RESEARCH



Symptom Clusters, Functional Status, and Quality of Life in Older Adults With Osteoarthritis

Jeanne B. Jenkins **v** Thomas P. McCoy

BACKGROUND: One in two people may develop symptomatic knee osteoarthritis (OA) in their lifetime. Many OA sufferers have multiple symptoms, including pain, fatigue, and depressive symptoms. Determining whether symptom clusters exist among these older adults and what their effects are on outcomes such as quality of life (QOL) and functional status is essential to provide evidence-based geriatric healthcare. **PURPOSE:** The purposes of the secondary analyses were to explore symptoms that form clusters in older adults with OA of the knee and the effects of symptom clusters on their QOL and functional status.

METHOD: A cross-sectional, methodological exploration of existing data from a convenience sample (N = 75) of adults aged 50 years and older with OA of the knee was used. Hierarchical and *k*-means cluster analyses were used to identify symptom clusters. MANOVA was performed to test for joint differences in QOL and functional status. **RESULTS:** Two large clusters of pain, fatigue, and depressive symptoms were identified from the cluster, and significant relationships were found between symptom clusters and both QOL (p = .008) and functional status (p < .001). Conclusions about QOL or functional status differences were similar for alternative clustering strategies or numbers of symptom clusters in sensitivity analyses.

CONCLUSION: The findings of this study provide a foundation for targeted interventions to improve QOL and functional status of older adults with OA of the knee.

rthritis is the single greatest cause of chronic pain and functional disabilities among older adults over age 65 years in the United States (Centers for Disease Control and Prevention, 2009[,] 2010). The number of arthritis sufferers is expected to grow to 67 million by 2030 (U.S. Department of Health and Human Services [US DHHS], 2008). According to the Centers for Disease Control and Prevention (US DHHS), arthritis now accounts for \$81 billion in medical costs (in 2003 dollars), and it is the reason for 750,000 hospitalizations and 36 million visits to healthcare providers each year. While arthritis seldom results in death, this common medical condition may substantially affect older adults' physical and psychological well-being and, ultimately, their quality of life (Ethgen, Bruyere, Richy, Dardennes, & Reginster, 2004; Farquhar, 1995).

Osteoarthritis (OA), the most common form of arthritis, affects nearly 27 million Americans and is expected to increase dramatically as the U.S. population ages (Ethgen et al., 2004; Gignac et al., 2006; Luggen, 2001). Many OA sufferers have multiple concurrent symptoms, such as pain, fatigue, and depressive symptoms. Research to date has focused primarily on single symptoms of OA, such as pain or functional status, but this approach is limited in its utility for guiding clinical practice with older adults who present with multiple symptoms. Therefore, it is important to evaluate multiple symptoms that exist concurrently in older adults with OA. The purpose of this secondary analysis was to explore the existence of symptoms that form meaningful clusters on the quality of life and functional status among older adults with OA of the knee. The specific aims of this study were to (a) identify symptoms that cluster in older adults with OA of the knee and (b) explore the effects of symptom clusters on quality of life and functional status of older adults with OA.

Background

Osteoarthritis now accounts for 55% of all arthritisrelated hospitalizations (McIlvane, 2007; US DHHS, 2008). Currently in the United States, 37.2 million Whites, 4.6 million Blacks, and 3.1 million Hispanic adults are living with OA (Lawrence et al., 2008; US DHHS). As the prevalence of OA increases, limitations to physical function also tend to increase (Appelt,

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Jeanne B. Jenkins, PhD, MBA, RN, Assistant Professor, School of Nursing, The University of North Carolina at Greensboro.

Thomas P. McCoy, Visiting Assistant Professor, School of Nursing, Department of Educational Research Methodology, The University of North Carolina at Greensboro.

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Burant, Siminoff, Kwoh, & Ibrahim, 2007; Quintana et al., 2008). Osteoarthritis of the knee is the most significant source of pain in older adults and is one of the five leading causes of disability among this group of older adults (US DHHS). Eighty percent of individuals with OA have some degree of limitation in physical function, and 25% cannot perform activities of daily living such as climbing stairs, bending, dressing, or bathing (Institute of Arthritis & Musculoskeletal & Skin Diseases, n.d.; US DHHS). Osteoarthritis may result not only in changes in physical function but also in symptoms, including pain, fatigue, and depressive symptoms, and poorer quality of life (Groessl, Kaplan, & Cronan, 2003). Disease progression may lead to social isolation, a sense of hopelessness, and loss of control (Kee, 2003). Worsening symptoms may affect individuals' quality of life and their ability to remain independent.

QUALITY OF LIFE

Quality of life is an important concept and it has particular significance for older adults with chronic disease such as arthritis. The *Healthy People 2010* initiatives (US DHHS, n.d.) focused on preventing disability related to chronic diseases such as arthritis. More recently, *Healthy People 2020* (US DHHS) updated its focus to health-related quality of life and well-being of individuals in the United States who are suffering from chronic disease. This study closely aligns with this foundation health measure aimed at improving quality of life.

Enhancing quality of life in older adults with physical limitations is a significant challenge for healthcare providers (Levasseur, Desrosiers, & Tribble, 2008). One of the first steps to improving quality of life in older adults with OA is developing a better understanding of the set of factors that coexist and influence quality of life. In an earlier study, Farquhar (1995) found that among individuals aged 65 years and older, a poor quality of life was related to increased functional limitations, dependency, and decreased social contacts. These findings are consistent with more recent research (Bowling, Banister, Sutton, Evans, & Windsor, 2002; Gabriel & Bowling, 2004) which indicated that social relationships and good health were among the top criteria for quality of life in adults aged 65 years and older. Gabriel and Bowling also interviewed adults aged 65 years and older (N = 80) and identified several quality-of-life themes: (a) good social relationships, (b) having good health and mobility, (c) having a positive psychological outlook and acceptance of circumstances that cannot be changed, and (d) retaining independence and control over life.

FUNCTIONAL STATUS

Functional status reflects the individual's ability to perform activities of daily living, fulfill usual roles, and maintain health and well-being (Bennett, Stewart, Kayser-Jones, & Glaser, 2002; Leidy, 1994). Functional status includes four dimensions: functional capacity, functional performance, functional reserve, and functional capacity utilization (Leidy, 1994). Multiple factors, including pain and fatigue, may influence an individual's functional status. For example, Kee (2003) found that pain and social support significantly influenced the psychological status and physical function of older adults with OA. Furthermore, in a cross-sectional study of community-dwelling older adults, Bennett et al. (2002) reported that pain and fatigue resulted from conditions such as arthritis and were strongly associated with decreased physical, role, and social functioning. Also, pain and fatigue were mediators between the medical conditions and physical function. Other reports note that limitations to physical function are associated with poor quality of life in older adults with OA (Ackerman, Graves, Wicks, Bennell, & Osborne, 2005; Jakobsson & Hallberg, 2006) and higher psychological distress (Ackerman et al., 2005; Theis, Helmick, & Hootman, 2007).

SYMPTOM: PAIN

Osteoarthritis pain is common among older adults and results in functional limitations, which influence their quality of life (Blixen & Kippes, 1999; Creamer, Lethbridge-Cejku, & Hochberg, 2000; Jakobsson & Hallberg, 2006; Yoon & Doherty, 2008). Nearly 41% of adults aged 65 years and older report hip or knee pain (Dawson et al., 2004). Dominick, Ahern, Gold, and Heller (2004) found that individuals with OA reported 3.7 more days of pain than a population control group without OA, and the majority of older adults who reported musculoskeletal pain (68%; N = 887) were three times more likely than a control group to have functional limitations (Scudds & Robertson, 1998).

Persistent, uncontrolled pain can have enormous consequences for quality of life. Older adults who have persistent pain may become anxious about the pain and engage in avoidance behaviors due to fear of pain (Vlaeyen & Linton, 2000). These avoidance behaviors may lead to decreased physical function and poorer quality of life for older adults. The consequences of persistent pain among older adults include depression (Creamer, Lethbridge-Cejku, & Hochberg, 1999; Dickens, McGowan, Clark-Carter, & Creed, 2002), fatigue (Bennett et al., 2002; Creamer et al., 1999), social isolation (Ashida & Heaney, 2008), a sense of helplessness (Creamer et al., 1999, 2000), and limitations in performing daily activities (American Geriatric Society Panel on Persistent Pain in Older Persons, 2002). Persistent pain that is poorly controlled has been found to negatively affect quality of life in individuals with chronic diseases such as OA (Chen, Devine, Dick, Dhaliwal, & Prince, 2003; Jakobsson & Hallberg, 2006). Pain is a related symptom of OA and may result in poor outcomes, including decreased functional status and quality of life.

SYMPTOM: FATIGUE

Fatigue in older adults with OA is not routinely evaluated in clinical assessments, and older adults generally do not discuss fatigue with their healthcare providers (Power, Badley, French, Wall, & Hawker, 2008). The relationship of fatigue to pain in older adults with OA has not been well studied (Murphy, Smith, Clauw, & Alexander, 2008; Wolfe, Hawley, & Wilson, 1996),

although some research has shown that older adults with OA describe fatigue as affecting physical function and ability to perform daily activities (Power et al., 2008). Bennett and colleagues (2002) report that pain and fatigue resulting from conditions such as OA were strongly associated with lower levels of physical, role, and social functioning. Murphy et al. (2008) examined daily life patterns of pain and fatigue among women aged 55 years and older with OA and an age-matched control group of healthy women. Researchers state that fatigue escalated throughout the day for the OA group, and it was strongly associated with physical activity ($\beta = -30.1$, p = .04). Thus, older adults with fatigue may avoid or require assistance with certain activities and this may negatively impact their quality of life.

SYMPTOM: DEPRESSIVE SYMPTOMS

Individuals with arthritis may also have a higher prevalence of depressive symptoms than those without arthritis (Dickens et al., 2002). An early review of research by Blixen and Kippes (1999) concluded that pain and disability were the most significant predictors of depressive symptoms among individuals with arthritis. More recently, Sale, Gignac, and Hawker (2008) reported that arthritis severity accounted for up to 38.5% of the variance in depression of older adults with OA. According to 2002 National Health Survey 2 data, one in four adults with arthritis reports frequent depression (Shih, Hootman, Strine, Chapman, & Brady, 2006). However, depressive symptoms often go undetected by healthcare professionals, resulting in poorer quality of life.

SYMPTOM CLUSTERS

For many, managing the symptoms of OA is a particular challenge. Identifying symptom clusters, that is, groups of more than two symptoms that occur concurrently (Dodd, Miaskowski, & Paul, 2001; Kim, McGuire, Tulman, & Barsevick, 2005), in older adults with OA will lay the ground work for interventions and future research. For example, in older adults with OA, pain may be caused by the disease, limited physical function may result from the pain, fatigue may be caused by both pain and limited physical function, and depressive symptoms may be due to limited physical function and loss of independence. These may be a cycle of ongoing and unrelieved symptoms that result in a decreased quality of life for the older adult (Dodd, Janson, et al., 2001; Kim et al., 2005). Developing interventions that account for symptom clustering may benefit patients more than the traditional clinical approach to treatment (Jakobsson & Hallberg, 2006; Miaskowski, Dodd, & Lee, 2004). Linking the symptom cluster to outcomes will provide a basis for targeted interventions to improve quality of life and physical function.

The concept of symptom clusters is useful in assessing the effects of multiple symptoms in older adults with chronic conditions. A symptom cluster has been defined as a group of more than two symptoms that occur together, concurrently, and are related but do not necessarily have the same etiology (Dodd, Miaskowski, et al., 2001; Kim et al., 2005). Cancer researchers have used symptom cluster analysis to examine the impact of concurrent symptoms such as fatigue, pain, and depression on individuals' quality of life and function and to develop interventions to improve symptom management (Dodd, Janson, et al., 2001; Jurgens et al., 2009; Ryu et al., 2010). More recently, symptom cluster research has been used with patients with heart failure to identify those at higher risk for poor outcomes (Jurgens et al., 2009). In both of these populations, symptom cluster methods have been found to be useful in assessing the effects of multiple occurring symptoms on patient outcomes such as quality of life and functional status (Miaskowski, Dodd, and Lee, 2004; Ryu et al., 2010).

The model of symptom management (Dodd, Janson, et al., 2001; Larson et al., 1994) was used to guide the study. This model has three dimensions: (1) symptom experience, (2) symptom management strategies, and (3) outcomes. The three dimensions are interrelated and symptom management is a dynamic process. Furthermore, all dimensions may be influenced by variables such as the person, environment, and health and illness (Dodd, Janson, et al., 2001). This framework has been used in research focused on symptom clusters in patients with cancer (Dodd, Miaskowski, et al., 2001).

Research Design

This study was a cross-sectional, methodological exploration of existing data among older adults with OA of the knee. Existing data were collected for the original study via convenience sampling design. Inclusion criteria for the original study were (a) scheduled first-time joint replacement surgery, (b) age at least 50 years or older, (c) ability to speak and understand English, and (d) medical diagnosis of osteoarthritis of the knee. Exclusion criteria were a medically documented diagnosis of dementia or other cognitive impairment.

The 32-item Quality of Life Index-Arthritis Version III (Ferrans & Powers, 1985) was used to measure quality of life in four domains: health and functioning, psychological/spiritual, social and economic, and family. Individuals are asked to rate the degree to which they are satisfied with a certain aspect of their life on a 6-point Likert scale, ranging from 1 (*very dissatisfied*) to 6 (*very satisfied*). Individuals are also asked to rate the importance of that aspect on a 6-point Likert scale, ranging from 1 (*very unimportant*) to 6 (*very important*). Satisfaction scores are recoded and weighted according to the individual's importance score to calculate an overall quality-of-life score, which may range from 0 to 30. Higher scores indicate better quality of life.

The Western Ontario McMaster University Osteoarthritis Index (WOMACTM)–physical function subscale was used to measure functional status. The WOMACTM index, which is widely used (Hamel, Toth, Legedza, & Rosen, 2008; Lingard, Sledge, & Learmonth, 2006; Salaffi, Carotti, & Grassi, 2005) to assess disability (functional status) related to OA of the hip and knee, has three subscales: pain, stiffness, and physical function. Participants respond to the items on a 5-point Likert scale. Physical Function subscale scores range from 0 to 68, with higher scores indicating higher disability.

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Pain and fatigue were measured using two numeric rating scales with scores from 0 (no pain/fatigue) to 10 (extreme pain/fatigue). Depressive symptoms were measured using the Geriatric Depression Scale Short Form (GDS-SF15), which consists of 15 items to which the participants were asked to respond yes or no. Total scores of 0-4 are considered normal, 5-8 indicate mild depression, 9-11 indicate moderate depression, and 12-15 indicate severe depression (Kurlowicz & Greenberg, 2007; Sheikh & Yesavage, 1986). The GDS-SF15 has been used extensively with communitydwelling older adults (Belza, Henke, Yelin, Epstein, & Gilliss, 1993; Crane, 2005) and has demonstrated good validity and reliability in both research and clinical practice, with 92% sensitivity and 89% specificity (Kurlowicz & Greenberg, 2007).

STATISTICAL METHODS

Hierarchical and *k*-means cluster analysis were performed to cluster patients into symptom clusters. On the basis of an *a priori* power analysis, it was determined that four groups with 15 subjects each would be sufficient to detect an effect size of 0.20 with 80% power at the 5% significance level. Symptom clusters were subjected to a principal components analysis (Polit, 2010) to explore if clusters formed reasonable and wellseparated groups (Rencher, 2002). A two-symptom cluster solution was selected on the basis of interpretability and separation of clusters.

Quality of life using QLI and functional status using the WOMACTM functional status scores were tested jointly for any differences in mean scores among the two clusters using MANOVA followed by individual ANOVAs (Polit, 2010). *Post hoc* multiple comparisons were carried out using Tukey's HSD or Tamhane's method (if variances were unequal). Reliability via internal consistency was estimated using Cronbach's alpha. Analyses were performed in Stata v11.2 (StataCorp, College Station, TX) and SAS v9.2 (SAS Institute, Cary, NC). A two-sided p value <.05 was considered statistically significant.

Results

The study consisted of 75 older adults who were planning first-time total knee replacement surgery for OA of the knee. The ages of the sample ranged from 52 to 86 years, with a mean age of 69 (SD = 8.179) years. Participants were mostly female (76%), White (67%), and married (73%), and approximately one-third reported an annual household income greater than \$71,000. On average, the older adults rated their pain as 5.15 (\pm 2.38) and fatigue as 5.17 (\pm 2.48) on 10-point scales, and their depressive symptom score as 2.43 (\pm 2.18). The mean functional status score for the sample was 32.40 (\pm 10.89) and overall quality-of-life score was 23.14 (\pm 3.58).

PRINCIPAL COMPONENTS ANALYSIS

The first two components accounted for 81.8% of the variation in symptom measures. Principal component 1 was interpreted as an "average score of all 3 symptoms" since it loaded approximately equally on all the measures, while principal component 2 was interpreted as "contrast of high depressive symptoms and low pain," since the loading for GDS-SF depressive symptoms was high and positive while the loading for pain was low and negative.

CLUSTER ANALYSIS

In Figure 1, the dendrogram for the cluster analysis shows how each participant was initially joined to



FIGURE 1. Dendrogram of symptom clusters.

various clusters. A two-symptom clusters solution separated well on the two principal component scores, because there was no overlap in the range of component scores between the two symptom clusters on either component dimension (average score or contrast of high depressive symptoms with low pain). Overall, higher depression paired with higher fatigue or pain and vice versa.

DIFFERENCES IN QUALITY OF LIFE AND FUNCTIONAL STATUS BY SYMPTOM CLUSTERS

There were significant mean differences in both qualityof-life scores and WOMAC[™] functional status scores based on the two symptom clusters in MANOVA (Wilks' lambda F = 14.012, p < .001). Symptom cluster 1 was characterized by relatively lower QLI quality-of-life scores and higher WOMAC[™] function status subscale scores (which indicate lower functional status). Symptom cluster 2 was characterized by relatively higher quality-of-life scores and lower WOMACTM function status subscale scores (indicating higher functional status). Significant differences were then separately explored for the quality-of-life scores and WOMACTM functional scores using ANOVA. There were significant mean differences in quality-of-life scores based on the two symptom clusters from ANOVA (F = 7.38, p =.0082), where symptom cluster 1 had significantly lower mean QLI scores relative to symptom cluster 2. There were also significant mean differences in WOMACTM functional status scores based on cluster membership (F = 25.44, p < .0001), where symptom cluster 1 had significantly higher mean WOMACTM functional status scores relative to symptom cluster 2 (see Figure 2).

Clinical Implications

Inconsistencies in the management of symptoms related to OA of the knee can be one of the greatest obstacles to older adults' functioning and quality of life. This study is one of the first to examine the prevalence of symptom clusters and their effects on quality of life and functional status in older adults with OA of the knee. Among this sample, older adults with OA of the knee clustered into two groups based on their average scores of pain, fatigue, and depressive symptoms, and significant differences in functional status and quality of life were found between the symptom clusters. As expected, the symptom cluster of individuals that exhibited higher pain or fatigue were significantly associated with lower quality of life and worse functional status scores.

The findings provide useful information for nurses in clinical practice by recognizing that pain is not the only symptom present that influences quality of life and functional status among older adults with OA of the knee. This exploratory research provides initial insights into the effects of symptom clusters on outcomes such as functional status and overall quality of life among older adults with OA. Nurses and other healthcare providers should expand their assessments to include multiple symptoms and functional disabilities. Assessing pain alone may not capture the entire symptom experience of older adults with OA of the knee. Further research is warranted to examine symptom clusters more closely to determine consistency of the clusters. In addition, studies are needed that focus on symptom management and multimodal approaches to care of older adults with OA of the knee since pain may not be the only symptom present.



FIGURE 2. Scatter plot of Quality of Life (higher scores indicate greater QOL) and Functional Status (higher scores indicate lower status) by the two identified clusters.

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Limitations

Limitations to this study are related to the use of an existing data set where data were collected through a convenience sample. The smaller sample size could possibly limit the generalizability of the study findings. In addition, the predefined measurements limited the focus to only three symptoms-pain, fatigue, and depressive symptoms. There may be other symptoms that need to be considered. Despite these limitations, the findings provide a foundation for further evaluating symptom clusters and determining whether the clusters vary over time or along disease and treatment trajectory and what their possible synergistic effects are on older adults' quality of life (Rutledge, Moutlapa, & Wood, 2009). Symptom cluster identification can also serve as the basis for tailored interventions for OA of the knee in older adults to improve quality of life and reduce healthcare utilization and associated costs.

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