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Colorectal Cancer-Related Health Worries and Functional Limitations among Older Adult, Long-Term Cancer Survivors

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AbstractCancer and aging are associated with functional limitations; however, the reasons for these limitations are unknown. The purpose of this study was to examine potential reasons of functional limitations among older long-term colorectal cancer survivors using a newly developed assessment tool, the Physical Function Perception Scale (PFPS).The particular reasons for functional limitations are currently unknown for older long-term colorectal cancer survivors. To provide the best preventative and rehabilitative care, however, it is necessary to understand these reasons. Therefore, the ability to identify modifiable reasons (e.g., pain, balance problems, fatigue) of functional limitations could have important implications for improving long-term outcomes in older cancer survivors (Bennett et al., 2002; Leville et al, 2004; Whitson et al, 2009). Although a number of valid assessment tools are available, a valid self-report assessment tool that allows individuals to identify the reasons for their functional limitations is currently not available.

Keywords: Colorectal Cancer, Functional Limitations, Older Adult, Long-Term Cancer Survivors,

Introduction

The older adult population is growing significantly in the world and clearly represents the fastest growing segment of the world's population Bennett et al., 2002; Fielding et al., 2011; Manini, 2011; Sweeney et al., 2006). The Administration on Aging (2008) suggests that by 2030 older adults will be 19.3% of the United States population. It has also been suggested that the number of older adults will double to over 80 million, or to greater than 20% of the United States population by the year 2050 (Manini, 2011).

Cancer is a common health issue among older adults, with over 50% of all cancers occurring in individuals older than 65 years of age (Deimling et al., 2005; Deimling et al., 2007; Hewitt et al., 2003). With the increasing older adult population, some estimate that cancer rates will double in the next forty years (Deimling et al., 2005; Edwards et al., 2002; Hewitt et al., 2003). A recent report suggests that the number of cancer cases will increase by more than 20% in the next ten years due to the increasing number of older adults (Weir et al., 2015). Research indicates that cancer-related health problems can persist for decades among cancer survivors (Deimling et al., 2005), and as the number of survivors and their length of survival expand, long-term health issues specific to this population are emerging as a public health concern (Demark-Wahnefried et al., 2005). Among these health issues is a decline in physical function (Deimling et al, 2005).

Physical function is an important measure of health as well as disability among older adults. Although aging is associated with deficits in physical functioning, chronic and complex health issues can also lead to declines in physical functioning (Manini & Pahor, 2009). Functional limitations often reduce older adults' ability to live independently and can increase the risk for additional physical limitations and health problems, as well as increase disability. Functional limitations also have an effect on life expectancy (Keeler et al., 2010; Paterson & Warburton, 2010; Sweeney et al., 2006). In addition, older adults with limitations may experience a reduced quality of life, and research indicates that older adults consider functional independence to be of greater concern than prevention of disease (Paterson and Warburton, 2010).

Functional limitations were also reported among recent and long-term cancer survivors compared to individuals without a history of cancer by Ness et al. (2006). In this study examining various cancers, 54.4% of recent survivors and 52.7% of long-term survivors self- reported functional limitations compared to 21.2% of individuals without a history of cancer. Activities that required sustained muscle activity, such as walking one-quarter mile, or large whole body movements, such as lifting and carrying objects, were the most common limitation among both groups of cancer survivors. The recent cancer survivors were 1.8 times more likely to report functional limitations and the long-term cancer survivors were 1.5 times more likely than those with no history of cancer. Over half of the cancer

survivors reported at least one limitation in physical functioning.

Physical functioning over time in cancer survivors was also examined by Schroevers et al. (2006). Participants in this study were asked about physical functioning three months, fifteen months, and eight years after diagnosis. The cancer survivors reported a significant decrease in physical functioning between three and fifteen months. At fifteen months following diagnosis, there were no significant differences in physical function between the cancer survivors and an age-matched control group of individuals not diagnosed with cancer. Interestingly, however, while both the cancer survivors and controls reported an increase in functional limitations at the eight-year follow-up, the cancer survivors reported a significantly greater increase.

Only a small number of studies have examined whether the cancer site impacts physical functioning differently (Kurtz et al., 1997; Sweeney et al., 2006). Sweeney et al. concluded that functional limitations among older women cancer survivors did not differ based on cancer site. The participants in this study were short and long-term survivors and reported a wide variety of cancer sites. In contrast, significant differences in physical functioning according to cancer site were reported by Kurtz et al. (1997). Older adults, both men and women, with lung cancer reported greater limitations than older adults with other types of cancer.

Colorectal cancer is one of the most common types of cancer among older adults (Arem et al., 2014; Courneya et al., 2003; Haggar & Boushey, 2009; National Cancer Institute, 2017; Ramsey et al., 2002). According to Haggar & Boushey, the likelihood of colorectal cancer diagnosis increases progressively after the age of 40, and increases sharply after the age of 50. More than 90% of colorectal cancer cases occur in people aged 50 years or older and the incidence rate is more than 50 times higher in persons aged 60-79 years than in those younger than 40 years. According to the National Cancer Institute (2017), colorectal cancer is more common in men than women. Fortunately, however, the survival rate for colorectal cancer is quite favorable (Courneya et al., 2003; Haggar & Boushey, 2009).

Little research has directly examined physical function among colorectal cancer survivors. Trentham-Dietz et al. (2003) reported that the physical function of older female long-term colorectal cancer survivors was comparable to that of published age-specific norms for the general population. Age and BMI, however, appeared to influence physical function. Female colorectal cancer survivors who were older and had a high BMI were found to have lower physical function/more functional limitations than younger colorectal cancer survivors and those with low BMI. Schootman et al. (2009) also reported that long-term colorectal cancer survivors did not have significant differences in lower body functional limitations compared to non-cancer controls. Sanchez-Jimenez et al. (2015), on the other hand, did find significantly lower functional performance (walk test, chair sit and reach test, balance test) among colorectal cancer survivors compared to non-cancer controls. Kurtz et al. (2007) compared physical functioning of colorectal cancer survivors to breast and prostate cancer survivors. Although the colorectal cancer survivors tended to have more functional limitations than the breast and prostate cancer survivors, the differences were not significant.

Public Health Implications of an Increasing Older Adult Population

There are important public health implications of the aging population, including the increased economic burden of chronic health conditions and the cost to society. Health care expenditures, older adult health care, and older adults' quality of life will certainly be affected by this growing population (King and Guralnik, 2010). Although a number of statistics have been reported, studies consistently cite figures showing that older adults account for a much greater percentage of healthcare expenditures than any other age groups. Dunlop et al. (2002) stated that older adults account for more than one-third of health care expenditures even though they represent approximately one-eighth of the United States population. In addition, research suggests that older adults with functional limitations who need assistance with activities of daily living, account for nearly half of all healthcare expenditures (Fried et al., 2001; Jindai et al., 2016; Manini and Pahor, 2009). Manini (2011) suggests that the health care costs associated with older age are expected to increase approximately 2% per year, causing an economic burden for both older adults as well as for public health.

Gender Differences in Functional Limitations

Although research has identified gender differences in chronic health problems, less research has examined differences in functional limitations between men and women (Naumann

Murtagh & Hubert, 2004). Several studies, however, suggest that women self-report greater functional limitations than men (Friedmann et al., 2001; Holmes et al., 2009; Liang et al., 2008; Merrill et al., 1997; Naumann Murtagh & Hubert, 2004, Wilson-Genderson & Pruchno, 2015).

In order to examine whether older men and women differ in functional limitations, Naumann Murtagh and Hubert (2004) examined self-reported demographic and health data from over 1300 older adults. Their results indicated that older women self-reported significantly more functional limitations than men and speculated the differences were probably due to women's greater prevalence of disabling conditions. Merrill et al. (1997) also stated that older women reported more functional limitations than older men, likely due to the greater prevalence of disabling and chronic conditions, including arthritis. Similarly, Liang et al. (2008) found that older women have a higher level of functional limitations than men due to higher rates of comorbidity and chronic health problems. Functional limitations were assessed every two years and results indicated the women not only had a higher level of functional limitations than men, but they also experienced a faster decline in functional status over a period of 8-11 years. Liang et al. explained that the women experienced a faster decline in functional status over time due to higher rates of comorbidity and disease diagnosis. Friedmann et al. (2001) examined the relationship between functional limitations and BMI among older men and women. The women reported more functional limitations across all BMI categories (e.g., normal weight, overweight, obese, morbidity obese), and the men and women with the greatest BMIs (>40) had significantly increased risk of functional limitations.

Data from the National Health Interview Survey also indicated that older women were more likely than older men to have one or more functional limitations (Holmes et al., 2009; Newman & Brach, 2001). This research also indicated that the differences between men and women widen with increasing age. Between the ages 65-74 yrs, 31% of the older women and 24% of the older men reported functional limitations. Between the ages 75-84 yrs, 46% of older women and 37% reported functional limitations. Finally, for older adults 85 years of age and older, 66% of the women and 50% of the men reported functional limitations.

Currently, it is unclear why there are differences between men and women but a number of explanations have been considered. The first hypothesis is that women may actually experience more disabling conditions and are truly more functionally impaired than men (Naumann Murtagh and Hubert, 2004; Friedmann et al., 2001). Rohlfsen & Jacobs Kronenfeld (2014) suggest that societal reasons may explain why women report greater functional limitations. Women are more likely than men to have lower levels of education and income, be unemployed or work part time, and are less physically active during all stages of life. It has also been suggested that women are conditioned by society to be more willing to report physical difficulties and functional limitations (Friedmann et al., 2001). In order to examine gender differences in the comparison of self-report to performance-based measures, Merrill et al. (1997) asked older men and women to complete both self-report and performance-based measures of functional limitations. Significantly more women than men reported functional limitations. The women also performed more poorly than the men did on the performance-based measures. Analyses further indicated that while both older adult men and women over- and underreported functional limitations, more women over-reported and more men underreported these limitations (Merrill et al., 1997).

Measurement of Functional Limitations

There has been considerable progress in the development of assessment tools to measure functional limitations in older adults (Gill, 2010). Functional limitations are useful to assess because they are often a strong predictor of disability, nursing home admissions, and even death (Centers for Disease Control and Prevention, 2003; Nikolova et al., 2011). Functional limitations are also a major factor in the overall health status of older adults (Cress et al., 1995; Gill, 2010). There have been, however, differences in the terminology used in this area (e.g., functional limitations, physical function, activities of daily living, activity limitations, disability), conceptual models used as the basis for the assessment of functional limitations (e.g., Nagi's Model of Disablement; the World Health Organization's International Classification of Functioning, Disability and Health Model, the Sociomedical Model of Disability), as well as how functional limitations are measured (e.g., self-reported difficulty performing a specific task, questionnaires, performance-based testing). For the purpose of this study, the focus is on the assessment of functional limitations which are defined as alterations/limitations in the performance of functional tasks (e.g., getting up

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out of a chair or bed, carrying groceries) (Bean et al., 2011). Functional limitations represent an interim state between impairment and disability (Nagi, 1991), and can be useful in identifying older adults at risk for disability. Also, functional limitations have been shown to be amenable to interventions (Jette, 2009; Verbrugge & Jette, 1994).

Functional limitations have been measured with both self-report measures and objective, or performance-based, assessment tools. A summary of some of these assessment tools appears in Table 1.

Table 1
Measures of Functional Limitations

Self-Report Assessment Tools
Medical Outcomes Study Short-Form Health Survey (SF-36)
Late-Life Function and Disability Instrument (LLFDI)
Patient-Reported Outcomes Measurement Information System (PROMIS)
Functional Difficulty Index
Disability Scale
Rosow-Breslau Health Scale
Functional Performance Inventory
Karnofsky Performance Score
Objective, Performance-Based Assessment Tools
The Short Physical Performance Battery (SPPB)
Continuous Scale-Physical Functional Performance test (CS-PFP)
Physical Performance Test
Health ABC Performance Battery
Various physical tasks

Self-Report Measures of Functional Limitations

The Medical Outcomes Study Short-Form Health Survey (SF-36) is a commonly used assessment tool to measure health-related quality of life and consists of eight subscales of health, including physical function (Ware et al., 2007). The other seven subscales include general health perceptions, role limitations due to physical problems, bodily pain, general mental health, vitality, role limitations due to emotional programs, and social functioning. Ten items make up the physical function subscale of the SF-36 (see Table 2).

Table 2
Items included in the Physical Function Subscale of the SF-36

Item	Abbreviated Item Content
1	Vigorous activities, such as running, lifting heavy objects, or participating in strenuous sports Moderate activities, such as moving a table, pushing
2	a vacuum cleaner, bowling, or playing golf
3	Lifting or carrying groceries
4	Climbing several flights of stairs
5	Climbing one flight of stairs
6	Bending, kneeling, or stooping
7	Walking more than a mile
8	Walking several hundred yards
9	Walking one hundred yards

10	Bathing or dressing oneself

Respondents self-report how much they are limited in each activity: "yes, limited a lot," "yes, limited a little," and "no, not limited at all." The SF-36 physical function subscale has been shown to be reliable and valid in multiple populations, including older adults and cancer survivors (Johnson et al., 2009; Pinar, 2005; Ware et al., 2007).

The Patient-Reported Outcomes Measurement Information System (PROMIS) was developed in 2004 by the National Institutes of Health to provide a standardized, yet detailed and precise assessment of common health-related quality of life symptoms including physical function (Rothrock et al., 2010). PROMIS is unique in that it contains an item bank for key symptoms and health concepts. An early study with PROMIS examined the relationship between chronic medical diseases and various domains of health-related quality of life, including physical function (Rothrock et al., 2010). Participants were grouped into those who reported zero chronic conditions, one condition, two or more conditions. Results indicated that participants with zero chronic conditions had better physical function than the general population. In addition, there were significant differences in physical function among participants with zero, one, or two or more chronic conditions. The participants with two or more conditions self-reported the lowest levels of physical function. Although the data were not analyzed by specific disease, physical function was always better for healthy individuals compared with all disease groups. It should be noted, however, that Rothrock et al. did not limit their study to older adults. The mean was 53 years of age with a range from 18-100 years of age.

Other self-report measures of functional limitations include the Functional Difficulty Index, the Nagi Disability Scale, Rosow-Breslau Health Scale, the Functional Performance Inventory, and the Karnofsky Performance Score. The Functional Difficulty Index addresses eleven specific motions such as standing, lifting or carrying objects, moving limbs, stooping/bending or kneeling, or buttoning a shirt (Deimling et al., 2005; Deimling et al., 2007; Deimling et al., 2009; Garman et al., 2003; Whitson et al., 2009). The Nagi Disability Scale assesses whether individuals are able to independently perform five tasks: pulling or pushing large objects; stooping, crouching, or kneeling; lifting or carrying weights over 10 pounds; reaching or extending arms above shoulder level; and writing or handling small objects (Whitson et al., 2009). The Functional Performance Inventory also asks individuals about their difficulty with specific activities (Marsh et al., 2003). The ten items include: doing light housework, preparing meals, participating in community activities, managing money, visiting with relatives or friends, using the telephone, dressing, taking care of a family member, eating, and shopping. The Karnofsky Performance Score examines individuals' performance of activities of daily living and is scored with a 10-level scale (Hirsch et al., 2008). Scores range from 100 (able to carry out normal activity with no physical complaints or limitations) to 0 (death).

Unlike the previous measures of functional health for use with older adults and cancer survivors, the Rosow-Breslau Health Scale does not provide a scale of responses. Participants simply respond "yes" or "no" if they are able to complete each task independently including heavy work around the house like shoveling snow or washing walls, windows, and floors; walk a half mile; go out to a movie, to church or a meeting, or to visit friends; walk up and down a flight

There has been considerable progress in the assessment of functional limitations in recent years (Gill, 2010). Reliable and valid self-report and objective, performance-based measures are available. However, what these measurement tools do not assess are the reasons for functional limitations among older adults. In order to provide older adults with the best preventative and rehabilitative care, it is necessary to understand the reasons why these individuals experience functional limitations.

Reasons for Functional Limitations

Medical conditions have been identified as a key predictor of functional limitations, but this knowledge in and of itself has limited utility for planning interventions to improve functioning because many medical conditions can be managed but not necessarily cured (Bennett et al, 2002, Leville et al, 2004, Whitson et al, 2009). Research suggests that medical conditions affect functioning by increasing the level of symptoms rather than by direct association (Bennett et al., 2002; Whitson et al., 2009), thus, symptoms of medical conditions may represent clinically relevant reasons for functional limitations and are promising targets for interventions. Pain, fatigue, and balance problems are common symptoms of various medical

conditions and have been shown to correlate with functional limitations including limitations in mobility and the performance of activities of daily living (Bennett et al., 2002; Ettinger et al., 1994; Leville et al, 2004; Whitson et al, 2009).

Pain

Bennett et al. (2002) suggested that symptoms of medical conditions, such as pain, have a stronger association with function than medical conditions. Based on a study with older adults, Bennett and colleagues found that medical conditions affected self-reported physical function among older adults by increasing the level of symptoms (e.g., pain) rather than by direct association. Older adults were asked to self-report medical conditions and associated pain using the pain subscale of the SF-36. Functional limitations were measured with performance-based assessments as well as with the SF-36 physical function subscale. The results indicated only a small direct association between medical conditions and both performance-based and self-reported functional limitations. Pain, however, was strongly associated with self-reported functional limitations.

Covinsky et al. (2009) also conducted a cross-sectional study examining the relationship between pain and functional limitations. Adults, aged 50 and older, were asked if they often experienced pain. They were also asked about the severity of their pain. Functional limitations were measured with a series of questions asking about mobility, stair climbing, upper extremity tasks, and activities of daily living. Older adults with pain had much higher rates of functional limitations than older adults without pain across all four of these domains of functioning. Interestingly, the participants who reported pain were similar in terms of the degree of functional limitations to participants two to three decades older without pain. An individual with pain aged 50 to 59 yrs, for example, was similar in terms of physical functioning to an individual aged 70 to 79 yrs or even 80 to 89 yrs without pain. Covinsky and colleagues concluded that older adults with significant pain develop functional limitations typically associated with aging at markedly earlier ages.

Bryant et al. (2007) examined the relationship between pain and functional limitations among adults aged 60 years and older over 22 months. Pain intensity and frequency, along with objective lower extremity physical function, were measured at baseline and approximately 22 months later. Chronic or frequent pain had a significant association with worse functional limitations. Results indicated that chronic pain more than doubled the likelihood of functional limitations. Individuals who recovered from chronic pain over the 22 months had two-thirds less risk of functional limitations. The intensity of pain, however, did not appear to be directly related to functional limitations. Bryant et al. (2007) concluded that controlling chronic pain among older adults may significantly reduce functional limitations.

Balance Problems

Balance problems are among the most common reasons for falls in older adults and often lead to injury, disability, loss of independence, and limited quality of life (Lin & Bhattacharyya, 2012; Salzman, 2010). According to Lin & Bhattacharyya (2012), balance problems are among the most common chronic issues experienced by the older adult population and reported to physicians. Data from a nation-wide study indicate that nearly 20% of older adults reported a problem with balance in the preceding twelve months. Balance problems may include unsteadiness, difficulty walking on uneven surfaces, walking upstairs, and walking in the dark.

According to Marsh et al. (2003), previous studies have examined balance among older adults during standing, but an individual's ability to perform tasks that require movement is a key factor in maintaining independence. Early identification and intervention strategies for balance problems among older adults may prevent declines in physical function and reduced functional dependence (Marsh et al., 2003; Salzman, 2010). According to Salzman (2010), modest improvements in balance may impact important functional outcomes, such as reduction in falls and overall limitations in mobility.

The relationship between balance and physical function was examined among arthritic older adults 65 years and older (Marsh et al., 2003). Balance was measured with a force platform and physical function was measured with preferred walking speed, stair-climbing, and transfer from a standing to a seated position. Self-reported physical function was assessed with the Functional Performance Inventory. All measurements were completed at baseline and again after 30 months. Results indicated that balance measured at baseline was associated with objective and self-report measures of physical function. Better balance at baseline was associated with a lower level of self-

reported functional limitations, less time needed to perform the stair-climb and transfer tasks, and a faster preferred walking speed. Marsh et al. (2003) concluded that balance is an important component of physical function.

Leveille et al.'s (2004) previously mentioned study reported that nearly 26% of the older women identified balance as the reason for their difficulties with activities of daily living. The women who reported balance as the reason for their difficulties were older (85 years and older) and had more limitations with the standing balance and gait tests of the Short Physical Performance Battery (SPPB).

Lin & Bhattacharyya (2012) stated that among older adults with balance problems, over 27% reported that balance problems prevent them from participating in activities involving exercise, social events, driving, and work/school. Over 25% report that their balance problems affect their activities of daily living (e.g., bathing, dressing, eating).

Fatigue

Fatigue is common among older adults for a variety of reasons, including the presence of medical conditions and changes in sleep patterns (Bennett et al., 2002). Fatigue may impact older adults' physical function but limited research has been conducted in this area. Bennett and colleagues examined the relationship between fatigue, medical conditions, and physical function in older adults aged 65 years and older. Fatigue was measured using the vitality/fatigue scale of the SF-36. Physical function was also self-reported with the SF-36 physical function subscale. Results indicated that fatigue resulting from a medical condition was significantly associated with lower levels of self-reported physical function. The association between fatigue and self-reported function, however, was stronger than the association between fatigue and any of the medical conditions (e.g., arthritis, osteoporosis, asthma, hypertension, diabetes, heart disease, stroke, etc.). As noted by Bennett et al. (2002), these results are important because fatigue can more often be modified whereas medical conditions cannot always be modified. Methods or interventions to improve fatigue could potentially improve physical function among older adults.

Fatigue is also commonly reported among cancer survivors and may persist for months or years after any evidence of active cancer (Hung et al., 2011). Hung et al. examined the association between fatigue and functional limitations among lung cancer survivors. Over 57% of the survivors reported some level of fatigue, with just over 40% reporting mild fatigue and nearly 17% reporting moderate or severe fatigue. Among the individuals who reported moderate or severe fatigue, nearly 24% reported functional limitations. About 3% of the individuals who reported mild or no fatigue also reported functional limitations. Hung et al., concluded that fatigue is highly prevalent among cancer survivors and associated with greater functional limitations.

Research has supported a symptom-oriented approach that is valid and feasible (Leveille et al., 2004). Leveille et al. used this approach to examine reasons for limitations in activities of daily living in older women with mild to severe disability in at least two of the four domains of functioning (i.e., activities of daily living, instrumental activities of daily living, upper extremity function, and lower body function mobility). The women in their study were able to identify a single main reason for their functional limitation that was consistent with objective performance measures and other symptom assessment information. In addition, their limitations were largely due to a limited set of symptoms and impairments (i.e., pain, balance problems).

Research indicates that most older adults can point to a single main reason for their functional limitation performing a specific task such as bathing, walking, or shopping (Leveille et al., 2004). Self-report of reasons causing functional limitations is informative to our understanding of functional limitations and is critical to developing more targeted approaches to treat and manage limitations.

Conclusion

The health care costs associated with cancer in older adults represent a large percentage of total health care costs in the United States, and are increasing annually due to the growing older adult population (Dunlop, 2002; Manini, 2011; Manini & Pahor, 2009). The annual medical care costs for colorectal cancer alone are estimated to be 14.4 billion dollars (National Cancer Institute, 2011). In addition, colorectal cancer is one of the most common types of cancer among older adults, with more than 90% of cases occurring in individuals over the age of 50 years (Arem et al., 2014; Courneya et al., 2003; Haggar & Boushey, 2009; Ramsey et al., 2002). Although survival rates are favorable for both men and women, long-term colorectal cancer survivors may experience reduced physical health, higher levels of fatigue,

and reduced quality of life compared to healthy older adults (Sanchez-Jimenez et al., 2015).

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