Understanding fatigue in rheumatoid arthritis and osteoarthritis: Are pain, disability and mental health related to fatigue?

BACHELOR THESIS

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Abstract

Rheumatism affects 2.3 million individuals in the Netherlands. The disease has a great impact on the health and quality of life of patients. Rheumatoid arthritis and osteoarthritis are two common forms of rheumatism and both share fatigue as an important symptom. Fatigue affects different areas of individuals' daily life which can lead to serious consequences in terms of financial or social loss. Even though both illnesses share common symptoms studies comparing rheumatoid arthritis and osteoarthritis are rare. Until today, there is a lack of understanding which factors provoke fatigue.

The purpose of this study was to investigate factors related to fatigue in both diseases. Three factors which were constantly cited in the literature were included consisting of pain, disability and mental health. A secondary data analysis was conducted with a sample of 744 patients from a rheumatology department of a hospital in the Netherlands. The data of the SF-36 and the Health Assessment Questionnaire was used to compare both illness groups for fatigue severity and factors relating to fatigue. The results of an independent sample t-test showed no difference in fatigue severity between rheumatoid arthritis patients and osteoarthritis patients. In a hierarchical multivariate regression analysis all three factors were significantly related to fatigue for both disease groups. However, the explained variance of 58% was higher for the osteoarthritis group compared to 52% in the rheumatoid arthritis group.

More similarities than differences between rheumatoid arthritis and osteoarthritis were found in this study, suggesting that the underlying mechanisms of fatigue may be similar between both diseases. Psychological distress seems to be the key factor whereas disease specific symptoms (like pain and disability) seem to play a subordinate role in the explanation of fatigue.

Samenvatting

2.3 miljoen Nederlanders zijn gediagnosticeerd met reuma. De ze ziekte heeft vaak ernstige gevolgen op de gezondheid en de kwaliteit van het leven van de patiënt. Reumatoïde artritis en artrose zijn twee van de meest voorkomende vormen van reuma waarvan beide vermoeidheid als belangrijk symptom delen. Deze symptomatische vermoeidheid beïnvloedt verschillende gebieden van het dagelijkse leven van het individu. Dit kan tot ernstige gevolgen leiden zoals financieël of sociaal verlies. Hoewel beide ziektes gemeenschappelijke symptomen delen zijn studies die reumatoïde artritis en artrose vergelijken zeldzaam. Tot op heden is er een gebrek aan kennis over factoren die vermoeidheid uitlokken te kunnen verklaren.

Het doel van deze studie was factoren te onderzoeken die samenhangen met vermoeidheid in beide ziektes. Drie factoren die voortdurend in de literatuur zijn genoemd en met rheumatische vermoedheid in verband gebracht zijn pijn, lichamelijke beperkingen en mentale gezondheid. Een secundaire data analyse was uitgevoerd in een steekproef van 744 patiënten van de reumatologie afdeling van een ziekenhuis in Nederland. De data van de SF-36 en the Health Assessment Questionnaire was gebruikt om beide ziekte groepen met elkaar te vergelijken qua mate van vermoeidheid en de factoren die met vermoeidheid samenhangen. De resultaten van een independent sample t-test toonden geen verschil in de mate van vermoeidheid tussen reumatoïde artritis en artrose. In een hierarchische regression analyse bleken de drie factoren significant gerelateerd te zijn aan vermoeidheid in beide groepen. Echter was de verklaarde variantie van 58% hoger in the artrose groep vergleken met 52% in de reumatoide arthritis groep.

In deze studie zijn meer overeenstemmingen dan verschillen gevonden tussen rheumatoid arthritis en osteoarthritis. Dit geeft aanwijzingen voor gemeenschappelijke onderliggende mechanismen voor vermoeidheid in beide ziektes. Psychologisch leed schijnt bij de verklaring van vermoeidheid de belangrijkste factor te zijn gevolgd van pijn en lichamelijke beperkingen.

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1.1 Rheumatism in general

The term rheumatism is used as a generic term for more than 100 chronic diseases affecting joints, bones and sinews. It is often mistaken as a disease most common among older adults but it can occur at any age as for example about half of all rheumatoid arthritis patients are younger than 65 (“Reuma, 2012). An increase in prevalence will be expected because of the growing number of elderly people among the population and the incidence of arthritis tends to increase with age. Arthritis has a great impact on the quality of life of patients as they show the poorest quality of life issues compared to cardiovascular conditions and chronic respiratory diseases (Reginster, 2002). In the Netherlands about 2.3 million people are affected by rheumatism (“Reuma”, 2012). Two of its most common forms are rheumatoid arthritis and osteoarthritis.

1.2 Rheumatoid arthritis

Rheumatoid arthritis is an auto-immune disease, meaning that one’s immune system turns against the own body ("Reuma”, 2012). In this process, inflammatory cells wander into a local area surrounding the joint and bones, called the synovium. The synovium has the function of a lubricant for the bones when involved in movement. The newly arrived inflammatory cells start causing rapidly increased cell production (*hyperplasia*) and form a pannus tissue. The pannus tissue in turn causes damage to the cartilage, erosion of the neighboring bone and finally loss of function in the affected bone (Kvien, Scherer & Burmeister, 2009). Functional loss can occur early in the progression of the disease and is difficult to retain. (McInnes, Jacobs, Woodburn & Van Laar., 2009). Even though genetic and environmental factors have been linked to the onset and progress of the disease, the trigger initiating the breakdown of the individuals immune system is still unknown (Kvien et al., 2009).

The disease can have far reaching consequences for the individuals and their well-being. Functional loss has been found to correlate strongly with unemployment, decline in social conditions and economic impairment for the affected person (McInnes et al., 2009). Inflammations caused at the joints are experienced as painful by patients (“Reuma”, 2012). Other common symptoms include tenderness, morning stiffness in the affected areas, swelling of the joints, loss of energy and fatigue (Kvien et al., 2009). Having rheumatoid arthritis reduces one's life expectancy by about seven years (Kvien et al., 2009).

In general, rheumatoid arthritis is a chronic disease, consisting of alternating good and bad episodes and can begin suddenly or very slowly. The disease ranges from mild, non-

erosive forms to severe destructive and rapidly progressive forms (Kvien et al., 2009). It can occur at all ages and in both genders, even though more women than men tend to be affected. ("Reuma", 2012). The risk of getting affected is increasing with age having its plateau around the age of 60 (Kvien et al., 2009). About 0.5 -1% of North American and European adults have been affected by the disease (Weisman, 2008).

1.3 Osteoarthritis

Another form of rheumatism is osteoarthritis. It can occur in any joint but is most common in the hips, knees, neck, fingers, big toes, thumps and lower back ("Reuma", 2012). The progression of the disease consists of degenerative and repair processes affecting the cartilage and subchondral bones with inflammation of the synovium (Sellam, Herrero-Beaumont & Berenbaum, 2009). The processes result in damaged articular cartilage ("Reuma", 2012) which usually connects two bones. As the articular cartilage is degraded progressively, the bones begin to chafe against one another. In trying to repair the damage, the bones get thicker ("Reuma", 2012). At the edges of the bone new bone formations (*osteophytes*) begin to develop. The illness results in deformity and later on in chronic disability (Sellam et al., 2009).

The development of osteoarthritis occurs as a reaction to joint infections, weak hinges or due to an unknown cause ("Reuma", 2012). Environmental factors correlating with the disease include age, obesity and pursuing professional sports (Sellam et al., 2009). However, others did not find a relation between aging and osteoarthritis (“Reuma”, 2012).

The disease can cause a significant deterioration of the quality of life of the affected person (Sellam et al., 2009). Processes caused by the disease are experienced as painful by the patient ("Reuma", 2012). Other common symptoms include stiffness and fatigue ("Reuma", 2012). Furthermore, the individual experiences limitations in motion and functioning concerning daily activities, disturbed sleep and depression (Sellam et al., 2009). More importantly, osteoarthritis in the knee was mentioned to be the main cause for mobility impairment (Symmons, Mathers & Pfleger, 2000)

In general, osteoarthritis is a chronic disease which develops slowly, gets worse with time ("Reuma", 2012) and develops progressively over several years (Sellam et al., 2009). About 10% of the world population, being under 60 years, is affected by osteoarthritis (Symmons et al., 2000). The illness has been mentioned as the leading cause for disability in older adults (Doherty, Yazdani & Punzi, 2009).

1.4 Fatigue as common symptom in rheumatoid arthritis and osteoarthritis

One of the symptoms that both diseases have in common is experiencing fatigue. Fatigue in rheumatoid arthritis has been recognized by patients as the most annoying symptom of the disease (Repping-Wuts, Uitterhoeve, Van Riel & Van Achterberg, 2008). Additionally, patients with osteoarthritis also identified it as a significant symptom (Stebbings, Herbison, Doyle, Treharne & Highton, 2010).

1.4.1 Fatigue in rheumatoid arthritis

The prevalence rate of fatigue in patients with rheumatoid arthritis is quite high, ranging from 42% up to 80% (due to differences in measurement; Repping-Wuts, Riel & Van Achterberg, 2009). Until today, no universal accepted definition of fatigue has been found (Piper, 1993). However, most authors define it as "an overwhelming sustained sense of exhaustion and decreased capacity for physical and mental work" (Reppings-Wuts et al., 2009). Furthermore it is described as multidimensional symptom consisting of psychological, physical, cognitive, social and behavioral aspects (Repping-Wuts, Riel & Van Achterberg, 2008). In general, patients experience fatigue as a whole body tiredness ranging from tiredness to exhaustion which cannot easily be dispelled by rest or sleep (Piper, 1993). Because of that, it can remain stable over days to months (Repping-Wuts et al., 2008) making it difficult to pursue daily life in a productive way. This can have far reaching consequences, one of which is leaving the workforce (Stebbings et al, 2010).

In general there appeared to be an agreement that fatigue has a large impact on the quality of life of patients (Repping-Wuts, Uitterhoeve et al., 2008). In addition, its importance has been indicated by the Outcome Measures in Rheumatology Consortium (in short OMERACT) which has endorsed studies to measure fatigue in rheumatoid arthritis. It was stated that fatigue is an important symptom which is severe and frequently reported by patients (Stebbing & Treharne, 2010). Furthermore, it appears to have greater impact than pain (Repping-Wuts, Uitterhoeve et al., 2008).

1.4.2 Fatigue in osteoarthritis

The prevalence of fatigue in osteoarthritis is somewhat lower than in rheumatoid arthritis, ranging from 41% up to 56% (Stebbings & Treharne, 2010). In a qualitative study of Power , Badley, French, Wall & Hawker (2008) osteoarthritis patients distinguished between mental and physical fatigue, stating mental fatigue to be "much worse". Descriptions of fatigue in osteoarthritis include occasionally restricting activity and deliberating (Stebbings & Treharne,

2010). Similarly, patients described the experience of fatigue as "[...] feel[ing] absolutely drained out and [not being able to] focus" and also as "totally consuming" and "overwhelming" (Power et al., 2008). Experiencing mental fatigue can last up to 2 or 3 days (Power et al., 2008).

Fatigue is linked to affect and physical functioning. For example, patients felt more easily exhausted and experienced doing daily activities as more time consuming (Power et al., 2008). In a review of Stebbings and Treharne (2010) fatigue is stated by patients as a very negative aspect of their lives.

1.4.3 Comparison of fatigue severity in rheumatoid arthritis and osteoarthritis

Fatigue severity is the subjective feeling of the intensity of fatigue experienced by patients.
In the past, fatigue severity of osteoarthritis and rheumatoid arthritis groups have been compared, showing mixed results. Some studies did not find a difference (Wolfe, Michaud & Pincus, 2004; Zautra, Fasman, Brendt & Davis, 2007) whereas others found fatigue severity to be higher in osteoarthritis patients (Stebbings et al., 2010; Novaes, Perez, Beraldo, Pinto & Gianini, 2011). Because osteoarthritis patients show higher levels of functional disability it was argued that they should experience higher levels of fatigue (Stebbings et al., 2010). However, osteoarthritis patients have been studied less extensively (Stebbings et al., 2010)

1.5 Model of fatigue

Until today a theoretical model explaining the experience of fatigue is still lacking (Nikolaus, Bode, Taal & Van De Laar, 2010). Fatigue as a symptom appears to be quite complex because it is a subjective feeling (Repping-Wuts et al., 2008) and is most likely to have multiple causes (Nikolaus & Van De Laar, 2011). Furthermore the underlying mechanisms which probably provoke fatigue are not yet fully understood (Riemsma et al., 1998).

However, in one study of Hewlett et al. (2011) a conceptual model for fatigue in rheumatoid arthritis was proposed, consisting of inter-relationships between three factors. These three factors included disease processes in rheumatoid arthritis (as physical consequences of inflammation and physical treatment experience), cognitive and behavioral processes (describing interactions between thoughts, feelings, behaviors and symptoms) and personal factors (such as social support, unhelpful personal environments and personal responsibilities). The model is dynamic and has to be set within the context of the individual's life (Hewlett et al., 2011).

Various studies confirmed high explanatory values when several variables from each factor (as described in the model of Hewlett et al., 2011) were included in a model to explain fatigue. For example, Belza, Henke, Yelin, Epstein & Gilliss (1993) found 60% of the variance in fatigue in rheumatoid arthritis explained by psychosocial, disease related and demographic factors. Two-thirds of these 60 % was explained by disease related factors such as overall pain, functional status and physical activity. Furthermore, Wolfe, Hawley & Wilson, (1996) found a value of 52% with similar factors for the data of three illness groups (rheumatoid arthritis, osteoarthritis and fibromyalgia). The main factors pain, sleep disturbance and depression accounted for 90% of the total explained variance of 52 %. Nevertheless, Hewlett et al. (2011) stated that to make statements about causation, more research has to be done on the different dimensions of fatigue (like physical severity or emotional fatigue.

1.6 Factors related to fatigue

A study review of Stebbings & Treharne (2010) listed several factors which have already been associated with fatigue in both diseases. These included disease severity/activity, pain, disturbed mood, self-efficacy, disability, coping and sleep disturbance.

1.6.1 Pain

Pain was consistently cited as a major symptom in both diseases. For example, Wolfe (1999) found a strong correlation between pain and fatigue in both diseases. Moreover, Zautra et al. (2007) found pain to be among the strongest related factors for both diseases. In osteoarthritis, qualitative and quantitative studies found an association between fatigue and pain (Stebbings & Treharne, 2010). Studies confirming pain as a related factor of fatigue in rheumatoid arthritis include Belza et al. (1993), Riemsma et al. (1998) and Wolfe et al. (2004). A study of Murphy, Smith, Clauw & Alexander (2008) found no association between fatigue and pain in osteoarthritis. Additionally, (Stebbings et al., 2010) reported no relationship for both illnesses, which in the authors view supports the idea of fatigue and pain being two different experiences and therefore not being related.

1.6.2 Disability

One other related factor which was constantly referred to in the literature is disability. An association of disability with fatigue in rheumatoid arthritis was found in several studies (Huyser et al. 1998; Repping-Wuts et al., 2008). This association was also found for

osteoarthritis patients (Wolfe, et al., 1996; Wolfe, 1999; Stebbings et al., 2010). Stebbings and Treharne (2010) suggested fatigue to be influenced by disability levels which may increase the level of effort to perform day-to-day tasks next to other influencing factors such as motivation, pain and mood. Nevertheless, one study of Novaes et al. (2011) did not find a relationship between fatigue in rheumatoid arthritis and disability.

1.6.3 Mental Health

Another important related factor found in studies is mental health or psychological well-being. The absence of psychological well-being is often defined as mood disturbance or negative affect and is frequently summarized by measuring depression and anxiety. A review of Dickens & Creed (2001) stated that research constantly confirms an association between depression and rheumatoid arthritis with a prevalence of 14-20% in patients. Depression interacts with the patient perception and coping of the disease. For example, patients experience hopelessness and perceive their disease as being more serious. Moreover, it is also associated with increased levels of pain and functional disability. However the direction of causality between the three concepts is poorly understood (Dickens & Creed, 2001). Anxiety has also been linked to fatigue. It was suggested that ongoing anxiety may be fatiguing (Stebbings & Treharne, 2010).

Several studies found an association between psychological well-being and fatigue in both diseases (Stebbings et al., 2010; Wolfe et al., 1996; Wolfe, 1999). Similarly, associations between depression, anxiety and fatigue were also found for rheumatoid arthritis (Belza et al., 1993; Huyser et al., 1998; Riemsma et al., 1998; Mancuso, Rincon, Sayles & Paget, 2006). However, no study was found investigating fatigue and psychological well-being for osteoarthritis.

A different relationship was reported by Zautra et al. (2007). They found the absence of positive affect significantly related to fatigue in all groups instead of negative affect. Positive affect is different from depression and negative affect (Zautra et al., 2007) and was administered with a daily diary using the negative and positive affect scales from the PANAS-X. Items defining negative affect scale on the PANAS-X included fear, nervousness and distress. Positive affect was measured by items such as attentiveness, alertness and pride (Watson & Clark, 1999).

1.7 The purpose of the study and research questions

The purpose of this study was to further investigate the understanding of fatigue in rheumatoid arthritis and osteoarthritis. Until today, there has been no theoretical model for explaining fatigue in rheumatism. Furthermore, factors provoking and causing fatigue and relations between variables are not fully understood. Additionally, there is no universal accepted definition for fatigue itself even though its importance for patients is evident. Despite both patient groups reporting high levels of fatigue, in osteoarthritis it is less intensively studied (Stebbings et al., 2010). Furthermore, Stebbings and Treharne (2010) concluded in their review that many related factors were the same for both conditions but they may differ qua influence across diseases. Nevertheless, direct comparisons in the literature between inflammatory and non-inflammatory arthritis are rare (Stebbings et al., 2010). For example, it was suggested that because of higher disability levels in osteoarthritis the fatigue severity seems to be higher than in rheumatoid arthritis. However this has not been confirmed yet (Stebbings & Treharne, 2010).

A better understanding of the concept fatigue was tried to be accomplished through a self-report study, investigating fatigue severity and different factors related to fatigue. In this study three related factors were included namely: pain, disability and mental health. The relation between these three factors and fatigue was mentioned repeatedly in the literature. For example, two studies showed that they were able to account for over 50 % of the explained variance in fatigue (Belza et al., 1993; Wolfe et al., 1996). The importance of the three factors was also mentioned in various studies. According to Hewlett et al. (2011) two of the main disease related factors can be defined as pain and disability resulting from inflammation. Additionally, Stebbings and Treharne (2010) mentioned in their review that the most consistent finding for fatigue across studies is the strong correlation between depression and fatigue.

Considering these findings, pain, disability and mental health seem to be the most important ones. We expect them to explain much of the variance in fatigue for both diseases. Investigating the factors related to fatigue is especially important for possible modifications in interventions which should be the ultimate goal in the study of fatigue (Stebbings & Treharne, 2010).

The research questions in this study are the following:

1. Is there a difference in fatigue severity as experienced by rheumatoid arthritis and osteoarthritis patients?

2. Are the factors pain, mental health and disability related to fatigue in both diseases?

3. Are there differences in the related factors between both diseases?

2. Method

2.1 Participants

The data for this study was collected in a previous study of the University of Twente, at the Medisch Spectrum Twente in the Netherlands. The Participants were patients from the rheumatology department diagnosed with various forms of rheumatism. Patients waiting in the waiting room were asked if they would like to fill in several questionnaires.

The average duration completing the two questionnaires and questions about demographic data was 12 minutes. In this study only the data from participants diagnosed with rheumatoid arthritis and osteoarthritis was used. In total it consisted of 744 participants from whom 619 were diagnosed with rheumatoid arthritis and 125 with osteoarthritis. Both genders were included with an over-representation of women. In rheumatoid arthritis 425 and in osteoarthritis 99 participants were female. Further details about demographic characteristics are shown in Table 1.

Table 1
Demographic Characteristics of Patients with Rheumatoid Arthritis and Osteoarthritis

	Rheumatoid arthritis (N= 619)				Osteoarthritis (N=125)			
Characteristic	M or N	SD	%	Missing	M or N	SD	%	Missing
Age (Years)	59.39	14.1		8	60.2	11.5		4
Gender, female,	425		68.7	0	99		79.2	0
Duration of illness (Years)		10.1	11.1	71	12.0	14.0		14
Education,				88				1
No education	22		4.1		2		1.6	
Elementary school	66		12.4		13		10.5	
Lower trade school	178		33.5		35		28.2	
High school	89		16.8		32		25.8	
Middle trade school	75		14.1		19		15.3	
Secondary school	31		5.8		5		4.0	
Higher trade school	62		11.7		16		12.9	
University	8		1.5		2		1.6	
Current Marital Status,				85				1
Unmarried/living alone	36		6.7		3		2.4	
Unmarried/living together	31		5.8		5		4.0	
Married	364		68.2		88		71.0	
Widow/widower	78		14.6		19		15.3	
Divorced	25		4.7		9		7.3	

The demographic characteristics of the two groups did not differ significantly except for gender, $X^2(1) = 5.55$, $p=.006$. This was important for the upcoming analysis, so that both groups could be compared against each other. For gender, the percentage of women in the

osteoarthritis group (79.2 %) was higher than the rheumatoid arthritis group (68.7 %). The majority (74.9 % for rheumatoid arthritis and 73.4 % for osteoarthritis) of the participants did have a partner which was defined as “married” and “not married/living together”. However, the difference between groups was non-significant, $X^2(1) = .123$, $p = .36$. The average duration of illness was 10 (11.1) years for rheumatoid arthritis patients and 12 (14) years for osteoarthritis patients. However this difference was also not significant, $t(657) = -1.57$, $p = .06$. The mean age for rheumatoid arthritis patients was 59 (14.1) years and for osteoarthritis patients 60 (11.5) years and was also non-significant $t(730) = -.63$, $p = .27$. At last, most of the participants (33.5% of the rheumatoid arthritis and 28.2% of the osteoarthritis patients) graduated from lower trade school. As mentioned above, this difference was also non-significant, $X^2(7) = 8.22$, $p = .11$.

2.2 Measures

The Health Assessment Questionnaire (HAQ) and the Short-Form 36 (SF-36) Version 2 were used in the study to assess the mental and physical health of the participants. The HAQ was developed by Fries in 1978 as a comprehensive measure of outcome for a wide variety of rheumatic diseases. It consists of four domains: disability, discomfort and pain, drug side effects and dollar costs. The disability domain used in this study consists of 20 items in eight categories namely: dressing and grooming, arising, eating, walking, hygiene, reach, grip and common daily activities. The disability Index is sensitive to change and has been proven to be reliable and valid in different languages and contexts. The HAQ uses a four-response scale including the options no difficulty, some difficulty, much difficulty and unable to do. In this study the HAQ Alternative Disability Index is used, ignoring the scores considering aids and devices. The scoring ranges from zero (no difficulty) to three (unable to do). Each category is scored by the highest score given by a person of the sub-categories (Stanford School of Medicine, 2004). For reliability, test-retest scores varied between 0.87 and 0.99. For criterion validity correlations between interview or questionnaire and task performance varied between 0.71 and 0.95. Other forms of validity like content or face validity have also been proven in a substantial number of other studies (“The Health Assessment Questionnaire”, n.d.). For reliability, in this study, a cronbach's alpha of 0.96 for the disability index scale was found. The purpose of the Health Assessment Questionnaire was mainly to assess disability scores from the participants.

The SF-36 was developed by the RAND Corporation and the Health Outcome Studies (MOS). It contains eight scales namely: physical functioning, role-physical, bodily pain,

general health, vitality, social functioning, role-emotional and mental health. The scales used in this study were the mental health scale, bodily pain and the vitality scale for measuring fatigue severity. The SF-36 mental health subscale was used to measure mental health. It consists of five items measuring psychological well-being and psychological distress (Ware & Sherbourne, 1992). In detail, these five items are: nervous, down in the dumps, peaceful, blue/sad and happy. The bodily pain scale contains the items: pain interference and pain magnitude. The items pep/life, energy, worn-out and tired describe the vitality scale. The survey uses a five-choice response scale containing excellent, very good, good, fair, poor. Over 25 studies published statistics showing a reliability exceeding the minimum standard of 0.70 which is recommended for measures used in group comparisons. This trend could be consistently replicated among 24 patient groups differing in diagnoses and socio-demographic characteristics (Ware, 2000). Ware (2000) reported a reliability of 0.93 of the mental health scale. As for the whole questionnaire, all items correlated substantially (0.40 or higher) with their hypothesized scales. Comparing the content validity to other generic health measures revealed that it consisted of the eight of the most frequently measured health concepts. Furthermore due to high sensitivity and specificity the mental health scale has been shown useful in the screening of psychiatric disorders. In addition, all scales correlate substantially (0.40 or higher) with the majority of the omitted general health concepts and with the severity and frequency of specific problems (Ware, 2000). For the Netherlands, a review of Reginster (2002) reported outstanding reliability and validity of the SF-36.

In this study a cronbach's alpha of 0.78 was found for the vitality scale, 0.84 for the mental health scale and 0.85 for the bodily pain scale. The SF-36 was used to determine fatigue scores and to assess mental health and pain scores. The norm based scores were used for the analysis which range from 0-100. The mean of fifty represents the average score of the norm group. Moreover a lower score on the vitality scale represents a poorer status of health (Rupp, Boshuizen, Jacobi, Dinant & Van den Bos, 2004). The scores are based on a population from the USA.

2.3 Procedure

The study consisted of a secondary data analysis. The data had already been collected from the years 2005 to 2008. For this thesis, a between-group comparison was conducted comparing two groups consisting of the rheumatoid arthritis group and the osteoarthritis group.

2.4 Analysis Plan

The data was analyzed with the statistics program SPSS 16. Before analyzing the data file the quality of data was estimated through checking the mean scores, homogeneity of variance, independence, multicollinearity, normality and independence of errors and frequencies for skewness and kurtosis. The demographic variables (gender and marital status were left out) were normally distributed except for duration of illness. Using a histogram, the variable was skewed to the left. For more details, a frequency table was used where the highest percentage of the participants (13.7%) reported one year of illness. All predictors and fatigue severity were normally distributed. For the first research question both variables, diagnosis and fatigue severity, were independent from each other as the correlation was lower than .9. Furthermore the Levene's test for homogeneity of variance was not significant, $p>.05$. A second test for homogeneity, Hartley's F, was conducted because the Levene's test can be unreliable for large samples (Field, 2009). The test was also non-significant, meaning that equal variances can be assumed. For research question two all predictors were independent from fatigue severity, because all correlations were lower than .9. The variables showed no multicollinearity as all VIF <10. Furthermore all Durbin-Watson scores ranged between one and three, meaning that the errors were independent. When testing for the normality of errors, all three predictors showed a normally distributed histogram, P-P Plot and Scatterplot. Only the scatterplot of mental health showed heteroscedasticity. Demographic variables were also tested for the requirements and no violations were found. As only variable, duration of illness showed an unusual pattern on the scatterplot. However, the histogram and the P-P Plot showed a normal distribution of errors. For research question three all predictors were independent, showed no multicollinearity and the errors were normally distributed and independent for both disease groups. The same was true for all demographic variables.

It was also checked for missing values and a reliability analysis for the disability index of the HAQ and subscales of the SF-36 was conducted.

To answer the research questions the following analyses were carried out. As a first step a bivariate Spearman correlation matrix was conducted to examine the possible relations between the factors. After that, an independent samples t-test was carried out to establish differences in fatigue severity between the two disease groups. For analyzing the relationships of pain, disability, mental health with fatigue multiple regression analysis was used. At last the predicting values of pain, disability and mental health were compared in both diseases with another regression analysis. Both regression analyses were controlled for possible influences of the demographic variables using hierarchical regression. For all analyses a significance level of .05 was used.

3. Results

3.1 Correlations between fatigue and other factors

To get an overview of the relation between the various factors correlations were calculated. Correlations were not included into the research questions. However, they were used as a requirement for the following regression analysis, to test if associations between fatigue, predictors and demographic variables were actually significant. Fatigue, mental health and pain scores have to be interpreted as follows: the higher the scores on each of these scales the better is the reported health. So, if for example an individual is reporting a high score on the fatigue scale, low fatigue is experienced. For the disability scale, higher scores are interpreted as higher levels of disability.

Investigating possible relations between fatigue and the demographic characteristics it was found that four of the five variables did correlate with fatigue. Especially gender (r= -.141**) and education (r=.190**) had significant but weak correlations with fatigue. Using a Scatterplot the negative correlation of gender showed that higher levels of fatigue were associated with being female. For education the association was positive, meaning that higher levels of education correlated with lower levels of fatigue. Correlating strongly with fatigue were pain (r=.538**) and mental health (r=.613**), which means that reporting a high score on the pain and mental health scale is associated with lower levels of fatigue. Furthermore disability had a strong negative correlation with fatigue (r= -.515**) meaning an association between higher level of disability and higher levels of fatigue. Considering the three predictors, all of them did significantly correlate with each other. The strongest negative correlation was between pain and disability (r= -.540**) meaning that more pain was associated with more disability. Mental health and pain did not correlate that strongly (r=.377**) showing an association between higher levels of mental health and lower levels of pain. Moreover lower levels of mental health were correlated with higher levels of disability (r=-.375**).

Table 2
Descriptive measures and Correlation matrix for demographic, predictors and fatigue variables for both groups

Variable	Gender	Age	Duration	Education	Marital Status	Fatigue	Pain	Mental Health	Disability
Mean						47.09	39.11	47.00	.95
SD						9.78	8.89	10.90	.72
Gender	------								
Age	-.01	-------							
Duration	.06	.23**	-------						
Education	-.12**	-.24**	-.05	---------					
Martial Status	.16**	.18**	.07	-.16**	--------				
Fatigue	-.14**	-.06	-.09*	.19**	-.10*	---------			
Pain	-.05	-.04	-.06	.15**	-.06	.54**	---------		
Mental Health	-.10**	.11**	.01	.21**	-.17**	.61**	.38**	---------	
Disability	.17**	.21**	.25**	-.22**	.16**	-.52**	-.54**	-.38**	-------

Note. *p<.05(2-tailed); **p<.001(2-tailed)
Gender: 1=male, 2=female
Marital status: 1=married; not married/living together, 2=not married/nor living together

3.2 Difference in fatigue severity

The first research question considered differences in fatigue severity in both patient groups, measured by the vitality scale of the SF-36 and was examined through an independent sample t-test. It was assumed that the osteoarthritis group would report higher levels of fatigue due to higher levels of disability. Table 3 shows the comparison between rheumatoid arthritis and osteoarthritis patients. On average the score of fatigue severity was 47.18 (9.85) for rheumatoid arthritis patients and 46.59 (9. 45) for osteoarthritis patients. The difference was not significant, $t(719) = .60$, $p>.05$. Therefore the first hypothesis of possible differences in experienced fatigue severity between both groups could not be confirmed. Additionally, both groups were compared for possible differences in the level of disability. The average score on the HAQ alternative disability index was .97 (.73) for the osteoarthritis group and .94 (.66) for the rheumatoid arthritis group. However, the difference was not significant, $t(737) = -.43$, $p>.05$. It has been criticized that t-tests can be unreliable when the compared groups have different sample sizes and can also influence the significance of a t-test (Gardner, 1975, Field, 2005). Therefore the effect size of the difference in fatigue severity between both groups was calculated (see Appendix). Nevertheless, the effect size was very small, $r=0.02$.

Table 3
Independent sample t-test comparing fatigue severity scores of the SF-36 for both groups

	Rheumatoid arthritis (N=602)		Osteoarthritis (N=119)			
Assessment	Mean	SD	Mean	SD	T-value	P-value
Fatigue Severity	47. 18	9.85	46.59	9.45	.60	.55
Disability	.94	.66	.97	.73	737	-.43

3.3 Hierarchical multivariate regression

A regression analysis was conducted to examine the relationship between the variables disability, pain, mental health and fatigue, which is described in the second research question. As estimated through correlation analysis four of the five demographic variables did correlate with fatigue. Therefore the demographic variables were entered as first step into the regression analysis, followed by the predictors in the second step. The demographic variables were entered first because they cannot be caused by fatigue and are therefore very stable (Wolfe et al., 1996).

3.3.1 Model with predictors and demographics for both diseases

As a first step all demographic variables were included. They explained 6 % of the variance in fatigue, ΔR^2=.06, F (5) = 7.97, p<.001. Because of the significant correlations between the demographic variables and fatigue, it had been estimated that gender and education would have significant effect. However, only age was related to fatigue, ß= .63, p<.05. In the second step, the three predictors were included into the model. All of them were significantly related to fatigue and accounted for 46% of the variance, ΔR^2=. 46, F (3) =197.19, p<.001. This was expected as other studies also reported high levels of variance when combining all three factors. The whole model was able to explain 53 % of the variance in fatigue, R^2=.53, F(8)=83.74, p<.001. All of the predictors had significant regression weights, indicating that higher scores on the vitality scale were related to higher (and healthier) levels of mental health, bodily pain and lower levels of disability. The regression coefficients indicate individual contributions of each independent variable in predicting fatigue. The most important predictor of fatigue in the model was mental health which was positively related to fatigue, ß = .43, p<.001. Disability, measured with the HAQ Disability Index, was significantly related to fatigue, ß = -.21, p<.001. Bodily pain, measured with the Bodily Pain Scale, was positively related to fatigue, ß = .26, p<.001. The results are reported in Table 4.

Table 4
Hierarchical Multivariate Regression Analysis with the Dependent Variable Fatigue Severity (N=615)

	Rheumatoid arthritis and osteoarthritis						
Step and variable	B	SE B	*ß*	t-value	p-value	Δ R^2	Δ*F*
Step 1						.06***	7.97
Gender	-.82	.63	-.04	-1.30	.19		
Age	.05	.67	.06	2.07	.04		
Duration of Illness	-.03	.02	-.03	-.97	.33		
Education	.12	.18	.02	.70	.48		
Marital Status	.41	.03	.02	.61	.54		
Step 2						.46***	197.19
Disability	-2.88	.51	-.21	-5.67	.000		
Bodily Pain	.28	.04	.26	7.25	.000		
Mental Health	.40	.03	.43	13.57	.000		
Total						.53***	83.74

Note. *p<.05, **p<.01, ***p<0.01.

3.3.2 Differences of predictors in both groups

For the third research question, possible differences of predictors between both groups, the data of the two groups has been analyzed separately.

3.3.2.1 Model for rheumatoid arthritis

The demographic variables accounted for 5 % of the variance, (R^2=.05, F(5) = 5.27, p<.001). Moreover, none of them had a significant effect. When the predictors were entered, the whole model explained 52 % of the variance (R^2= .52, F(8)= 68.12, p<.001) which was similar to the explained variance for both diseases. Again, all predictors were significant with mental health as the strongest predictor, ß=.45, p<.001.The results are summarized in Table 5.

Table 5
Hierarchical Multivariate Regression with Dependent Variable Fatigue Severity for Rheumatoid Arthritis (N=508)

Step and variable	B	SE	*ß*	t -value	p-value	Δ R^2	Δ F
Step 1						.5***	5.27
Age	.04	.02	.06	1.85	.07		
Duration of Illness	-.01	.03	-.01	-.39	.70		
Gender	-.66	.69	-.03	-.96	.34		
Education	.18	.20	.03	.94	.35		
Marital Status	.82	.75	.04	1.01	.28		
Step 2						.47***	164.29
Disability	-2.87	.55	-.21	-5.18	.000		
Bodily Pain	.26	.04	.24	6.03	.000		
Mental Health	.41	.03	.45	12.78	.000	.52***	68.12
Total							

Note. *p<.05, **p<.01, ***p<.001

3.3.2.2 Model for osteoarthritis

The demographic characteristics explained 17 % of the variance (R^2= .17, F (5) = 4.171, p<.001). When taken the predictors into account as well, all predictors correlated significantly and positively with the criterion. The whole model accounted for 58 % of the variance, R^2= .58, F(8)= 16.65, p<.001. This was considerably higher than in the model for both diseases were the variance was 53%. When looking at the predicting variables, bodily pain (ß=.36, p<.001) and mental health (ß= .35, p<.001) had stronger effects for predicting fatigue in the osteoarthritis group than disability. This was different from the other two models were mental health had been the strongest predictor of all three variables. The results are shown in Table 6.

Table 6
Hierarchical Multivariate Regression with Dependent Variable Fatigue Severity for Osteoarthritis (N=107)

Step and variable	B	SE	*β*	t-value	p-value	Δ R^2	ΔF
Step 1						.17***	4.17
Age	.07	.06	-.08	1.12	.27		
Duration of Ilness	-.06	.05	-.08	-1.10	.27		
Gender	-2.01	1.66	-.09	-1.26	.21		
Education	-.14	.43	-.02	-.33	.74		
Marital Status	-1.56	1.59	-.07	-1.04	.30		
Step 2						.41***	31.21
Disability	-2.94	1.31	-.21	-2.25	.03		
Pain	.45	.12	.35	4.12	.000		
Mental Health	.34	.08	.36	4.54	.000		
Total						.58***	16.65

Note. *p<.05, **p<.01, ***p<.001

As a result mental health, pain and disability were significantly related to fatigue, but the explained variance was higher in the osteoarthritis than in the rheumatoid arthritis group. It was expected that the three predictors would relate to fatigue in both diseases. However, the higher explained variance of the model for the osteoarthritis group was not anticipated.

4. Discussion

Fatigue was repeatedly stated in the literature as reducing the quality of life in rheumatoid arthritis and osteoarthritis patients. This study investigated a multivariate model to examine possible factors related to fatigue. The most common factors cited were pain, disability and mental health. The results showed that all three factors were significantly related to fatigue. Of all three, mental health seemed to be most important factor related to fatigue in the model

including both diseases and also in the model for rheumatoid arthritis. However, in osteoarthritis, mental health and pain were equally important.

4.1 Results of the analysis

4.1.1 Hypothesis 1: Osteoarthritis patients experience more fatigue than rheumatoid arthritis patients

The first hypothesis was not confirmed, because the two groups did not differ significantly qua fatigue severity. Other studies confirm this finding (Wolfe et al. 1996; Bergman et al. 2009) as well as disconfirm it (Stebbings & Treharne, 2010; Novaes et al. 2011). More important, Zautra (2007), using the vitality scale, did not find a significant difference between rheumatoid arthritis scores (33.5) and osteoarthritis scores (37.5).

Furthermore the difference of disability levels was tested and was non-significant as well. This is rather surprising because our sample contained individuals suffering from later stages of osteoarthritis. Interestingly, both groups reported lower fatigue and disability scores compared to other studies (see section 4.2). In the literature it was stated that osteoarthritis patients should experience more fatigue due to higher levels of disability (Stebbings & Treharne, 2010). However, contradictory findings by Wolfe et al. (1996) showed different levels of disability measured with the HAQ (1.38 for rheumatoid arthritis and 0.88 for osteoarthritis patients) but no significant difference in fatigue. Other studies did not find a relationship between inflammation and fatigue neither in osteoarthritis (Wolfe et al., 2004) nor in rheumatoid arthritis (Wolfe et al., 2004; Pollard, Choy, Gonzales, Khoshaba & Scott, 2005; Bergman et al., 2009). Instead, distress was identified by Wolfe et al. (2004) as the key factor for fatigue instead of physical illness. Our study confirms a body of research which found no evidence for differences in fatigue scores between both diseases. Even though this sample reported lower scores, still no significant difference was found. This means that fatigue severity is not influenced by special forms of rheumatism but is experienced similarly across diseases.

4.1.2 Hypothesis 2: Mental health, pain and disability are related to fatigue in both diseases

This hypothesis was supported as mental health, pain and disability were significantly associated with fatigue. Of the demographic variables only age was related to fatigue in multiple regression analysis even though the two variables did not correlate and no

multicollinearity was found. Interestingly, this means that fatigue severity levels were lower in older patients. The whole model explained 53 % of the variance of fatigue which falls into the range of findings of similar studies. For example, the explained variance in a study of Wolfe et al. (1996) was 52% with depression, pain and functional loss as most strongly related factors to fatigue. Other studies failed to report the explained variance of their models (for example, Stebbings et al., 2010).

In our study, mental health was most strongly related with fatigue in the model with both groups. Findings on this topic in other studies are mixed. Among the strongest predictors for fatigue similar for both illnesses were pain and the absence of positive affect (Zautra et al. 2007) and depression (Wolfe et al., 1996). Novaes et al. (2011) failed to include mental health in their research when comparing related factors in both disease groups.

However, a difficulty in the differentiation between fatigue and depression was stated in the literature (Stebbings & Treharne, 2010). For example diagnosing depression in rheumatoid arthritis is complicated because symptoms of rheumatoid arthritis (e.g. fatigue) and depression may overlap (Dickens & Creed, 2001). Moreover, Wolfe et al. (1996) criticized depression to be the only factor related to fatigue, because they found the relationship of pain and fatigue independent of depression. Furthermore, fatigue was present in depressed as well as in non-depressed participants (Wolfe et al., 1996). Nevertheless, the findings of our study indicate that fatigue is mainly related to psychological distress. This is confirmed by literature where depression and pain were reported as common shared factors for both diseases in predicting fatigue. Because both variables were self-reported measures, this indicates the importance of psychological distress in fatigue rather than physical illness.

4.1.3 Hypothesis 3: The three predictors are differently related to fatigue in rheumatoid arthritis and osteoarthritis

This hypothesis was partly confirmed. When comparing both groups, mental health was still the best predictor for the rheumatoid arthritis group whereas in osteoarthritis mental health and pain were the best predictors. The difference in related factors between illnesses is confirmed by other studies (Wolfe et al., 1996; Stebbings et al., 2010). However, both models show the importance of mental health. Moreover, disability was the weakest predictor related to fatigue in both groups suggesting that disability is subordinate in the explanation of fatigue. The model accounted for a higher variance in the osteoarthritis group. This has not been expected. One suggestion is that rheumatoid arthritis patients may experience other physical and psychosocial aspects which have not been measured. For example, rheumatoid

arthritis patients often suffer from other comorbidities as well, due to their older age. None of the demographic variables were significantly related for fatigue in both groups.

The explained variance for the rheumatoid arthritis group was 52 % thus similar to the one in the model with both diseases. In other studies investigating factors related to fatigue in rheumatoid arthritis, including similar related factors as in this study, explained variances of 49 % (Wolfe et al., 1996) and 61% (Belza et al., 1993) were found. A study by Pollard et al. (2005) used the modified version of the HAQ for disability and the SF-36 for fatigue and mental health. Interestingly, pain, disability, mental health and two other factors also accounted for 53% of the variance in fatigue.

The literature showed mixed results considering the most strongly related factor for fatigue in rheumatoid arthritis. Riemsma et al. (1998) found self-efficacy expectancy to be more importantly related to fatigue than depression and pain. Contrary findings are reported by Huyser et al. (1998) where the best model consisted of pain, depression and female sex. Finally, Pollard et al. (2005) found pain to be the most strongly related factor, followed by mental health. However, mental health was the only comorbidity invariably associated with fatigue. Additionally, Hewlett, Nicklin & Treharne (2008) stated in their review that fatigue was found to be higher in rheumatoid arthritis patients reporting a lifetime history of mood disorder (generalized anxiety or clinical depression).

In osteoarthritis, the whole model accounted for 58 % of the variance. Wolfe et al. (1996) found pain, tender point count and depression to account for 45% of the explained variance of fatigue in osteoarthritis. Mental health and pain were most strongly related to fatigue. Stebbings et al. (2010) found sleep disturbance, anxiety and a measure for change in bodily symptoms (CRP) to be the most strongly related factors. Novaes et al. (2011) found disability measured with the HAQ to be the factor most strongly related to fatigue. Interestingly, Murphy et al. (2008) found pain to increase with physical activity in osteoarthritis patients experiencing fatigue. This could confirm the importance of psychological distress stated by Wolfe et al (1996). It is noticeable, that 17 % of the variance was explained solely by demographic variables.

4.2 The sample and sample scores

The two groups of patients did not differ significantly qua demographic characteristics from each other except for gender. This is not surprising as women are three times more affected than men (Rupp et al., 2004). Because of that and the different sample sizes more women were present in the osteoarthritis group. A shortcoming of the sample were the different

sample sizes as a substantial greater amount of patients was diagnosed with rheumatoid arthritis. Studies used in the introduction used the same sample sizes or ones with minor differences, when comparing both disease groups (Wolfe et al., 1996, Zautra et. al, 2007, Novaes et al., 2011, Stebbings et al., 2010).

Scores of the SF-36 and the HAQ subscales were compared to other studies. Our sample reported less fatigue and substantially lower mental health scores compared to studies of Kosinski, Zhao, Dedhiya, Osterhaus & Ware (2000) and Zautra et al. (2007). However, pain scores were the same.

For disability the average scores were .94 for rheumatoid arthritis patients and .97 for osteoarthritis patients. In a study of Slatowsky-Christensen, Mowinkel, Loge & Kvien (2007) using a modified version of the HAQ, 1.07 was reported by healthy controls. Furthermore rheumatoid arthritis patients had an average score of 1.63, while osteoarthritis patients had an average score of 1.48. Nevertheless, all respondents were women and a Norwegian sample was used. Suurmeijer et al. (2001) found an average score of 1.0 in rheumatoid arthritis patients in the Dutch population using the complete HAQ. Therefore the sample for this study reported somewhat lower levels on disability.

Another important point concerning the sample were the reported years of the duration of the illness. 14 % reported one year of illness duration. This can have an influence on the results because functional limitations increase with disease duration (Uhlig, Kvien, Glennås, Smedstad & Førre 1998; Wolfe, Hawley & Cathey, 1991). For example, Uhlig et al. (1998) found that after 5 years, 40-50% of the rheumatoid arthritis participants showed clinically important changes in their health status. Moreover, Wolfe et al. (1991) found that anxiety increased with disease duration as well. However, the average duration of the illness is around 10 to 12 years which is consistent with other study samples.

4.3 Evaluation of Measurements

In this study, subscales of the HAQ and the SF-36 were used to measure the related factors as well as fatigue severity. For the vitality scale Stebbings & Treharne (2010) state in their review that direct comparisons between many chronic diseases (for example rheumatoid arthritis and osteoarthritis) are possible. Moreover in a review of Repping-Wuts et al. (2009) the vitality scale is stated as one of the six scales with evidence of reasonable validity when assessing fatigue in rheumatoid arthritis. On the other hand it was criticized that lack of vitality may conceptually not be a measure of fatigue. It is also possible to be neutral, meaning being neither full of pep nor fatigued (Hewlett et al., 2008). For our study this

means that we may have measured something different than fatigue. One suggestion could be that because the experiences of fatigue and depression are difficult to differentiate, this may have influenced the predicting effect of the mental health scale. This would mean that the predicting effect of mental health may be weaker.

The alternative disability index of the HAQ had one shortcoming when used to measure disability. The scores were not normally distributed, with a peak between zero and one. This so called floor effect was stated as a well-known problem of the HAQ and was found in other studies as well (Wolfe, 2001; Ten Klooster, Taal & Van De Laar, 2008). This effect results in lower sensitivity of the questionnaire meaning that patients reporting normal scores nonetheless experience functional limitations (Wolfe, 2001). However, Bruce & Fries (2003) considered it not as a problem but as the characterization of the disability status of the patient as it is defined by the questionnaire. Therefore, scoring zero does not exclude difficulties in other areas not covered by the HAQ. Additionally, it was stated by Talamo, Frater, Gallivan & Young (1997) that the HAQ as a health status measure is the one most commonly used in rheumatology. However, because of the low scores on the duration of the illness, the probability of low disability scores in the sample are possible.

4.4. Limitations and strenghts of this study

Several limitations in comparability between studies comparing fatigue related factors between musculoskeletal conditions are named by Stebbings & Treharne (2010).

For example, they criticized comparisons between studies to be inappropriate when different assessment tools are used. However, further in their review, they also pointed out that the SF-36 can be used for comparison between chronic conditions. Because direct comparisons between both diseases are rare (Stebbings et al., 2010) our study was only able to compare the fatigue scores to one other study using the vitality scale, namely Zautra et al. (2007). Nevertheless, most studies used the VAS scale among others to measure fatigue (Wolfe et al., 2004; Bergman et al., 2009; Novaes et al., 2011). Concerning the HAQ, it is used in several studies comparing rheumatoid arthritis to osteoarthritis (Wolfe et al., 1996; Wolfe et al., 2004; Stebbing et al., 2010; Novaes et al., 2011). Moreover, Wolfe (1991) found little differences between the HAQ and the HAQ-DI which leads to a better comparability between the literature and our study. However, only one study used the SF-36 for fatigue and mental health as well as the HAQ for disability to examine correlates in rheumatoid arthritis (see Pollard et al., 2005). Unfortunately, this setting could not be found for both diseases.

Another critical remark from Stebbings & Treharne (2010) concerned the disparity between correlates of fatigue between both diseases, making generalization to other studies inappropriate. Most of the studies used for comparison did include similar related factors, like depression, anxiety, pain, fatigue and disability (Wolfe et al., 1996; Zautra et al., 2007; Wolfe et al., 2004; Novaes et al., 2011; Stebbings et al., 2010).

Furthermore studies may also not be comparable due to different cultures. Most of the studies used contained samples from the USA whereas this study used a sample from the Netherlands. Moreover, causal relationships cannot be implied from the data because it is cross-sectional and mainly consists of self-reported measures. For example, self-reported fatigue scores may be unreliable due to influences of poorer mood in both disease groups (Hewlett et al., 2008).

In summary, the majority of the used literature shows consensuses with the findings of the current study. Because the HAQ and the SF-36 are comparable between illnesses and are widely used, findings can be compared to other studies using the same measures. However, findings should be compared carefully due to sample differences.

Further, various variables often related to fatigue were not included in our study. For example, environmental factors (like obesity or sleep disturbance) and psychosocial factors (like social support and self-efficacy) which were found significantly related to fatigue (Riemsma et al., 1998, Wolfe et al., 1996, Murphy et al., 2008, Stebbings et al., 2010) were missing. All these factors contribute to fatigue on a personal level which would have covered all domains of the theoretical model by Hewlett et al. (2011).

Another limitation of this study was that correlations between both diseases were not compared to each other. Finally, the sample included more women than men.

4.5 Suggestions for further research

A clarification on the relationship and interactions between related factors of fatigue and fatigue itself is needed. Even though important relations in various studies were found between pain, mental health, disability and fatigue, the direction of causality between the concepts is poorly understood (Dickens & Creed, 2001). Moreover, research needs to focus more on men (Hewlett et al., 2008) because fatigue may be experienced differently across genders. Our study did not include comparisons between genders. Moreover, our study could be improved by several factors. One suggestion is assessing fatigue multidimensionally. Additionally, the sample sizes need to be more even, depending on the number of participants as well as on gender. Moreover, longitudinal and objective measures of pain and disability

need to be included as well to make statements more reliable. For example, one important factor that may have influenced the results was the therapy received by patients.

4.6 Conclusion

This study showed strong relations between mental health, pain, disability and fatigue in two forms of arthritis. It makes a contribution to the understanding of factors related to fatigue between rheumatoid arthritis and osteoarthritis. Comparisons between both diseases are rare, even though they share the same symptoms (like fatigue). Moreover, as stated by Wolfe (2004) little interest has been shown towards psychological distress in osteoarthritis patients. This study was able to explain over 50% of the variance in the concept which is high compared to other studies. Even though the differences of the sample sizes were quite high between both groups the demographics were very similar, allowing for a good comparability between groups. Fatigue levels and the significance of the related factors of both groups did not differ much from each other. Differences were found for the strongest predictor. However, mental health seemed to be important in all three models. Moreover, all three models shared disability as the weakest predictor. This means that patients in both disease groups may experience fatigue in a similar way because disease specific symptoms (like pain and disability) seem to play a subordinate role in the explanation of fatigue. This is also confirmed by the fact, that no difference in fatigue levels was found. Nevertheless, no generalizations and causal relationships can be made from this study. Further longitudinal research is needed as well as different interventions applied to different related factors of fatigue to test their influences on the concept (Hewlett et al., 2011).

Appendix

Calculating effect size from t-test output (Field, 2009).

$$r = \frac{t^2}{\sqrt{t^2 + df}} = \frac{.0183}{\sqrt{737,18}} = 0.02$$

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