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Association of somatic comorbidity and treatment adherence in patients with psychotic disorder

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ABSTRACT

Background: Increased risk for somatic comorbidity in individuals with schizophrenia has been well established. In addition, psychiatric patients with somatic illnesses are more likely to have more psychiatric readmissions. Increased burden of treatment related to chronic somatic comorbidities may be associated with lower adherence to psychiatric medication.

Methods: Cross-sectional study of 275 patients with schizophrenia spectrum disorder. A general practitioner performed a complete physical health checkup for all participants, including a complete medical examination and laboratory tests. Patients' adherence, attitudes, insight, and side-effects were evaluated using the Attitudes toward Neuroleptic Treatment Scale. Overall symptomatology was measured using the Brief Psychiatric Rating Scale. Regression analysis was used to investigate interactions and associations among health beliefs, disease burden, and treatment adherence. Separate regression models were utilized to account for the complexity of health behavior and treatment adherence pathways.

Results: Patients' somatic comorbidity and health behavior were not associated with adherence or attitudes toward antipsychotic treatment. High dose of antipsychotics and obesity were related to the need for medical interventions, while a healthy diet reduced the risk. Higher BPRS score and older age were associated with having somatic symptoms. Somatic comorbidities had no negative effects on treatment adherence or attitudes.

Conclusion: This study focuses on exploring possible associations between health beliefs and treatment adherence pathways in patients with psychotic disorders. Contrary to our hypotheses, we found no evidence to support our health belief and diseases burden models and their associations.

1. Introduction

Poor adherence and negative attitudes to treatment are common clinical problems in psychiatry, and the rate of medication adherence in schizophrenia is reportedly 47–95% (Kemmler et al., 2005; Sendt et al., 2015). Adherence to medication is a multifactorial phenomenon including factors pertaining to the patient, therapy, illness, socio-economic status, and the healthcare system (De Geest and Sabaté, 2003). In psychotic disorders factors such as side-effects, illness insight and severity, beliefs and attitudes towards medication, comorbidities, and substance abuse have been identified as reasons for non-adherence (Sendt et al., 2015). It has been estimated that as many as 60% of patients discontinue medication use after two to three months, and 80% after two years (Kemmler et al., 2005). Poor treatment adherence is likewise common in chronic somatic diseases; it has been estimated that only 50% of patients are adherent to recommended treatment (Haynes et al., 2002; Sackett et al., 1978). Patient well-being can be impacted by both physical and mental health, with a significant correlation between mental and physical health (Naber et al., 2001; Ohrnberger et al., 2017).

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Abbreviations

ANT	Attitudes towards Neuroleptic Treatment scale
AUDIT-C	Alcohol Use Disorders Identification Test-Concise
BMI	Body mass index
BPRS	Brief Psychiatric Rating Scale
COM-B	Capability (C), Opportunity (O) and Motivation (M) and behavior (B) model
CI	Confidence Intervals
CPZ	chlorpromazine
FDR	False Discovery Rate
GAF	Global Assessment of Functioning
GP	general practitioner
ICD-10	International Classification of Diseases 10th
ICPC-2	International Classification of Primary Care, version 2
SANS	Scale for the Assessment of Negative Symptoms
SPSS	Statistical Package for Social Sciences
VIF	Variance inflation factor

People with schizophrenia have a high risk for a wide range of somatic illnesses (Leucht et al., 2007; Smith et al., 2013). According to a systematic review, psychiatric patients with co-occurring somatic illnesses were more likely readmitted to psychiatric care (Sprah et al., 2017). Chronic physical illnesses in patients with psychotic disorders are associated with higher rates of psychiatric rehospitalization (Filipcic et al., 2017; Yang et al., 2020). One possible explanation is that chronic somatic disorders affect patients' adherence to psychiatric treatment. On the other hand, adherence patterns regarding atypical antipsychotics predict patient adherence to somatic medications (MacEwan et al., 2018). It is reasonable to assume that when someone deems the treatment of a particular illness significant, they will also prioritize other treatments. Conversely, if they regard a specific illness and its treatment as insignificant, they will be likely also to dismiss other treatments.

A few studies have explored the connections between physical comorbidity, adherence, and attitudes toward antipsychotic medication (Sprah et al., 2017). Treatment adherence requires effort from the patient, and this effort increases with the number and severity of comorbidities (Heckman et al., 2015). The increased treatment burden related to having several chronic conditions can lead to treatment fatigue (Heckman et al., 2015). Treatment fatigue may, in turn, lead to poor treatment compliance (Heckman et al., 2015). This may be particularly important in patients with psychotic illnesses, as neurocognitive and negative symptoms associated with psychotic disorders have a negative effect on a capacity to cope with increased disease burden. Disease burden could lead, via treatment fatigue, to discontinuation of antipsychotic medication. An association has been demonstrated between symptom severity and well-being (Naber et al., 2001; Teetharatkul et al., 2021). This association may add considerably to the treatment burden, particularly in cases with accompanying comorbidities.

According to the health belief model, whether or not a person undertakes a recommended health action depends on the person's perceptions of the threat of illness, the potential benefits or efficacy of the action, and potential barriers or costs related to the action (Becker et al., 1978). Health beliefs affect people's health behaviors such as diet, exercise, alcohol use, smoking, and adherence to medical treatments (Champion and Skinner, 2008). It is likely that the same health beliefs that affect people's lifestyle choices also have an effect on their attitudes to antipsychotic treatment, causing treatment non-adherence (Perkins, 1999). Health behavior depends on three primary sources: capability, opportunity, and motivation (COM-B model) (Michie et al., 2011). Schizophrenia and other psychotic disorders exert multifaceted impacts on health behavior within the COM-B framework. Cognitive impairments compromise capability, impeding the comprehension of health-related information and the adoption of healthy behaviors. Concurrently, social isolation and mistrust constrain opportunities, limiting access to healthcare, physical activities, and the resources necessary for a healthy lifestyle. Moreover, negative symptoms such as amotivation diminish motivation, posing barriers to treatment adherence and engagement in health-related activities. Furthermore, beliefs affecting health behavior can increase the risks for somatic chronic illnesses.

The aims of this study are to investigate health beliefs and disease burden-related pathways of somatic comorbidity and antipsychotic treatment adherence. Our hypotheses related to health beliefs were that poorer health behavior and negative attitudes toward antipsychotic treatment reflect health beliefs and explain the greater need for somatic health care interventions. The hypotheses related to disease burden were that chronic somatic diseases are associated with poor adherence and negative attitudes towards antipsychotic treatment and poorer health behavior (unhealthy diet, sedentary lifestyle, smoking, problematic alcohol consumption). To the best of our knowledge, this is the first study to integrate health belief and disease burden models, examining their impact on factors related to treatment adherence among patients with psychotic disorders.

2. Methods

2.1. Subjects

In The Living Conditions and the Physical Health of Outpatients with Schizophrenia Study, a comprehensive clinical assessment and physical health examination was offered to all patients treated in the psychosis outpatient clinics in three municipalities in Southern Finland. The study encompassed a population of 99,000 in the catchment area, representing neighboring towns and suburbs. The data were collected between June 2009 and December 2013. The study was approved by the Ethics Committee of the Hospital District of Helsinki and Uusimaa and by the Hyvinkää Hospital Area. All participants gave written informed consent. Out of the 409 patients who received invitations, 276 completed the study protocol, resulting in a participation rate of 67.5%.

2.2. Measures

Patient adherence, attitude, insight, and medication side effects were measured using a self-report questionnaire, the Attitudes towards Neuroleptic Treatment Scale (ANT) (Kampman et al., 2000). The ANT includes measurements of patient insight into mental problems, side effects of medication, adherence, and attitudes toward antipsychotic treatment. Other psychiatric measures used in the study were the 24-item version of the Brief Psychiatric Rating Scale (BPRS) (Lukoff et al., 1986; Ventura et al., 1993), the Global Assessment of Functioning (GAF) (American Psychiatric Association, 2000), and three global scores – alogia, anhedonia and apathy from the Scale for the Assessment of Negative Symptoms (SANS) (Andreasen, 1989).

Patients took part in a health examination, including laboratory tests, a questionnaire, an appointment with a nurse and a physical examination with a general practitioner. The general practitioner (GP) concluded appointments by discussing the findings of the health examination with the patient. The GP went through the previously completed questionnaire with the patient at the beginning of the appointment, and rechecked current medications taken. When needed, medical interventions, such as modification of somatic medication, referrals for consultations or for further treatment with the patient's GP or specialists or other professionals such as a physiotherapist were made. The sum score of the number of healthcare interventions each patient needed was used in the analysis (Eskelinen et al., 2017).

Several questionnaires were used to assess participants' health behavior. The Alcohol Use Disorders Identification Test-Concise (AUDIT-C) was used to screen for problem drinking (Bush et al.,

1998). Index of healthy food habits was used as described in the Health Behaviour and Health among the Finnish Adult Population Survey (Helakorpi et al., 2011): eating habits were considered healthy when the patient reported at least two of the following: 1) eats vegetables daily, 2) drinks skimmed milk and/or 3) uses soft margarine or low fat spread on bread. The patient was considered physically active if he/she reported walking, bicycling or otherwise moving at least 4 h per week, or exercising at least 3 h per week (Adapted from the Gothenburg Scale) (Wilhelmsen et al., 1972). The patient was considered a current smoker if they had smoked at least 100 cigarettes and had smoked for at least one year and had smoked on the day of the interview or the day before (Kestilä et al., 2006). Body mass index (BMI) $\geq$ 30 kg/m^2 was used to identify obesity (World Health Organization, 2021). More detailed information on variables is presented in the supplementary material (Supplement 1.).

Psychiatric and somatic diagnoses had been made previously by treating psychiatrists and physicians. Patients' current diagnoses were classified according to the International Classification of Diseases 10th revision (ICD-10). Numbers of somatic comorbidities were not normally distributed so a categorical ($0 = 0; 1 = 1; 2 \geq 2$) variable was used in the final analyses. The patient-reported current somatic symptoms affecting daily life were coded based on the International Classification of Primary Care, version 2 (ICPC-2), the dichotomous ICPC-2 based somatic symptoms variable was used in the analyses (cutoff $\geq$1).

The medication in use was elicited from the patient and checked from the medical records. Being on five or more medications was considered polypharmacy. Participants' daily doses of antipsychotic medication were first converted to chlorpromazine (CPZ) equivalents and then divided into three categories: low < 300 mg, middle 300–600 mg and high > 600 mg (Aronson JK, 2009).

2.3. Statistical methods

Statistical analyses were performed using SPSS software version 24.0 (IBM, Armonk, NY, USA). Demographic and clinical characteristics of the sample were calculated using descriptive statistics. The upper limit of the correlation between the explanatory variables was set at 0.5 (Pearson's correlation, $r > 0.5$) to avoid multicollinearity. Variance inflation factor (VIF) was calculated to test for multicollinearity in regression models, but no multicollinearities were found in any of the models. All VIF values were below 2.0. Level of statistical significance was set at $p < 0.05$, and all confidence intervals at the 95% level.

Building the statistical models was started by drawing an association diagram of health beliefs and treatment adherence related to our hypotheses (Fig. 1.). Based on expert knowledge, we formed models to explore if treatment adherence could be explained by health beliefs, and models to test if treatment adherence could be explained by burden of disease. We explored how a range of factors tied to health beliefs and disease burden theories impacted patients' adherence to treatment. Using various models, we examined these influential factors at different junctures. We assumed that attitudes and health behavior would have the same common factor, namely health beliefs. In our data, the ANT attitude variables served as surrogates for health beliefs. In health belief models 1 and 2, we studied if the need for medical interventions (model 1) and patients' reported somatic symptoms (model 2) were explained by ANT attitude and health behavior. With disease burden model 1, we explored if ANT attitude was explained by somatic illness and health behavior. Thus, in this model ANT attitude was the dependent variable and somatic comorbidities were the independent variable. Based on an earlier study, we know that negative attitudes are an important factor in poor adherence (Leijala et al., 2021). Thus, if poor health behavior or somatic comorbidities have an interaction with attitudes, there could be an indirect effect on adherence. In disease burden model 2, we studied if need for healthcare interventions, somatic symptoms or diagnosed comorbidities explained treatment adherence in antipsychotic treatment. The adjusted R square and Nagelkerke R square were used to compare the superiority of the models. The variables that were not statistically significant or relevant for comparison purposes were excluded from the final models. All models were adjusted for several confounding factors.

In health belief model 1, we used a hierarchical linear regression model to determine whether need for medical interventions for somatic morbidity was explained by ANT attitude, ANT insight, number of somatic comorbidities, physically active lifestyle, healthy diet, daily smoking, obesity, and alcohol consumption. In health belief model 2, we used a hierarchical logistic regression to determine whether patients' reported somatic symptoms were explained by ANT attitude, ANT insight, number of somatic comorbidities, physically active lifestyle,

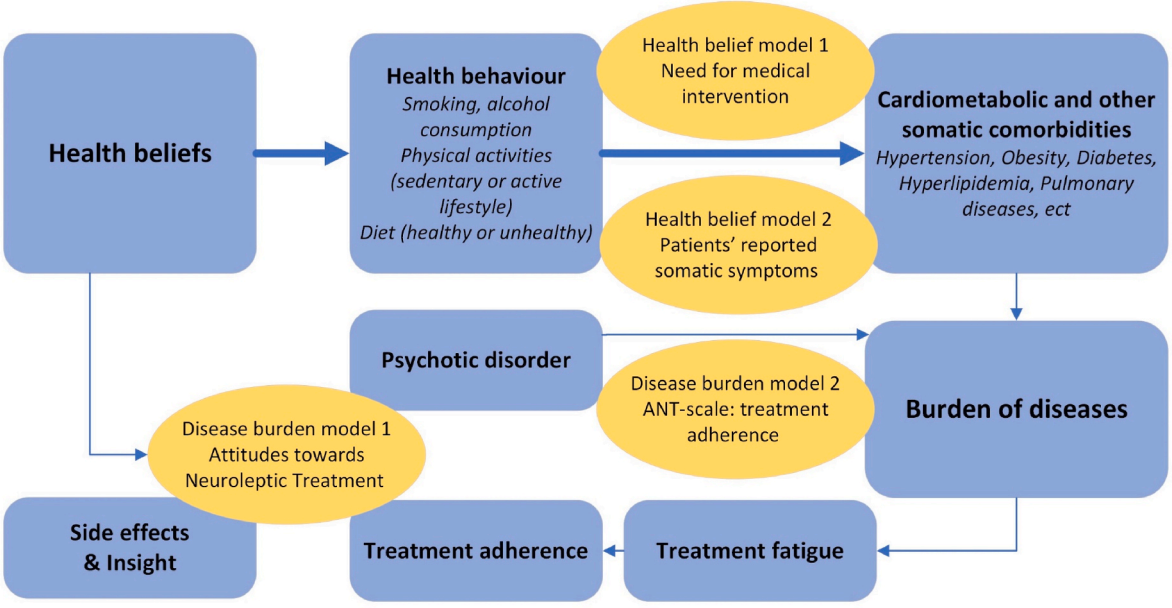

Fig. 1. Diagram depicting the connections between health beliefs and treatment adherence regression models used in this study.
A diagram illustrating the potential pathways through which 1) health beliefs impact the risk of somatic diseases (such as diabetes, cardiovascular disease, hypertension, hyperlipidemia, COPD), and 2) how these illnesses increase the disease burden. ANT: Attitude towards Neuroleptic Treatment.

healthy diet, daily smoking, obesity, and alcohol consumption. In both models, sex, age, living in a rehabilitation home, daily antipsychotic dose (as CPZ equivalent), and psychopathology (BPRS) were used as confounding variables.

In disease burden model 1, we used a hierarchical linear regression model to ascertain if ANT attitude is explained by ANT insight, ANT side effects, number of somatic comorbidities, physically active lifestyle, healthy diet, daily smoking, obesity, and alcohol consumption. We used disease burden model 2 to ascertain by means of a hierarchical logistic regression model if ANT adherence is explained by ANT-insight, ANT-side effects, number of somatic comorbidities, patients' reported somatic symptoms and a sum score of healthcare interventions. In both models, sex, age, living in a rehabilitation home, daily antipsychotic dose (as CPZ equivalent), psychopathology (BPRS), ANT insight and ANT side effects were used as confounding variables.

3. Results

Of the 409 patients who received invitations, 276 completed the study protocol, resulting in a participation rate of 67.5%. Among the 276 patients who completed the study protocol, only 1 (0.0036%) refused to participate further and was consequently excluded from subsequent analyses. The total sample size was 275 patients. Clinical characteristics of the sample are presented in Table 1.

The mean age of the participants was 44.9 years, and 152 were men.

Table 1
Patients' demographic, clinical and lifestyle characteristics.

Variables	Total (n = 275)	
	Mean or n (%, S. D.)	Missing data n (%)
Male sex n (%)	152 (55.1 %)	0 (0 %)
Age	44.9 (12.6)	0 (0 %)
Schizophrenia	190 (68.8 %)	0 (0 %)
Schizoaffective disorder	49 (17.8 %)	0 (0 %)
Other schizophrenia spectrum disorder	37 (13.4 %)	0 (0 %)
Living in rehabilitation home	51 (18.5 %)	0 (0 %)
CPZ dose < 300 mg	93 (33.7 %)	0 (0 %)
CPZ dose 300–600 mg	77 (27.9 %)	0 (0 %)
CPZ dose > 600 mg	106 (38.4 %)	0 (0 %)
ANT-attitude (0–100)	72.0 (16.5)	12 (4.3 %)
ANT-adherence (over 75%)	228 (82.6 %)	0 (0 %)
ANT-insight (0–100)	49.5 (24.9)	3 (1.1 %)
ANT-side effects (0–100)	62.4 (24.0)	4 (1.4 %)
BPRS (24–168)	34.6 (7.8)	19 (6.9 %)
Polypharmacy (five or more drugs)	172 (63%)	0 (0 %)
Interventions sum score (0–9)	2.9 (1.9)	0 (0 %)
ICPC based somatic symptoms (1 or more)	124 (45.1 %)	0 (0 %)
Diagnosed somatic comorbidities: 0	93 (33.7 %)	0 (0 %)
Diagnosed somatic comorbidities: 1	82 (29.7 %)	0 (0 %)
Diagnosed somatic comorbidities: 2 or over	101 (36.6 %)	0 (0 %)
AUDIT-C	3.12 (2.7)	90 (32.7 %)
Active lifestyle	162 (58.7 %)	0 (0 %)
Current smoking	106 (38.4 %)	0 (0 %)
Obesity	131 (47.5 %)	0 (0 %)
Healthy diet index	1.4 (0.8)	4 (1.5 %)

High score in ANT -attitude, -insight and -side effect indicates positive attitudes toward medication, better sickness awareness and less experienced side effects. High score in BPRS indicates more severe symptom. High score in interventions sum score indicates more medical interventions needed. High score in Audit-C indicates higher consumption. High score in healthy diet index indicates more healthy diet. ANT, Attitude toward Neuroleptic Treatment; AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BMI, Body mass index; BPRS, Brief Psychiatric Rating Scale; CPZ, chlorpromazine; ICPC-2, International Classification of Primary Care, version 2.

Previously diagnosed somatic comorbidities were common. The most common chronic physical illnesses were endocrine, nutritional, and metabolic diseases (24.6%), and diseases of the circulatory system (26.8%) (Table 2.)

In linear regression analysis with the sum score of healthcare interventions as the outcome variable (health belief model 1), high CPZ dose ($p = 0.016$) and obesity ($p = 0.004$) were associated with needing more interventions, whereas having a healthy diet ($p = 0.002$) was associated with needing fewer interventions (Table 3). In logistic regression analysis with patients' reported somatic symptoms as an outcome variable (health belief model 2) higher BPRS score ($p = 0.022$) and older age (p = 0.005) were associated with having somatic symptoms (Table 4).

In linear regression analysis with the ANT attitude score as the outcome variable (disease burden model 1), middle CPZ ($p = 0.011$) and high CPZ ($p = 0.005$) doses, ANT insight ($p < 0.001$) and ANT side effects ($p < 0.001$) had a statistically significant effect on attitudes (Table 5). In logistic regression analysis with the ANT adherence class as an outcome variable (disease burden model 2) living in a rehabilitation home ($p = 0.045$), CPZ middle ($p = 0.014$) and CPZ high ($p = 0.026$) doses, higher ANT side effects ($p = 0.006$), and lower BPRS score ($p = 0.015$) were associated with better treatment adherence. (Table 6).

4. Discussion

The aims of the study were to investigate associations between somatic comorbidity and antipsychotic treatment adherence among patients with schizophrenia. Chronic physical illnesses are common in people with schizophrenia (Leucht et al., 2007). Earlier research suggests that somatic comorbidity and adherence could be linked in different ways (Sprah et al., 2017). Based on expert knowledge we formulated four different statistical models to test if patients' health beliefs could explain both attitudes towards antipsychotic treatment and health behavior, and if burden of multiple diseases and treatment fatigue could explain non-adherence to antipsychotic medication.

Our hypothesis was that need for somatic healthcare interventions could be explained by the ANT attitude – a surrogate for health beliefs – but attitudes toward psychiatric medication did not explain the need for somatic health care interventions. By contrast, high antipsychotic dose, was connected with need for medical interventions. One possible explanation could be medication side-effects such as weight gain

Table 2
Participants'previously diagnosed physical illnesses.

Physical illnesses (ICD-10)	n (%)
IV Endocrine, nutritional and metabolic diseases (E00-E90)	68 (24.6 %)
IX Diseases of the circulatory system (I00–I99)	74 (26.8 %)
XI Diseases of the digestive system (K00–K93)	14 (5.1 %)
III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89)	3 (1.1 %)
X Diseases of the respiratory system (J00-J99)	40 (14.5 %)
VI Diseases of the nervous system (G00-G99)	17 (6.2 %)
XIII Diseases of the musculoskeletal system and connective tissue (M00-M99)	16 (5.8 %)
II Neoplasms (C00-D48)	6 (2.2 %)
XII Diseases of the skin and subcutaneous tissue (L00-L99)	41 (14.9 %)
XIV Diseases of the genitourinary system (N00–N99)	11 (4.0 %)
Other diseases	16 (5.8 %)

Other diseases: I Certain infectious and parasitic diseases (A00-B99), VII Diseases of the eye and adnexa (H00–H59), VIII Diseases of the ear and mastoid process (H60–H95), XIX Injury, poisoning, and certain other consequences of external causes (S00-T98).

Abbreviations: *ICD-10, International Classification of Diseases 10*th.

Table 3
Results of linear regression model explaining healthcare interventions sum score (health belief model 1).

	B	95% CI for *B*	Beta	*p*
Age	0.02	[0–0.04]	0.13	0.104
Sex (male)	0.38	[-0.21 - 0.97]	0.10	0.203
Living in rehabilitation home	−0.34	[-1.24 - 0.55]	−0.06	0.451
CPZ dose				
low (<300 mg)	*ref.*			
middle (300–600 mg)	0.07	[-0.63 - 0.78]	0.02	0.842
high (>600 mg)	0.88	[0.17–1.6]	0.23	**0.016**
ANT attitude	−0.01	[-0.02 - 0.01]	−0.04	0.616
BPRS score	−0.02	[-0.06 - 0.03]	−0.06	0.476
Audit-C	0.03	[-0.08 - 0.13]	0.04	0.647
Healthy diet index	−0.57	[-0.92 to −0.22]	−0.24	**0.002**
Regularly physically active	−0.21	[-0.8 - 0.39]	−0.05	0.5
Smoking	−0.14	[-0.71 - 0.44]	−0.04	0.642
Obesity	0.88	[0.28–1.48]	0.23	**0.004**
Number of somatic comorbidities				
0	*ref.*			
1	0.39	[-0.34 - 1.12]	0.09	0.294
≥2	0.55	[-0.16 - 1.25]	0.14	0.128
Adjusted R Square	0.14			
p for model	<0.001			

Confidence Intervals at level 95%. FDR threshold set at 0.05. In the presentation of categorical variables: a positive estimate indicates a perceived need for medical intervention. In the presentation of three-class variables: lowest CPZ dose and zero somatic comorbidities were used as reference categories. Abbreviations: ANT, Attitude toward Neuroleptic Treatment; AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BPRS, Brief Psychiatric Rating Scale; CI, Confidence Intervals; CPZ, chlorpromazine; FDR, False Discovery Rate.

Table 4
Results of logistic regression analysis explaining patients reported somatic symptoms (health belief model 2).

	OR	95% CI	*p*
Age	1.05	[1.01–1.08]	**0.005**
Sex (male)	1.76	[0.84–3.69]	0.137
Living in rehabilitation home	0.74	[0.22–2.42]	0.613
CPZ dose			
low (<300 mg)	*ref.*		
middle (300–600 mg)	0.66	[0.27–1.62]	0.36
high (>600 mg)	0.83	[0.33–2.12]	0.703
ANT attitude	0.99	[0.96–1.01]	0.297
BPRS score	1.07	[1.01–1.13]	**0.022**
Audit-C	0.99	[0.86–1.13]	0.85
Healthy diet index	1.18	[0.76–1.85]	0.466
Regularly physically active	0.86	[0.4–1.83]	0.696
Smoking	1.29	[0.62–2.67]	0.5
Obesity	1.72	[0.81–3.67]	0.161
Number of somatic comorbidities			
0	*ref.*		
1	1.24	[0.49–3.15]	0.646
≥2	2.27	[0.94–5.45]	0.068
Nagelkerke R Square	0.29		
p for model	<0.001		

Confidence Intervals level at 95%. FDR threshold set at 0.05. Abbreviations: ANT, Attitude toward Neuroleptic Treatment; AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BPRS, Brief Psychiatric Rating Scale; CI, Confidence Intervals; CPZ, chlorpromazine; FDR, False Discovery Rate.

(Eskelinen et al., 2017) and gastrointestinal problems (Virtanen et al., 2017). On the other hand, patients on a higher dose of antipsychotic medicine are more likely to have severe psychotic disorders with more concomitant somatic health problems and more difficulties in self-care and in seeking help. A healthy diet reduced the need for interventions and obesity increased this need. Obviously, there was a negative correlation between healthy diet and obesity. In clinical practice supporting a healthy diet and screening for obesity should be done systematically and routinely (Curtis et al., 2012).

Table 5
Results of linear regression model explaining ANT –attitude scores (disease burden model 1).

	B	95% CI for *B*	Beta	*p*
Age	0.04	[-0.15 - 0.23]	0.03	0.672
Sex (male)	3.14	[-1.57 - 7.85]	0.10	0.19
Living in rehabilitation home	1.19	[-6 - 8.38]	0.02	0.744
CPZ dose				
low (<300 mg)	*ref.*			
middle (300–600 mg)	3.03	[-2.59 - 8.66]	0.09	0.289
high (>600 mg)	7.34	[1.7–12.98]	0.23	**0.011**
ANT insight	0.14	[0.04–0.24]	0.24	**0.005**
ANT side effects	0.22	[0.11–0.32]	0.31	**<0.001**
BPRS score	−0.70	[-1.03 to −0.36]	−0.35	**<0.001**
Audit-C	−0.10	[-0.95 - 0.75]	−0.02	0.822
Healthy diet index	−0.36	[-3.18 - 2.46]	−0.02	0.8
Regularly physically active	1.88	[-2.93 - 6.7]	0.06	0.441
Smoking	−2.20	[-6.8 - 2.4]	−0.07	0.347
Obesity	3.40	[-1.4 - 8.19]	0.11	0.164
Number of somatic comorbidities				
0	*ref.*			
1	−2.18	[-8.04 - 3.69]	−0.06	0.465
≥2	0.81	[-4.84 - 6.46]	0.03	0.777
Adjusted R Square	0.16			
p for model	<0.001			

Confidence Intervals at level 95%. FDR threshold set at 0.05. In the presentation of categorical variables: a positive estimate indicates a more positive attitude. In the presentation of three-class variables: lowest CPZ dose and zero somatic comorbidities were used as reference category. Abbreviations: ANT; Attitude toward Neuroleptic Treatment; AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BPRS, Brief Psychiatric Rating Scale; CI, Confidence Intervals; CPZ, chlorpromazine; FDR, False Discovery Rate; ICPC-2, International Classification of Primary Care, version 2.

Table 6
Results of logistic regression analysis explaining ANT-adherence (disease burden model 2).

	OR	95% CI	*p*
Age	1.01	[0.98–1.04]	0.501
Sex (male)	2.01	[0.92–4.42]	0.081
Living in rehabilitation home	4.80	[1.04–22.22]	**0.045**
CPZ dose			
low (<300 mg)	*ref.*		
middle (300–600 mg)	3.28	[1.27–8.43]	**0.014**
high (>600 mg)	2.78	[1.13–6.85]	**0.026**
ANT insight	1.01	[0.99–1.03]	0.387
ANT side effects	1.02	[1.01–1.04]	**0.006**
BPRS score	0.94	[0.89–0.99]	**0.015**
Interventions sum score	1.01	[0.82–1.25]	0.933
ICPC-2 based somatic symptoms	0.99	[0.45–2.2]	0.988
Number of somatic comorbidities			
0	*ref.*		
1	0.96	[0.38–2.43]	0.938
≥2	1.92	[0.75–4.95]	0.175
Nagelkerke R Square	0.22		
p for model	<0.001		

Confidence Intervals at level 95%. FDR threshold set at 0.05. Abbreviations: ANT; Attitude toward Neuroleptic Treatment; AUDIT-C, Alcohol Use Disorders Identification Test-Concise; BPRS, Brief Psychiatric Rating Scale; CI, Confidence Intervals; CPZ, chlorpromazine; FDR, False Discovery Rate, ICPC-2, International Classification of Primary Care, version 2.

In the disease burden models, none of the health behavior variables explained variation in attitudes toward antipsychotic medication. We had expected that unhealthy (smoking and alcohol) or healthy habits (active lifestyle and healthy diet) would have had some impact. Adverse

effects of medication, insight and severe psychopathology have been associated with more negative attitudes towards antipsychotic medication (Lambert et al., 2004; Mohamed et al., 2009). However, adherence to antipsychotic treatment was not explained by number of somatic comorbidities, patients' reported somatic symptoms or need for medical interventions in the model. A comprehensive meta-analysis found that individuals with schizophrenia and concurrent diabetes were more likely to adhere to diabetes treatment than were the controls (Gorczynski et al., 2017). Medium and high-level antipsychotic doses and living in a rehabilitation home were connected to good adherence, whereas higher BPRS score and more side effects were associated with poor adherence. Side effects of medication and psychotic symptoms are known risk factors for non-adherence (Acosta et al., 2012). Individuals living in supported housing receive more support, likely promoting adherence.

Of the confounding factors, age was a significant explainer of patients' reported somatic symptoms, which seems logical as all kinds of health problems increase with age. Quite interestingly, the increase in BPRS score was linked to more somatic symptoms. In the BPRS there is a question about somatic concern, but dropping these items from the analyses did not change the significance levels in the model. A possible explanation for this is that higher BPRS score is likely related more severe psychopathology and to more health problems overall.

Contrary to our hypotheses, we did not find evidence to support our health belief and diseases burden models and their associations. Attitudes toward antipsychotic medication had no effect on models predicting health behavior or health problems. While adherence to antipsychotic medication was not explained by somatic comorbidities, self-reported somatic symptoms, or the need for medical interventions. As far as we know, this is the first study attempting to explore the connections between somatic illnesses and commitment to psychiatric treatment, integrating these into a comprehensive framework involving health behavior and disease burden. This study offers a framework for exploring the connections between health beliefs, disease burden, and treatment adherence. Given that the influence of beliefs and attitudes, along with their associated unhealthy habits and potential subsequent illnesses, requires time, this calls for further examination in longitudinal studies.

The present study has some limitations. A cross-sectional study cannot support causal conclusions. The influence of health beliefs on human behavior and subsequent potential illnesses constitutes a multifaceted process that exhibits temporal evolution. Delving into these complexities within a cross-sectional framework poses challenges, given the inability of the data to establish causal relationships. Yet there remains an opportunity to explore the potential correlation between inadequate health behaviors or illnesses and their impact on treatment adherence and patient attitudes toward psychiatric medication within a clinical setting. Due to the limitations of the data, we were only able to explore some of the questions about the matter. Both patient attitudes and health beliefs are multidimensional and are difficult to validate. In addition, patients declining treatment are probably less likely to participate in studies of this type. The overall high adherence in our sample reflects this participation bias. The self-reports scales used in the study are also biased to overestimate adherence. As a limitation of this study, it's important to note the absence of routine correction performed on p-values, aimed at mitigating the risk of Type II errors.

Somatic illnesses are remarkably common among individuals with psychotic disorders, and the likelihood of accumulating disease burden is high. Interestingly, more severe psychiatric symptoms were associated with patients reporting physical ailments. One plausible explanation is that more severe psychiatric symptoms negatively impact an individual's overall well-being, potentially increasing the need to seek treatment. This highlights the importance of holistic care, emphasizing the need for psychiatric interventions that address physical health concerns alongside mental health.

5. Conclusion

To the best of our knowledge, this study is the first to explore possible associations between health beliefs and treatment adherence pathways in patients with psychotic disorders. We found no evidence to support our health belief and diseases burden model/hypotheses and their associations. The factors related to somatic comorbidity and psychiatric readmissions among patients with schizophrenia are probably quite complex. One explanation could be that patients are accustomed to seeking help for medical problems by using the psychiatric services, or may have difficulties using other healthcare services. Somatic comorbidities had no negative effect on adherence or attitudes towards antipsychotic treatment.

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Availability of data and materials

In research collaboration, sharing of the data is possible if the intended collaboration is concordant with the informed consent given by the participants and the general data protection regulations. It requires a separate agreement with the Hospital District of Helsinki and Uusimaa.

Ethical standards

The study was approved by the Ethics Committee of the former Hospital District of Helsinki and Uusimaa and by the former Hyvinkää Hospital Area. All participants gave written informed consent.

CRediT authorship contribution statement

J. Leijala: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. **O. Kampman:** Conceptualization, Formal analysis, Investigation, Supervision, Writing – review & editing. **J. Suvisaari:** Data curation, Project administration, Resources, Supervision, Writing – review & editing. **S. Eskelinen:** Funding acquisition, Investigation, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

All authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2024.03.039.

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