52(58.4) 8(26.7); 22(73.3)	NS (.193) 41(56.9); 31(43.9) 22(44.9); 27(55.1)	.012 60(64.5); 33(35.5) 12(38.7); 19(61.3)	NS (.112) 66(73.3); 24(26.7) 18(58.1); 13(41.9)	NS (.256) 78(86.7); 12(13.3) 24(77.4); 7(22.6)	.026 (†) 85(91.4); 8(8.6) 23(74.2); 8(25.8)
Patient activation level (n=100) High Low	.004 45(84.9); 8(15.1) 28(59.6); 19(40.4)	NS (.124) 45(79.0); 21(21.0) 34(72.3); 13(27.7)	.005 29(54.7); 24(45.3) 11(26.2); 31(73.8)	NS (.069) 35(66.0); 18(34.0) 21(47.7); 23(52.3)	.002 40(75.5); 13(24.5) 21(44.7); 26(55.3)	NS (.880) 34(66.7); 17(33.3) 30(65.2); 16(34.8)	NS (.270) 40(78.4); 11(21.6) 40(87.0); 6(13.0)	NS (.948) 46(86.8); 7(13.2) 41(87.2); 6(12.8)

Used test Chi-squared test, or Fisher's exact test (†) or Fisher-Freeman-Halton Exact Test (‡), as appropriate

NS= non-significant (P > .05)

§ number of conditions remained significant for alcohol consumption when age and gender were adjusted in same model by linear modelling

Table 6. Binary logistic regression analysis with factors affecting adherence on different parts of self-management (Odds ratio, 95% Confidence interval, p-values)

Factors affecting adherence according to ACIDI	Adherence to care regimens (n=124)		Physical activity		Varied diet (n=124)	Alcohol use (n=121)		Tobacco use (n=124)
	Total Good vs others	Medication Good vs others	FIT- index (n=119) High vs low	Frequency (n=121) at least 3 /week vs less	Yes vs no	Consumption Low vs others	Risk use No vs yes	No vs yes
Explanatory variable	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value	OR (95 % CI) p-value
Energy and willpower to care oneself Has energy vs Does not have energy	1.52 (.60–3.83) .374	1.77 (.64 – 4.89) .269	1.94 (.70–5.35) .202	2.09 (.84–5.24) .115	3.71 (1.50– 9.14) .004	.47 (.16–1.36) .163	.38 (.082–1.77) .220	.81 (.20–3.07) .754
Motivation to care oneself Good motivation vs Poor motivation	3.96 (1.44–10.90) .008	4.36 (1.51 – 12.62) .007	2.39 (.74–7.78) .148	2.48 (.86–7.11) .092	4.97 (1.65–14.77) .004	.56 (.17–1.81) .331	.26 (.03–2.07) .203	.77 (.16–3.67) .738
Experienced result of care Produces well-being vs Not produce well-being	7.90 (1.91–32.72) .004	3.33 (.86–12.96) .082	6.09 (.75–49.80) .092	1.72 (.46–6.36) .429	1.43 (.39–5.2) .591	1.58 (.417–5.95) .502	.57 (.07–4.82) .609	Final solution cannot be found.
Sense of normality in care Positive feelings vs Negative feelings	3.16 (1.19–8.37) .021	2.72 (.95–7.79) .062	3.01 (.96–9.76) .059	1.99 (.76–5.21) .163	4.46 (1.59–12.48) .004	.78 (.26–2.36) .661	.59 (.12–2.79) .504	.67 (.14– 3.19) .614
Fear of complications and additional diseases No. does not have fears vs Yes. has fears	1.54 (.62 – 3.81) .354	5.82 (1.29 – 26.23) .022	1.39 (.63 -3.08) .413	1.54 (.70–3.37) .281	1.60 (.72 -3.53) .248	.83 (.36 – 1.92) .669	.68 (.24–1.90) .463	1.38 (.41–4.59) .601
Support from family and friends Receives support vs Not receive support	2.75 (1.10–6.91) .031	2.64 (.96–7.19) .059	1.62 (.61– 4.28) .331	1.69 (.68–4.17) .258	3.89 (1.52–9.91) .004	.66 (.24 – 1.82) .425	.40 (.00–1.88) .248	.90 (.24–3.45) .880
Support from physicians Receives support vs Not receive support	5.14 (2.19–12.10) .00017	4.99 (1.92–12.96) .001	2.17 (.91–5.19) .082	2.35 (1.05–5.28) .038	3.01 (1.40–6.64) .006	1.07 (.47 – 2.45) .872	.53 (.16–1.73) .295	.48 (.13– 1.80) .277
Support from nurses Receives support vs Not receive support	4.70 (1.58–13.97) .005	2.25 (.70–7.26) .176	3.67 (.77–17.39) .102	4.10 (1.07–15.73) .040	2.58 (.87–7.63) .087	1.07 (.34 – 3.34) .907	.34 (.04 – 2.76) .341	Final solution cannot be found.

OR: Odds ratio

CI: Confidence interval

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2–5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6–7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6–7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7–9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7–8
Bias	9	Describe any efforts to address potential sources of bias	7, 19
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7–10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	9–10
		(b) Describe any methods used to examine subgroups and interactions	9–10
		(c) Explain how missing data were addressed	10
		(d) If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	-
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9–13, tables
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12
		(b) Indicate number of participants with missing data for each variable of interest	12–14, tables
Outcome data	15*	Report numbers of outcome events or summary measures	12–15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted	12–15

		estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	13–14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15–17, 20
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	20
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title page

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.