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The effects of different types of chronic disease on anxiety, depression, and fatigue.



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Abstract:

Objective: As suffering from a chronic disease can lead to comorbid psychological symptoms, such as depression, anxiety, and mental fatigue, treatments are being developed to treat patients both for their physical and mental symptoms. In order to determine if treatment should be specialised depending on different chronic diseases, it is important to know whether different chronic diseases affect psychological symptoms differently. This study aimed to distinguish between different chronic diseases and if they can lead to differences in range and severity of comorbid psychological symptoms,

Methods: A cross-sectional study design has been used, with 129 participants (50 males and 79 females) who in total were diagnosed with one or multiple of 38 different chronic diseases. These chronic diseases were divided into 4 subtypes: 'Skin diseases', 'Gastrointestinal diseases', 'Chronic pain', and 'Other'. Between these groups differences were studied on depression, anxiety and fatigue symptoms. Measurement instruments included the PHQ-9 (depression), GAD-7 (anxiety) and VVV (fatigue). Three one-way ANOVAs were used to determine the effect of age, gender and education level on psychological outcomes. A MANCOVA was performed in order to test for the effect of chronic disease subtype on depression, anxiety, and fatigue.

Results: There were significant differences of depression scores and anxiety scores for age, gender and education level, but not for fatigue. There was a main effect of chronic disease subtype on psychological symptoms, with chronic pain patients scoring significantly higher on anxiety compared to other chronic disease subtypes. No other effects were found.

Conclusion: Chronic pain patients experience significantly more anxiety than skin diseases, gastrointestinal-diseases or other type of diseases. This indicates that the psychological impact of suffering from a chronic disease is generally quite similar between different types of chronic diseases, with the exception of chronic pain having a higher rate of anxiety symptoms.

Layman's abstract:

As the prevalence of patients suffering from a chronic disease is increasing, studying its effects and treatments becomes a more pressing matter. One of those aspects is how suffering from a chronic disease can lead to experiencing mental symptoms such as feelings of depression, anxiety or mental fatigue. Since new treatments are being developed focussing on treating the mental burden that comes with suffering from a chronic disease, it is important to know more about its effects. This study focusses on the question if different chronic diseases differently impact mental health. Such as experiencing certain symptoms more often or in higher frequency or severity. In order to study this, we asked 129 participants that all suffer from one or multiple chronic diseases, and experience psychological symptoms, to complete several questionnaires about different psychological symptoms. We divided the 129 participants into 4 subgroups of chronic diseases, i.e.: 'Skin diseases', 'Gastrointestinal diseases', 'Chronic pain', and 'other type of chronic diseases.' Subsequently, we analysed if psychological symptoms varied for age, gender, and education level and compensated for that effect in the main analysis. We discovered that suffering from chronic pain is associated with significant higher scores on feelings of anxiety, compared to the other subtypes of chronic diseases. No other differences were found for the other subtypes and psychological symptoms. This indicates that the psychological impact of suffering from a chronic disease is generally similar between different subtypes of chronic diseases, with the exception of chronic pain where patients report more feelings of anxiety.

Currently approximately 10.3 million people in the Netherlands (59% from the total population) suffer from a chronic disease (Volksgezondheid en Zorg, 2022) and due to several factors this number is steadily increasing (RIVM 2018). The term ‘Chronic disease’ is defined as: ‘health conditions that last 1 year or more, and require ongoing medical attention or limit activities of daily living, or both’ by the Centre for Disease Control and Prevention (CDC, 2022), and consists of a broad list of conditions, of which heart disease, cancer, and diabetes are the most common. One reason for this increase in patients is the impact of the growing and aging population (RIVM, 2018). Adding to this growth, is the impact of several developments in healthcare. More effective treatments for several chronic diseases such as heart disease, cancer, and diabetes, have been developed causing patients to have a longer lifespan. However, despite the positive impact on the mortality rate of chronic diseases, this does contribute to the growing numbers as patients live longer while suffering from the long-term consequences of their disease (RIVM, 2018).

This increasing patient population forms a strong economic impact. The current prevalence of chronic diseases not only leads to a high burden on the health care system and its costs, with treatments for chronic diseases costing millions of dollars globally (World Health Organization, 2022), but impacts the socio-economic climate as well as patients are often less able to contribute to society due to their chronic disease and its symptoms, decreasing human capital and productivity (World Health Organization, 2022; Essue et al., 2017). In addition, people with a lower socio-economic position are more likely to become chronically ill due to limited access to preventative health care, lessened financial stability, experiencing higher stress levels, and lower education levels (World Health Organization, 2022; Essue et al., 2017). This can lead to chronically ill patients getting stuck in a loop of poverty, where their lower socio-economic status made them more at risk for chronic diseases, and the impact of their chronic illness limits their ability and opportunity to work, impacting their socio-economic status even further (RIVM, 2018; Hajat & Stein, 2018).

This widespread impact is currently recognized as a problem on a global and regional scale by the World Health Organization (WHO), the European Union (EU) and the Rijksinstituut voor Volksgezondheid en Milieu (RIVM) stressing the importance of studying all aspects regarding chronic diseases and the need for further developments focussing both on prevention and treatment (WHO, 2022; European Commission, 2021; RIVM, 2018). The World Health Organization (2022) calls for a change in policy regarding the health care

systems, recommending investing in several interventions regarding preventative measures such as motivating people to stop smoking, eat healthier, and exercise more. In addition, the World Health Organization recommends investing in developing more cost-effective treatments that are accessible for all countries. These recommendations are also seen in the report by the RIVM (2018) which sketches a detailed plan focussing on several aspects surrounding the prevention and treatment of chronic diseases.

All these reports form a solid route for decreasing the impact of chronic diseases but focus mostly on the physical aspect of the problem. However, as mental health is intrinsically linked with chronic diseases (Hajat & Stein, 2018), a multidimensional approach focussing on both the physical and psychological aspects could be highly beneficial. Multiple studies in literature show that chronic diseases carry a high comorbidity of psychological symptoms such as depression, anxiety, and mental fatigue. Lotfaliany et al. (2018) showed an association between depression and chronic diseases, while Clark and Currie (2009) discovered that comorbid depression is often prevalent in all chronic disease groups, but has a higher prevalence in patients with cancer, rheumatoid arthritis or heart disease. More disease-specific, Connor (2017) showed that psychological comorbidity is highly prevalent in patients suffering from chronic skin conditions, ranging from social anxiety and depression to OCD and psychosis. These psychological conditions can especially occur due to the emotional burden of living with an often visible and symptomatic chronic disorder. This comorbid anxiety is not limited to only chronic dermatology patients, as comorbid anxiety symptoms are often seen in other patient groups as well, such as heart disease (Clark and Currie, 2009), chronic obstructive pulmonary disease (COPD) (Pumar et al., 2014), inflammatory bowel disease (IBD) (Kredentser et al., 2020), and chronic pain patients (Tunks et al., 2008). In addition to comorbid anxiety and depression, mental fatigue symptoms are found (David and Walsh, 2010) to be commonly experienced by many patients as well, ranging from cancer patients to COPD, post-stroke, and other chronic diseases.

As psychological comorbidities are highly prevalent within chronic disease patient groups, patients often benefit from psychological treatment adjacent to their physical healthcare. Quality of life for chronically ill patients can significantly improve after psychological intervention, with effects lasting up 12-months post-intervention (Anderson & Ozakinci, 2018). In addition to lessening the psychological burden, psychological treatment can support treatment-adherence, making patients more likely to continue their medical treatment

(Kahana et al., 2008; Pai & McGrady, 2014). Grenard et al. (2011) showed that depressed patients are 1.76 times more likely to not adhere to their treatment than non-depressed patients. Seaton et al. (2022) argued a need for developing targeted interventions in order to improve both physical and mental health care for chronically ill patients. This adds to the approach recommended by Sperry (2006), which calls for development of comprehensive biopsychosocial treatment, integrating both biological aspects as well as psychological treatment. They argue that integrating treatment for comorbid psychological symptoms will benefit patients suffering from chronic diseases in several ways, and in turn will lessen the impact of chronic diseases on society.

While currently more psychological treatments are considered and developed for patients suffering from chronic disease, these often do not consider if there are different effects on mental health between different chronic diseases (Anderson and Ozakinci, 2018). To develop specialized treatment a strong theoretical foundation is needed that indicates why certain aspects would work for certain diseases, and if the specialized treatments should differ. In doing so, we would be able to delineate more clearly between subgroups of diseases and their specific psychological issues, and develop treatment based on those results. As developing specialized treatment is expensive and takes a lot of time, it is essential that this is done with a strong theoretical base. And while time is of the essence regarding the current epidemic of chronic illnesses, we need to establish a theoretical base first.

This study aims to assess whether there are differences in psychological symptoms between different chronic diseases, and if these differences associated with age, gender and education level of the participants. These psychological symptoms consist of anxiety, depression and fatigue.

Hypothesis 1: It is hypothesized that patient groups will experience different psychological symptoms and severity, with depression being more prevalent in patients with cancer, heart diseases or arthritis, anxiety being more prevalent in patients with skin diseases, and fatigue being more prevalent in patients with gastrointestinal diseases.

Hypothesis 2: It is hypothesized that being older, female, and/or having a lower education level significantly correlates to higher scores on depression.

Methods

Design

This study was part of a bigger research project on the treatment of psychological disorders of patients suffering from health issues at LUBEC. This study focused on patients who were referred to LUBEC (Team Health) for their psychological problems related to their health issues. A cross sectional between group study design was used to assess the differences between groups of patients with different health issues and their psychological problems. In addition, the effect of different patient characteristics such as age, gender, and education levels were taken into account.

LUBEC is an expertise centre where new diagnostic and treatment methods are developed by connecting psychological treatment with scientific research and education. The most frequent psychological disorders were somatic symptom disorders, PTSD, depression and anxiety disorders. Different evidence-based treatments are applied, both online, face-to-face, or using both (hybrid). Treatment methods consist of CBT, ACT, EMDR, mindfulness or other psychotherapies, or a combination of these. Patients are referred to LUBEC by either the LUMC (specifically the dermatology or gastroenterology departments), General Practitioners or GGZ Rivierduinen.

Participants

Participants were referred to this study (as part of regular care) through either the LUMC, GP or GGZ Rivierduinen. The study consisted of 129 participants, with a minimum age of 18. The target group consisted of patients who suffer from a range of chronic illnesses such as Crohn's disease, Cancer, Colitis Ulcerosa, eczema, diabetes, and more. Patients were most frequently diagnosed and treated with a co-morbid psychological disorder such as somatic symptom disorder, depression, PTSD, or anxiety.

Measures

Patient characteristics such as age, gender, education level, type of chronic illness and psychological diagnosis were collected by questionnaires and the patient information system. Psychological symptoms were measured by several questionnaires administered during the intake procedure at the start of the treatment. The questionnaires consist of; the Dutch version of the Patient Health Questionnaire (PHQ-9) for measuring depressive symptoms, the Dutch

‘Verkorte vermoeidheidsvragenlijst (VVV) for measuring fatigue, and the Dutch version of the General Anxiety Disorder questionnaire (GAD-7) for measuring anxiety symptoms.

The PHQ-9 is a questionnaire in which patients score on each of the nine diagnostic criteria for major depression as stated in the DSM-5. Scores range from ‘0’ (Not at all) to ‘3’ (Nearly every day), on symptoms of “Experience of please, feeling down, sleep disruption, energy levels, appetite, feelings of failure, trouble concentrating, speaking slowly or being fidgety and having negative thoughts around suicide or self harm, over the previous 2 weeks.” (PHQ-9, 2005). A sum of scores is calculated with a higher score indicating a higher level of depression symptoms. The PHQ-9 can be used to both assist with diagnosis of major depression and assess symptom severity. For this study the PHQ-9 was used to assess symptom severity regardless of meeting the diagnostic criteria for depression. According to Kroenke et al. (2001) the PHQ-9 is a reliable and valid measure of depression severity. The study by Martin et al. (2006) supports the construct validity of the PHQ-9 as a measure of depression, and reports that the PHQ-9 is not only a useful tool for recognizing major depression, but also for subthreshold depressive disorders and symptoms in the general population. These aspects make the PHQ-9 a suitable measure for determining severity of depressive symptoms within the population group of this study.

The VVV is the Dutch version of the ‘Short Fatigue Questionnaire (SFQ)’ and was used in order to assess severity of fatigue symptoms. The questionnaire consisted of four items: ‘I feel tired’, ‘I tire easily’, ‘I feel fit’, and ‘I feel physically exhausted’ (Meetinstrumenten in de zorg, 2019). A 7-point Likert Scale is used for scoring, ranging from 1 ‘Yes, that is true’ to 7 ‘No, that is not true’. The sum of scores is used to assess fatigue, with a higher score reflecting a higher level of fatigue. Analysis by Penson et al. (2020) showed that the VVV/SFQ is reliable and valid measurement for fatigue in a clinical and research setting within the Dutch population. In addition, due to its format the VVV/SFQ is a compact and easy to administer measurement, compared to more extensive validated questionnaires such as the Checklist Individual Strength (CIS) or the Multidimensional Fatigue Instrument (MFI), which are relatively long (Penson et al., 2020). This makes the VVV/SFQ a suitable instrument for measuring fatigue severity in this study.

The GAD-7 is a questionnaire that reports how often a patient has experienced different symptoms of anxiety in the last two weeks. Patients score on the following seven items:

‘being bothered by feeling nervous, anxious or on edge’, ‘not being able to control or stop worrying’, ‘worrying too much about different things’, ‘having trouble relaxing’, ‘being so restless that it is hard to sit still’, ‘becoming easily annoyed or irritable’, and ‘feeling afraid, as if something might happen’. Scores range from 0 to 3 for experiencing symptoms, with 0 as ‘Not at all’, 1 as ‘for several days’, 2 for ‘more than half the days’ and 3 for ‘nearly every day’ (Williams, 2014). The sum of scores is used to assess anxiety symptom severity, with a higher score indicating higher anxiety symptom severity. The study by White and Karr (2023) showed that the GAD-7 is a reliable and valid measurement for assessing anxiety symptom severity, and thus suitable for measuring anxiety severity within this study.

Procedure

Participants completed the questionnaires at home before the start of a two-session intake, either online or on paper. If the participant had not filled out the questionnaires before the first intake session, they were instructed to fill out the questionnaires at home before the second intake session. In case of missing values, participants were requested to still complete the missing items with the help of a psychologist during the intake.

Ethics

Ethical approval for this study has been given by the Psychology Research Ethics Committee (CEP) ON 13-07-2023 with the research proposal number 2023-07-07-J.S.Voorwinden-V2-u4884.

Statistical analyses

First, three separate ANOVAs were performed to test if gender, age and education level affect the different psychological symptoms consisting of depression, anxiety, and fatigue. Considering the found effect, a MANCOVA was used to test the effect of subtypes of chronic illness on different psychological symptoms, using gender, age and education level as covariates. If age, gender and education level would not have had a significant impact on the psychological symptoms, a MANOVA would have been performed.

The independent variable of the MANCOVA were the different types of chronic illness. The dependent variables were the different psychological symptoms (depression, anxiety and fatigue). A Shapiro-Wilk test was performed to check for the assumption of univariate normality. Pearson’s correlation was used to check for multicollinearity and Mahalanobis

Distance for multivariate outliers. In addition, the assumption of linearity was checked using scatterplots, Levene's test for equality of error variances, and Box's test of Equality of Covariance Matrices was used to determine if the data violates the homogeneity of variance-covariance. For the hypothesis testing a p-value of .05 was considered statistically significant. In order to correct for multiple testing when interpreting the MANCOVA, a Bonferroni correction was done according to Allen & Bennet (pg. 755, 2014). Statistical analysis was performed using IBM SPSS Statistics version 28.0.1.0.

Results:

Descriptive statistics:

In total 129 participants were included in the dataset, of which 50 males and 79 females. The total sample consisted of 38 different diagnoses regarding chronic diseases, with the main diagnoses being Crohn's disease (33 participants), Colitis Ulcerosa (26 participants) and Eczema (12 participants). The other participants were spread approximately equally across the other 35 diagnoses. In order to divide the participants into comparable groups the diagnoses were separated into four categories. The four categories consisted of 'Skin diseases', 'Gastrointestinal diseases', 'Chronic pain', and 'Other'. For the complete list of diagnoses separated into categories, see appendix 1.

Exploratory testing:

Three separate ANOVAs have been performed in order to test for potential effects of age, gender and education level on depression, anxiety and fatigue. The first ANOVA showed a significant main effect for age, gender, and education level on depression, where a higher age, being female, and having lower education levels correlates with higher depression scores. The second ANOVA showed a significant main effect for age and gender on anxiety, but not for education level, where a higher age and being female correlates with higher anxiety scores. The third ANOVA showed no significant main effects for age, gender, and education level on fatigue. See Table 1 for further information. In order to compensate for these effects, age, gender and education were added as covariates in the main analysis.

Table 1*Effects of age, gender and education level on depression, anxiety and fatigue.*

		<i>F</i>	<i>p</i>	η^2
Depression	Age	429.343	<.001*	.999
	Gender	609.447	<.001*	.970
	Education level	169.805	<.001*	.973
Anxiety	Age	2.265	.030*	.858
	Gender	4.488	.048*	.200
	Education level	1.888	.156	.296
Fatigue	Age	.891	.638	.716
	Gender	1.164	.296	.064
	Education level	1.017	.426	.193

Note. *Significant at a power of .05**Hypothesis 1:**

A multivariate analysis of covariance (MANCOVA) has been used in order to examine the effects of the four different subtypes of chronic diseases on depression, anxiety and fatigue ($N = 129$). Before running the analysis, the data was examined using SPSS statistics to test the underlying assumptions.

Assumptions:

Shapiro-Wilk tests and boxplots were used to assess univariate normality. The Shapiro-Wilk test of univariate normality was statistically significant for Skin Diseases on depression, $W(27) = .923, p = .048$, and on anxiety, $W(27) = .914, p = .028$. In addition, the Shapiro-Wilk test is significant for MDL and Chronic pain on fatigue with respectively $W(60) = .917, p < .001$, and $W(20) = .840, p = .004$. A MANCOVA has been used to compensate for this univariate non-normality. Multicollinearity was assessed by checking for significant correlations between the dependent variables, and no significant effects were found. The

found maximum Mahalanobis distance is 10.962, which is lower than the critical chi-square value of 16.266 for this study, what means that there is no concern regarding multivariate outliers. Linearity has been observed using scatterplots, thus the assumption of linearity has been met. Levene's test of equality of Error Variances was non-significant as well. Lastly, Box's M was non-significant at sig. = .474, indicating that the assumption of homogeneity was not violated.

Main analysis:

The MANCOVA was then conducted, using gender, age and education level as covariates. Roy's Largest Root was used to assess significance as according to Ateş et al. (2019) and Field (2017) it is the most robust when the normality assumption is violated in small samples, which is the case. Findings show a significant main effect of chronic disease on the different psychological symptoms, $F(3,114) = 3.654, p = .015$, partial $\eta^2 = .088$.

Further analysis showed that the between group effect of different chronic diseases on anxiety was significant at a Bonferroni adjusted alpha level of .017; $F(3,114) = 3.630, p = .015$, partial $\eta^2 = .087$. Post-hoc testing using pairwise comparisons revealed that patients with chronic pain report significantly higher levels of anxiety than patients with gastrointestinal-diseases, skin diseases, and other chronic diseases. This is visible as well in Table 2, with chronic pain patients scoring on average significantly higher on anxiety compared to the other 3 groups.

No significant effect was found for depression, with $F(3,114) = 1.734, p = .164$, and no significant effect was found for fatigue, with $F(3,114) = 1.126, p = .342$.

Table 2

Differences between the chronic disease subgroups on depression, anxiety and fatigue, taking covariates into account.

	Subgroup	Mean (SE)*	N	F	p	η^2
Depression	Skin diseases	10.03 (1.05)	27	1.734	.164	.044
	MDL	11.22 (.70)	60			
	Chronic pain	13.63 (1.20)	20			
	Other	11.18 (1.44)	14			
Anxiety	Skin diseases	7.60 (.91)	27	3.630	.015	.087
	MDL	9.79 (.61)	60			
	Chronic pain	11.75 (1.04)	20			
	Other	7.81 (1.25)	14			
Fatigue	Skin diseases	19.01 (1.17)	27	1.126	.342	.029
	MDL	20.75 (.78)	60			
	Chronic pain	21.69 (1.34)	20			
	Other	22.08 (1.61)	14			

Note. * Covariates appearing in the model are evaluated at the following values: Year of birth = 1980.77, Gender = 1.62, Education level = 2.54

Exploratory hypothesis:

No significant effect was found for the covariates age ($F(3,112) = 1.992, p = .119$), gender ($F(3,112) = 2.657, p = .052$) and education level ($F(3,112) = 1.463, p = .228$) for each subtype of disease on depression, anxiety and fatigue. This means that despite the effect of age and gender on depression, anxiety, and fatigue, these factors do not form an interaction effect with subtype of disease.

Discussion:

The aim of this study was to assess if different types of chronic diseases differently affect several psychological comorbid symptoms, focusing on depression, anxiety, and fatigue. This aim was chosen to explore if the development of specialised psychological treatments is necessary in case that specific diseases have associations with particular psychological symptoms.

As seen in current literature as well (Lotfaliany et al., 2018), age, gender and education level were found in this study to impact depression and anxiety scores, but not fatigue. Being older, female and having a lower education level significantly correlated to higher depression scores and being older and female significantly correlated with higher anxiety scores regardless of chronic disease subtype. Age, gender and education level had no significant effect on fatigue. In order to further delineate the main effect of the different types of chronic disease, age, gender and education level were taken into account during the data analysis as covariates.

Data analysis showed that patients suffering from chronic pain score significantly higher on anxiety symptoms than other subtypes, indicating that pain patients seem to suffer more from anxiety compared to patients with other type of diseases. No significant difference was found between the chronic disease subtypes on depression and fatigue symptoms. In addition, age, gender or education level did not mediate or moderate the main effect of chronic disease subtype on psychological symptoms. Thus, the effect of chronic disease subtype on anxiety was on average the same across age, gender, and education level.

The results of this study are in line with current research on the psychological effects of chronic pain, as the study by Kroenke et al. (2013) shows that nearly half of patients suffering from chronic pain screen positive for one or more anxiety disorders, and the study by Lerman et al. (2015) shows that chronic pain patients report significant more anxiety symptoms. However, both studies do not compare different groups of chronic diseases, only stating that chronic pain patients suffer from anxiety, but not showing if that is more than other types of patients, or a control group. This study is unique in that it not only shows that chronic pain patients suffer from psychological symptoms such as anxiety/depression/fatigue, but that patients with chronic pain score significantly higher on anxiety symptoms compared to other types of chronic disease.

Previous findings show that different chronic diseases are linked to several co-morbid psychological symptoms (Clark and Currie, 2009; David and Walsh, 2010). However, these

studies have not measured if the severity of symptoms differ between different types of diseases. This study is the first to delineate the effect of different chronic disease subtypes on different psychological symptoms, by showing that depression and fatigue symptoms do not significantly differ between subtypes, but that anxiety is more prevalent and severe for chronic pain patients. When looking at the goal of this study, to support development of specialised treatment, it is good to know that specialised treatment per subgroup might be less relevant, with the possible exception of chronic pain, where the focus could be more on dealing with anxiety. However, as this is something that is already being done in pain revalidation (Basalt, 2024), the question remains if it is needed to include this in the form of an extra psychological treatment option.

When looking at the broad set-up of this study, a couple of strengths and weaknesses can be seen and have to be considered when taking these results into account. First, the study offers a new perspective on the current field by using a sample of patients suffering from a wide range of chronic diseases, allowing for comparison between several different types of diseases. This has not yet been done within the current literature and allows us to create a broad overview of potential effects, compared to studies using only patients suffering from one type of chronic disease. However, this study does not use a control group in the form of a sample group of participants who are not suffering from a chronic disease. Furthermore, this sample consisted only of patients suffering from psychological symptoms that were severe enough for them to be referred to psychological treatment at LUBEC, thus possibly only measuring the more severe side of the spectrum. It is possible that anxiety symptoms are less present and severe under chronic pain patients who are not referred for psychological treatment. In order to see the broader scope of the psychological impact of diseases, it is valuable to include a control group in replication studies.

Second, the sample size of the current study consisted of 129 participants, spread across 39 different chronic diseases. To be able to compare different chronic diseases, they were separated into four subgroups. This limited the division of chronic diseases and their subgroups, possibly limiting the theoretical and practical range of the study. A bigger sample size would allow for easier comparisons between different diseases, possibly with a different division and number of subgroups, but was not possible due to the constraints of this study.

Lastly, as age, gender, and education level have been shown to impact presence and severity of psychological symptoms, these factors should be taken into account as covariates when studying the effect of chronic diseases on psychological symptoms. Most studies in the

current literature do not include these variables as covariates, which could possibly influence their findings. The fact that the current study does account for these factors strengthens its findings. When continuing further research, it is recommended to continue controlling for these variables in order to strengthen the focus on the main effect.

There are several other recommendations for future research that could be taken into account. First, in case of the research sample a bigger sample size is recommended in order to more thoroughly compare the effects of different chronic diseases on psychological symptoms. In addition, using a participant group consisting of patients suffering from a chronic illness regardless of the presence and severity of potential psychological symptoms is recommended in order to assess the full spectrum of psychological comorbidity. Or using a control group of patients without a chronic disease in order to allow for comparison to a neutral group. Secondly, this study did not explore any presence of psychological symptoms prior to onset of chronic disease. It is unknown whether participants suffered from any psychological symptoms prior to getting ill, or if they had a pre-occurring psychological disorder. Considering the high frequency of psychological disorders in the general population, it is possible that this influences the relation between chronic diseases and psychological comorbidity and could form an interesting factor to take into account during future research. Third, another factor that could be relevant is the timing of onset of illness. It is possible that whether a patient just recently received their diagnosis or having been living with their illness and diagnosis for a while, influences how it affects them psychologically. It is feasible that patients could be more anxious or depressed when just getting diagnosed because they still have to process this development, or it is possible that patients get more depressed, anxious and fatigued after having been sick for a while, possibly if the chronic nature of their illness becomes more clear. Lastly, as this study only focused on studying if there is a difference in psychological symptoms between subgroups of chronic diseases, the question of what causes this difference remains, and could form a relevant topic for further research.

Concluding, considering that this study shows that only chronic pain was associated with higher anxiety scores compared to other diseases, and that pain revalidation focuses on dealing with anxiety surrounding chronic pain, it seems that there is no current indication for further specialisation within psychological treatment of pain. If such a treatment program will be developed, more scientific research is necessary to determine if such a program is

significantly more effective than the current more generalised treatment options. Future studies could also focus on more preventative treatment options, where patients for example get offered psychological help and strategies to learn to deal with psychological symptoms if these appear in the future, after getting diagnosed with a chronic disease. This could support patients to become more resilient and equipped to deal with the burden of chronic disease, to prevent the development of psychological comorbidity.

Conclusion:

This study aimed to assess if different types of chronic diseases are associated with different psychological comorbid disorders. Results show that only chronic pain is associated with significant higher anxiety scores compared to other chronic diseases. Age, gender, and education level affect depression, anxiety and fatigue symptoms in general, but do not mediate or moderate the main effect of chronic disease subtype on psychological symptoms. These results indicate that chronic diseases are associated with mental health issues, but that aside from chronic pain, there are no other significant differences in how chronic disease types affect psychological symptoms. As chronic pain patients already receive treatment in the form of pain rehabilitation, in which learning to deal with anxiety is part of the treatment, we argue that there is no need for additional specialised treatment based on this study's outcomes. This field might benefit from further research on this topic with a larger sample size and control condition, in order to support and continue developing treatments to deal with the consequences of the increasing prevalence of chronic disease.

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Appendix 1

Frequency chronic diseases by different diagnoses and group type

Code	Diagnosis chronic disease	Frequency
1	Crohn's disease	33
2	Inflammatory Bowel Disease (IBD)	26
3	Eczema	12
4	Psoriasis	3
5	Alopecia	1
6	Fibromyalgia	2
7	Arthroses	1
8	Cancer	3
9	Pruritis	5
10	Somatisation disorder	2
11	Pouchitis	1
12	Pulmonary Embolism	1
13	Hepatitis	1
14	Diabetes	1
15	Irritable Bowel Syndrome (IBS)	2
16	Lichen Plamus	1
17	Tuberculosis	1
18	Chronic Headaches	2
19	Rosacea	1
20	Vulvodynia	1
21	HPV	1
22	Granula Annulaire	1
23	Rheumatoid Arthritis	2
24	Zoon's Balantis	1
25	Trigeminus Neuralgie	1
26	MS	1
27	Prurigo	2
28	Post Covid	4
29	Chronic Pain	8
30	Micturion Symptoms	1
31	Lichen Scelsis	2
32	Pityriasis lichenoides	1

Code	Subgroep	Diagnoses	
		Eczema, Psoriasis, Alopecia, Pruritis, Lichen Plamus, Rosacea, Granula Annulaire, Prurigo,	
1	Skin diseases	Lichen Sclersis, Pityriasis Lichenoides, scleroderma	
	Gastrointestinal		
2	diseases	Crohn's Disease, IBD, Pouchitis, IBS	
		Fibromyalgia, Arthroses, Chronic Headaches, Reumatoid Arthritis, Trigeminus Neuralgie,	
3	Chronic Pain	Chronic Pain, Hernia, Somatisation Disorder, Vulvodynia, Pelvic Floor Syndrome, Polyneuropathy	
	Others	Pulmonary Embolsim, Tuberculosis, Post Covid, Cancer, Hepatitis, HPV, Zoon's Balantic,	
4		Micturion Symptoms, Diabetes, MS, Epilepsy	
		33 Pelvic Floor Syndrome	1
		34 Hernia	1
		35 Herpes	1
		36 Epilepsy	2
		37 Scleroderma	1
		38 Polyneuropathy	1
			129