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The Effect Of Insomnia On Functional Status Of Community-Dwelling Older Adults

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THE EFFECT OF INSOMNIA ON FUNCTIONAL STATUS OF COMMUNITY-DWELLING OLDER ADULTS

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Abstract

The Effect of Insomnia on Functional Status of Community-Dwelling Older Adults

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This secondary data analysis examined the extent to which fatigue mediates the relationship between insomnia and the physical, social, and psychological domains of functional status in community-dwelling older adults. Data were obtained from 209 older adults with insomnia. Regression analysis was used to test the proposed mediating role of fatigue. Findings identified insomnia of moderate severity in community-dwelling older adults. Insomnia was directly associated with social function and indirectly associated with physical and psychological function. Fatigue mediated the relationship between insomnia and all three domains of functional status. The findings highlight the importance of successfully managing insomnia and fatigue to promote functioning in older adults.

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Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1

Problem Statement

Introduction

Canada's population is aging. The number of individuals over the age of 65 is projected to double to approximately 10 million by 2036 (Statistics Canada, 2010). With greater than 90% of older Canadian adults residing in the community (Statistics Canada, 2006), an important aspect of nursing care is the maintenance and improvement of functional status aimed to promote independence and overall well-being in this population (Chen & Snyder, 2001). Insomnia is a type of sleep disturbance that may contribute to functional status impairment as a consequence of poor sleep quality and resulting daytime fatigue (Lichstein, Durrence, Bayen, & Riedel, 2001). Additionally, depressive symptoms have been associated with both insomnia and impaired functional status in older adults (Motivala, Levin, Oxman, & Irwin, 2006), potentially confounding the relationship between the two. Understanding the relationship between insomnia and functional status, while controlling for depressive symptoms, and examining the role of fatigue in mediating the relationship between insomnia and functional status, is of relevance to nursing, and is the focus of this study. As holistic health care professionals, nurses are in a unique position to identify threats to functional status, such as insomnia and resulting fatigue, which may impact healthy aging and independent living in older adults. In addition, nurses can also provide interventions that will assist older adults manage such threats and consequently improve functional status.

Background

Having both good quality and an adequate amount of sleep is a basic requirement for all individuals' general well-being because of the restorative nature of sleep (Crowley, 2010). Insomnia is a condition that interferes with sleep quality and quantity and is associated with subjective complaints of sleep disturbance that are generally characterized as: (a) difficulty initiating sleep, (b) difficulty maintaining sleep, (c) premature morning awakening, and/or (d) non-restorative sleep (National Institutes of Health [NIH], 2005). Insomnia's significance lies in the residual daytime effects of poor sleep quality and quantity, which is manifested as cognitive and physical fatigue that can impair daytime functioning.

The reported prevalence of insomnia in the general population is approximately 30%, and it is recognized as a significant public health concern because of the related fatigue that is experienced during the day following poor sleep and is reported by an estimated 10% of the population (NIH, 2005). Insomnia and subsequent fatigue are associated with high health care utilization, absenteeism, impaired work performance, and reduced quality of life. The effects of insomnia in the older adult population may be even more concerning because the prevalence and the severity of insomnia increase with age (Lichstein, Stone, Nau, McCrae, & Payne, 2006). Insomnia is prevalent in approximately 30-50% of older persons (Ancoli-Isreal & Cooke, 2005; Benca, Ancoli-Isreal, & Moldofsky, 2004; Kamel & Gammack, 2006), and while insomnia tends to follow a transient course of exacerbation and remission in younger persons, older adults tend to experience persistent or chronic insomnia that lasts more than 6 weeks (Ancoli-Isreal, 2009). Vaz Fragoso and Gill (2007) suggest that the high prevalence and persistent course of insomnia in older persons is the result of a combination of predisposing (e.g., gender, genetics), precipitating (e.g., illness, stress), and perpetuating (e.g., poor sleep hygiene) factors that

undermine sleep in this population. Normal aging results in changes to sleep architecture that predispose older adults to insomnia. Aging is also characterized by declining health status and loss of physical function that can precipitate insomnia in older persons. Vaz Fragoso and Gill identified that perpetuating psychosocial factors such as social isolation, poor sleep hygiene, and bereavement may serve to prolong and intensify insomnia in older persons. The literature indicates that insomnia is under-diagnosed and under-treated in older adults because it is often considered a normal outcome of aging and a typical symptom of many chronic physical and/or psychological conditions associated with aging (NIH, 2005; Ohayon, Zulley, Guilleminault, Smirne, & Priest, 2001). A comprehensive understanding of insomnia and recognition that it is related to multiple factors in older persons is important for the implementation of effective treatment plans that can address the multifactorial causes of the condition.

Empirical evidence indicates that insomnia in older adults is associated with both daytime cognitive (Edinger, Means, Carney, & Krystal, 2008; Haimov, Hadad, & Shurkin, 2007; Nebes, Buysse, Halligan, Houck, & Monk, 2009) and physical fatigue (Dam et al., 2008; Goldman et al., 2007; Stenholm et al., 2010). Fatigue is of particular concern in older adults because of the potential impact on the physical, psychological, and social domains of an older person's functional status (Gill, Desai, Gahbauer, Holford, & Williams, 2001). Additionally, fatigue offers a mechanism through which the nature of the relationship between insomnia and functional status can be clarified and more fully understood.

Studies that examined the relationship between insomnia and functional status, inclusive of the physical, psychological, and social domains, have revealed inconsistent findings. Lichstein et al. (2001) and Schubert et al. (2002) reported an association between insomnia and all domains of functional status, while others have reported a relationship with one or two domains

of functional status (Byles, Mishra, & Harris, 2005; Gureje, Kola, Ademola, & Olley, 2009; Hidalgo et al., 2007; Motivala et al., 2006; Reid et al., 2006). Results of these studies provide some evidence that insomnia may be related to functional status in older adults, but conceptual and methodological variations may have contributed to inconsistency in findings. For example, the measurement of insomnia differed across studies, with some using established, although varied, measures of insomnia severity (Byles et al., 2005; Gureje et al., 2009; Hidalgo et al., 2007; Lichstein et al., 2001; Motivala et al., 2006), whereas others utilized a limited number of "sleep-related questions" to assess the presence of insomnia (Reid et al., 2006; Schubert et al., 2002). Functional status measures were also different across studies and may account for some of the inconsistency in results. Further, only two studies excluded individuals with an alternative primary sleep disorder, such as sleep apnea, which is known to cause excessive daytime sleepiness and fatigue and may impact functional status (Hidalgo et al., 2007; Lichstein et al., 2001). In addition, depressive symptoms, that may significantly impact both insomnia and functional status, were measured with variable instruments across studies (Byles et al., 2005; Gureje et al., 2009; Hidalgo et al., 2007; Lichstein et al., 2001; Motivala et al., 2006), or were not measured and controlled (Reid et al., 2006; Schubert et al., 2002), which may have confounded the results. Together the findings of these studies suggest that in community-dwelling older adults, insomnia may be related to functional status. Further examination of the relationship utilizing valid and reliable measures of insomnia and functional status and appropriately controlling for possible confounding variables, such as depressive symptoms and sleep apnea, is required to clarify the magnitude of the relationship between insomnia and functional status in older adults. Additionally, an examination of the role of fatigue as a mediator

of the relationship between insomnia and functional status provides a clearer understanding of the mechanism underlying the relationship.

Depressive symptoms are prevalent in approximately 15% of older adults living in the community (VanItallie, 2005; Zivin et al., 2010). Historically, insomnia was considered a symptom of depression, however the current conceptualization proposes that the relationship between insomnia and depression is bidirectional and complex (Paudel et al., 2008). In older adults insomnia and depressive symptoms are often comorbid conditions that contribute to the severity of each other, which may complicate assessment and/or treatment of both conditions (Foley, Ancoli-Isreal, Britz, & Walsh, 2004). Empirical evidence indicates the severity of depressive symptoms is significantly related to increased insomnia severity (Motivala et al., 2006; Paudel et al. 2008), that insomnia is a risk factor associated with the onset of depressive symptoms (Perlis, et al., 2006), and that insomnia is a perpetuating factor for the presence of depressive symptoms (Pigeon et al., 2008).

Researchers that have examined the relationship between depressive symptoms and physical functioning in older adults have reported an association between depressive symptoms and limitations in activities of daily living (Wada et al. 2005) and instrumental activities of daily living (Hybels, Pieper, & Blazer, 2009), as well as poorer overall physical function (Morala, Shiomi, & Maruyama, 2006). Investigators have also identified depressive symptoms as a risk factor of physical functional decline (Hybels et al., 2009; Iwasa et al., 2009). The presence of depressive symptoms in older adults has also been associated with decreases in overall functional status, inclusive of physical, psychological, and social functioning (Gallegos-Carrillo et al., 2009; Wada et al., 2005; Wada et al., 2004). Specifically, Motivala et al. (2006) reported that older adults with current depressive symptoms or a history of depressive symptoms have more

severe insomnia and higher declines in functional status compared to persons with no history of depressive symptoms. Given the strong association between insomnia and depressive symptoms and the potential confounding effect of depressive symptoms on insomnia and functional status, an examination of the relationship between insomnia and functional status should control, at least statistically, for depressive symptoms.

Problem Statement

Promoting independence in community-dwelling older adults through improvement or maintenance of functional status is an important outcome of holistic nursing care. Identification of potential risk factors related to functional status decline in older adults is important to guide nursing practice, which will address identified risk factors to promote maintenance of functional status. Insomnia is a factor that may interfere with functional status. Additionally, fatigue is proposed as a mediator in the relationship between insomnia and functional status. Research evidence suggests that the presence of insomnia may negatively impact functional status in older adults (Byles et al., 2005; Gureje et al., 2009; Hidalgo et al., 2007; Lichstein et al., 2001; Motivala et al., 2006; Reid et al., 2006; Shubert et al., 2002). Insomnia in older adults may also be associated with both cognitive (Edinger et al., 2008; Haimov et al., 2007; Nebes et al., 2009) and physical fatigue (Dam et al., 2008; Goldman et al., 2007; Stenholm et al., 2010). Research using established measures of insomnia, fatigue, and functional status and appropriately controlling for potential confounding variables, is required to develop a clearer understanding of the nature and magnitude of the relationship between insomnia and functional status in older adults.

Purpose

The overall purpose of this study was to examine the relationship between insomnia and functional status, inclusive of fatigue as a mediator, in older adults (65 years or older) living in the community, while controlling for the confounding influence of depressive symptoms. The specific objectives were: (a) to examine the severity of insomnia in the older adults, (b) to determine the relationship between insomnia severity and the physical, psychological, and social domains of functional status, and (c) to examine fatigue as a mediator in the relationship between insomnia and functional status.

Significance to Nursing

Given the high prevalence of insomnia in community-dwelling older persons, an examination of the relationship between insomnia and functional status, and the mediating role of fatigue, is relevant to guide future nursing practice that is aimed to promote independence and overall well-being in this population. If insomnia and resulting fatigue are identified as factors contributing to functional status impairment in older adults, nursing assessment and intervention strategies can be implemented to target insomnia and reduce fatigue. Reduced fatigue will consequently improve functional status, which may in turn, promote independence in this population.

Chapter 2

Theoretical and Empirical Literature

In this chapter the theoretical and empirical literature supporting the relationships among insomnia, fatigue, and functional status is critically reviewed. The influence of depressive symptoms on these relationships is also explored.

Insomnia

Insomnia is a condition that results in poor sleep quality and quantity in the presence of available opportunity and conditions conducive to sleep. Specifically, insomnia is characterized by subjective complaints of poor or interrupted sleep that can include one or more of the following: (a) difficulty initiating sleep, (b) difficulty maintaining sleep, (c) premature morning awakening, and/or (d) non-restorative sleep (NIH, 2005). Insomnia can be categorized by its duration with short term or acute insomnia lasting less than 6 weeks and long term or chronic insomnia lasting 6 weeks or more (Krystal, 2005; NIH, 2005).

Persons older than 18 years of age may experience insomnia and resulting daytime consequences, manifested primarily as fatigue and reduced functioning (NIH, 2005). The prevalence and severity of insomnia is generally considered to be higher in adults over the age of 65 years compared to younger age groups (Lichstein et al., 2006; Morin et al., 2009). Older adults tend to experience chronic or persistent insomnia more so than younger individuals (Ancoli-Isreal, 2009), which is commonly considered to be associated with the presence of chronic, age-related comorbidities, in combination with poor sleep hygiene and/or psychosocial factors, such as social isolation and bereavement (Ancoli-Isreal, 2009; Bloom et al., 2009; Vaz Fragoso & Gill, 2007). It is reported that insomnia is prevalent in the range of 30-50% of older

adults (Ancoli-Isreal & Cooke, 2005; Benca et al., 2004; Kamel & Gammack, 2006). Differences in the operational definition of insomnia across studies and a lack of standardized criteria for identifying insomnia in participants have resulted in variability in the reported insomnia prevalence rates (NIH, 2005; Ohayon, 2002). Specifically, insomnia in older adults has been operationalized as: (a) the presence or absence of one night time symptom, such as disturbed sleep (Reid et al., 2006) or a combination of two night time symptoms, such as difficulty initiating sleep and early morning awakening (Foley et al., 1995); or (b) frequency of insomnia symptom occurrence, encompassing 3 times per week or most of the time (Jaussent et al., 2011, Shubert et al., 2002); or (c) the duration of insomnia symptoms, such as less than or greater than 2 weeks (Gureje et al., 2009). Other studies have defined insomnia through a consideration of both duration and frequency of night time insomnia symptoms, as well as inclusion of daytime consequences, such as activity limitation (Hidalgo et al., 2007; Su, Huang, & Chou, 2004). Appendix A summarizes results of studies that examined the prevalence of insomnia in community-dwelling older adults.

Studies with broad definitions of insomnia, identified as subjective reports of the presence of one or two night time symptoms (Foley et al., 1995; Reid et al., 2006), have reported higher prevalence rates of insomnia in comparison to studies with a more specific operationalization of insomnia, that have included either frequency (Jaussent et al., 2011; Schubert et al., 2002) or duration of night time symptoms (Gureje et al., 2009) with or without daytime consequences. Two studies were identified that examined the prevalence of chronic insomnia in older persons (Hidalgo et al., 2007; Su et al., 2004). Again reported prevalence was inconsistent. Su et al. (2004) reported a prevalence of chronic insomnia at 6%, whereas Hidalgo et al. (2007) reported a prevalence of approximately 30%. Su et al. defined parameters for night

time insomnia symptoms that included, sleep latency longer than 30 minutes and sleep maintenance insomnia entailing three or more night time awakenings. Hidalgo et al. did not define such parameters in the operationalization of insomnia, which may account for the inconsistent results. In addition, Su et al. reported the high use of sleeping medications in their study population, which may have masked insomnia symptoms and resulted in lower reporting of insomnia symptoms.

Despite the variability in reported prevalence rates of chronic insomnia in older adults, it appears that insomnia is present in a substantial number of older adults. Fatigue, which is a consequence of insomnia in older adults, is of particular concern because it may reduce physical, social, and psychological functioning (Goldman et al., 2008).

Fatigue

Fatigue has been identified as a multidimensional concept that involves physical, cognitive, and behavioural components (Avlund, 2010; Trendall, 2000; Watt et al., 2000). Although recognized as an ambiguous concept, fatigue generally relates to an individual's feelings of tiredness or lack of energy in relation to physical and psychological tasks, which may impact behaviours (Avlund, 2010). Physical fatigue is characterized as feelings of weakness, decreased energy, or bodily heaviness. Manifestations of cognitive fatigue include feelings of weariness, forgetfulness, lack of focus, confusion, and lack of enthusiasm. The behavioural aspects of fatigue are the result of physical and cognitive fatigue and are characterized by making mistakes, not getting things done, and generally not functioning as usual.

Insomnia and Fatigue

The association between insomnia and fatigue in older adults is supported by research that has revealed poorer cognitive functioning, reflective of cognitive fatigue, for persons with compromised sleep. Results of these studies indicated that insomnia is related to poorer performance in tasks requiring sustained attention and concentration (Bastien et al., 2003; Blackwell et al., 2006; Nebes et al., 2009; Vignola, Lamoureux, Bastien, & Morin, 2000), rapid reaction to visual stimuli (Edinger et al., 2008; Haimov et al., 2007), and memory recall (Blackwell et al., 2006; Nebes et al., 2009; Schmutte et al., 2007). Appendix B presents results of studies examining insomnia and cognitive fatigue. There was some variability noted in reported cognitive function deficits across studies; the variability is likely related to the application of different cognitive measures, small sample sizes, and inconsistent control of potentially confounding variables. Overall the findings indicate that older adults with insomnia are experiencing cognitive difficulties, which are reflective of cognitive fatigue, and may impact functional status. Older adults experiencing cognitive fatigue may feel less motivated to participate in physical and social activities, and may experience difficulties interacting with others if they do participate (Yu, Lee, & Man, 2010). Decreased participation or interactions may consequently negatively affect older adult's psychological well-being.

Physical fatigue has been examined in a limited number of studies that have evaluated physical function in older adults with insomnia. Physical function measures encompassed walking speed and mobility in older adults (Stenholm et al., 2010) and walking speed, chair stands, and grip strength in older women (Goldman et al., 2007) and older men (Dam et al., 2008). Appendix C is a summary of studies examining insomnia and physical fatigue. The results consistently revealed an association between insomnia and poorer physical performance,

indicative of physical fatigue. The association between insomnia and reported physical fatigue in older adults may result in the curtailing of physical and social activities. These findings are supported by research evidence indicating that fatigue is the most common reason for activity limitation in the older adult population (Gill et al., 2001).

A limited number of studies have examined the relationship between insomnia and general fatigue in older adults (Alapin et al., 2000; Goldman et al., 2008). The results of these studies are summarized in Appendix D. They are consistent in showing that insomnia and fatigue are concurrent conditions. However, none of these studies examined the severity of insomnia relative to the severity of fatigue symptoms. The present study examined insomnia severity in relation to fatigue severity, utilizing valid and reliable instruments to measure both concepts, in order to provide a more complete understanding of the relationship.

Functional Status

Functional status is a reflection of an individual's functioning within three domains: physical, psychological, and social. The physical domain includes performance of usual activities, such as walking, bathing, and dressing. The psychological domain pertains to emotional status. The social domain reflects an individual's participation in social activities, such as visitation with friends and relatives (Ware, Snow, Kosinski, & Gandek, 1993).

Research evidence has revealed that declines in functional status in older adults are the culmination of a complex interaction of biological, psychological, and social risk factors (Beswick et al., 2008, Stuck et al., 1999). In a systematic review Stuck et al. (1999) identified several factors that are associated with an increased risk of functional decline in older persons. The factors included: physical and psychosocial health, comorbidities, social circumstances,

environmental conditions, lifestyle, and nutrition. Although insomnia has not been identified as a risk factor predictive of functional decline in older adults, it has been associated with chronic health conditions and comorbidities that lead to functional status decline (Ancoli-Isreal, 2006; Bloom et al., 2009, Foley et al., 2004). Results of studies indicate that insomnia is associated with cardiovascular disease (Fraguas et al., 2007; Hayes, Anstead, Ho, & Philips, 2009), diabetes mellitus (Kawakami, Takatsuka, & Shimizu, 2004), HIV infection (Reid & Dwyer, 2005; Robbins, Phillips, Dudgeon, & Hand, 2004), cancer (O'Donnell, 2004; Theobald, 2004), renal disease (Merlino et al., 2006; Violani, Lucidi, Devoto, Lombardo, & De Santo, 2006), arthritis (Power, Perruccio, & Badley, 2005), depression (Foley et al., 2004), and anxiety (Spira et al., 2008; Uhde, Cortese, & Vedeniapin, 2009). In addition, it is recognized that insomnia is more severe in the face of higher comorbidity (Foley et al., 2004). Although insomnia is associated with many chronic comorbid diseases, it is recognized that the relationships are complex and not well understood (Ancoli-Isreal, 2006). Consequently, it is difficult to accurately assess the extent to which chronic conditions contribute to insomnia and/or functional status decline. Fagerström and Hellström (2011) examined the relationships between insomnia, comorbidities, and the physical and psychological domains of functional status. Their results indicated that insomnia associated with chronic comorbid diseases negatively influenced physical and psychological functioning, independent of the effects of the chronic comorbid diseases.

Insomnia and Functional Status

Studies that have examined the relationship between insomnia and functional status in older adults have produced inconsistent results (Byles et al., 2005; Gureje et al., 2009; Hidalgo et al., 2007; Lichstein et al., 2001; Motivala et al., 2006; Reid et al., 2006; Schubert et al., 2002); the results are presented in Appendix E. Schubert et al. (2002) and Lichstein et al. (2001)

reported a significant relationship between insomnia and all three domains of functional status in older adults. Other researchers have reported a relationship between insomnia and one or two of the domains of functional status, but not all three. Gureje et al. (2009), Motivala et al. (2006), and Reid et al. (2006) reported a relationship between insomnia and the physical and psychological domains of functional status but not the social domain. Hidalgo et al. (2007) reported a relationship between insomnia and the psychological and social domains but not the physical domain of functional status. Further, Byles et al. (2005) found a relationship between insomnia and only the psychological domain of functional status. Although all these studies offered a broad conceptualization of functional status, inclusive of the physical, psychological, and social domains, there were methodological differences across studies that may account for inconsistent findings. Conflicting results are likely related to the use of different and poorly validated measures of insomnia, variation in the operationalization of functional status, and inconsistent identification and control of potential confounding variables that may influence insomnia and/or functional status, such as depression, comorbidities, and the presence of sleep apnea. The present study examined the relationship between insomnia and functional status in older adults and attempted to overcome prior methodological limitations through the utilization of valid and reliable instruments to measure both concepts. Further it controlled for potential confounding variables, specifically depression and sleep apnea.

Fatigue and Functional Status

There are a limited number of studies that have examined the relationship between fatigue and functional status in older adults. Three studies (Appendix F) examined the association between fatigue and physical function longitudinally (Avlund, Pedersen, & Schroll, 2003; Hardy & Studenski, 2008; Moreh, Jacobs, & Stessman, 2010). All three studies indicated

that fatigue at baseline predicted declines in physical function at follow up. Although findings were consistent, it was noted that fatigue was operationalized differently and not measured with reliable and valid instruments across studies. Additionally, functional status was assessed with different measures across studies and captured only the physical domain of functioning. The present study addressed these methodological problems through the utilization of reliable and valid measures of both fatigue and functional status, and examined a broader conceptualization of functional status that encompassed the physical, psychological, and social domains.

Insomnia, Fatigue, and Functional Status

One study (Appendix G) was found that examined the relationships between insomnia, fatigue, and functional status in an adult population, aged 30 years or older (Fortier-Brochu, Beaulieu-Bonneau, Ivers, & Morin, 2010). The authors reported that individuals with more severe fatigue had poorer physical, psychological, and social functioning than individuals with milder fatigue. In addition, individuals with severe insomnia, in combination with fatigue, had significantly lower functional status than individuals with mild insomnia and severe fatigue. The severity of subjectively reported insomnia was associated with increased severity of fatigue, however objective measures of sleep disturbance (polysomnography) were not strongly associated with fatigue severity. It was noted that these findings may be related to (a) subjective reports of sleep being influenced by feelings of fatigue and/or, (b) parameters of sleep examined with polysomnography (duration and continuity of sleep) not being as relevant to fatigue as other subjective parameters of sleep, such as sleep quality (Fortier-Brochu et al., 2010). Van Den Berg et al. (2008) identified that there is often inconsistency between subjective and objective sleep measures, whereby individuals subjectively rate their sleep as poorer than objectively measured sleep parameters. However, the authors also recognized that subjective measures of sleep are

more sensitive to the subtleties of sleep disturbance including sleep quality. The findings support the interrelationships among insomnia, fatigue, and functional status. Nonetheless, fatigue was not examined as a mediator in the relationship between insomnia and functional status.

The present study examined the relationship between insomnia, fatigue, and functional status in older adults and attempted to overcome prior methodological limitations through the utilization of valid and reliable instrumentation to measure all three concepts. In addition, the present study explored the extent to which fatigue mediates the relationship between insomnia and functional status and controlled for the potential confounding effect of depression.

Depressive Symptoms

Approximately 15% of the older adult population living in the community experience depressive symptoms that are associated with functional and psychosocial impairment (Blazer, 2003; Cole & Dendukuri, 2003; VanItallie, 2005; Zivin et al., 2010). Longitudinal studies that have examined risk factors for decline in the physical domain of functional status in older adults, revealed that depressive symptoms are predictive of physical function declines over time (Hybels et al., 2009; Iwasa et al., 2009). Similarly, findings of correlational studies in older adults indicate that depressive symptoms are associated with significant decreases in physical functioning (Morala et al., 2006; Schulman, Gairola, Kuder, & McCulloch, 2002), and overall functional status decline, inclusive of the physical, psychological, and social domains (Gallegos-Carrillo, et al., 2009; Motivala et al., 2006; Wada et al., 2005; Wada et al., 2004). Appendix H summarizes results of studies examining depressive symptoms and functional status.

Research evidence has consistently showed a high association between insomnia and depressive symptoms in older adults (Foley et al., 2004; Gureje et al., 2009; Jaussent et al., 2011;

Mallon, Broman, & Hetta, 2000; Nebes et al., 2009). However, the precise nature of the relationship is complex, bidirectional, and not fully understood (Paudel et al., 2008). In the past, insomnia was primarily considered a symptom of depression, however recent studies have identified insomnia as a risk factor for the development of depressive symptoms (Cole & Dendukuri, 2004; Perlis et al., 2006; Yokoyama, 2010), and depressive symptoms as a risk factor for the development of insomnia (Buysse, 2004; Su et al., 2004). Current findings indicate that insomnia perpetuates depressive symptoms (Pigeon et al., 2008) and depressive symptoms perpetuate insomnia in older adults (Quan et al., 2005), with each condition complicating the other. Further research showed that increases in graded severity levels of depressive symptoms are associated with corresponding increases in insomnia severity among older adults (Motivala et al., 2006; Paudel, et al., 2008). Appendix I presents results of studies examining depressive symptoms and insomnia.

Fatigue is identified as a symptom of depressive mood in older adults (Blazer, 2003; Fiske, Wetherell, & Gatz, 2009). This study controlled statistically for depressive symptoms, which may confound the relationship between insomnia and functional status in older adults.

Conceptual Definitions and Framework

The following conceptual definitions have been developed for the present study. In addition, the conceptual framework guiding the study is presented.

Insomnia. Insomnia is conceptually defined as subjective complaints of sleep disturbance that were generally characterized as difficulty initiating sleep and/or difficulty maintaining sleep, for ≥ 3 months (Sidani et al., 2009).

Fatigue. Fatigue is conceptually defined as low levels of energy, tiredness, and feelings of exhaustion. Fatigue was operationalized through self-reported levels of energy.

Functional status. Conceptually, functional status represents the physical, psychological, and social domains of functioning. Physical functioning refers to performance of daily activities, such as walking, bathing, and dressing. Psychological functioning reflects emotional status related to anxiety. Social functioning captures an individual's participation in visitation activities with family and friends (Ware et al., 1993). Functional status was operationalized as perceived alteration in physical, social, and psychological functioning.

Depressive symptoms. Depressive symptoms are conceptualized as self-reported feelings of guilt, worthlessness, helplessness, and hopelessness.

Conceptual framework. In community-dwelling older adults, it is hypothesized that (a) increased levels of insomnia severity contribute to decreases in physical, psychological, and social function, independent of depressive symptoms, and (b) fatigue mediates the relationship between insomnia and functional status. The proposed relationships are illustrated in Figure 1.

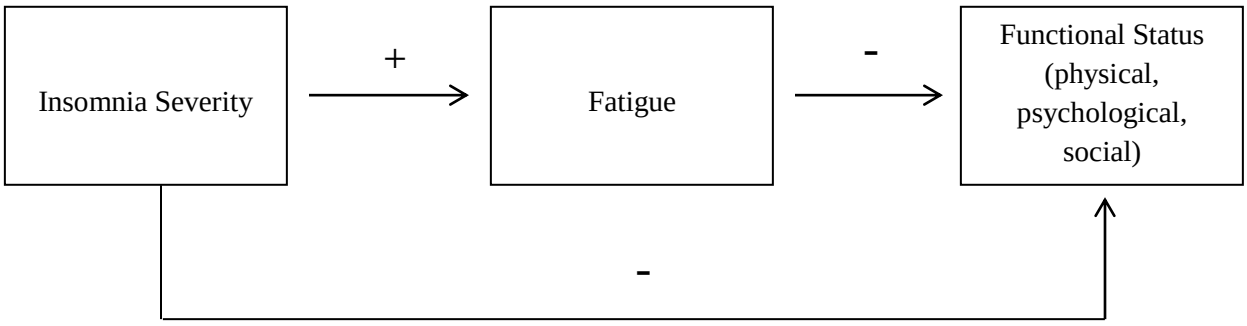

Figure 1. Conceptual model of proposed relationships among insomnia, fatigue, and functional status.

Chapter 3

Methods

Design

This secondary analysis used data obtained from a large methodological study that examined the effects of: (a) different research designs varying in terms of method of assignment to study groups (i.e., random vs. preference), and (b) type of behavioural interventions under evaluation, on the validity of conclusions in clinical research (Sidani, Epstein, Bootzin, Moritz, & Sechrest, 2007). In the original large study, the target population consisted of persons with chronic insomnia, manifested as difficulty falling and/or staying asleep. Eligible participants completed baseline measures prior to assignment to behavioural interventions for the management of insomnia. The baseline measures assessed severity of insomnia, fatigue, functional status, and depression, as well as socio-demographic variables. A subgroup of participants who provided baseline data was selected for the secondary analysis, to include only participants aged 65 years and older. The database was un-coded and contained no potentially identifying information on participants.

Ethics

In the original study ethics approval was obtained from the appropriate institutional sites' ethics review boards. For the present study the Chair of the Ryerson University Research Ethics Board was consulted to determine if further ethics approval was required. It was determined that no further ethics review was required for the present study as the database was decoded and anonymized and as such contained no potentially identifying information related to participants

(see Appendix J for e-mail communication clarifying requirement for Research Ethics Board review).

Sample

The original sample consisted of 769 participants with chronic insomnia, recruited from four investigational sites in North America (Sidani et al., 2007). Participants met the following inclusion criteria: (a) non-institutionalized, community dwelling, adults aged 21 years or older, (b) able to read and write in English, and (c) complaint of insomnia lasting more than three months in duration. The presence of insomnia at baseline was determined through the completion of a daily sleep diary over 14 days (Sidani et al., 2009). Sleep patterns that indicated the presence of insomnia were sleep onset latency and/or wake after sleep onset of 30 minutes or longer for a minimum of 3 nights per week. The duration of insomnia was reported by participants in an initial screening interview. Exclusion criteria for participation in the original study were: (a) a diagnosis of sleep apnea or use of continuous positive air pressure (CPAP) device, as reported by participants, (b) cognitive impairment indicated by a score < 27 on the Mini-Mental State Exam (MMSE) (Folstein, Folstein, & McHugh, 1975), or (c) psychological impairment assessed with a Global Severity Index T score > 50 on the Brief Symptom Inventory (BSI) (Derogatis & Melisaratos, 1983). The sample for the present study included the subgroup of 209 participants representing all those aged 65 years and older from the original study who completed the baseline measures on insomnia severity, fatigue, and functional status. All other eligibility criteria remained as described for the original study.

A power analysis was undertaken to determine the number of participants required to provide adequate power to detect significant relationships among insomnia, fatigue, and

functional status, while controlling for depressive symptoms (Cohen, 1992). In their study of older women, Byles et al. (2005) reported a relationship of a moderate magnitude between sleep quality and functional status (physical, social, and psychological), controlling for depressive symptoms. As outlined by Cohen (1992), at a pre-set α of .05 and power of .80, a sample of 76 participants is required to detect moderate relationships between the three variables using multiple regression analysis. Of the 209 participants, 193 had complete data sets. Consequently, the available sample size of 193 participants is more than adequate to detect small-to-moderate relationships between insomnia, fatigue, and functional status, while controlling for depressive symptoms.

Variables and Measures

Insomnia. Perceived insomnia severity, reflecting sleep quality, was measured with the Insomnia Severity Index (ISI) (Bastien, Vallières, & Morin, 2001). The ISI consists of seven questions that assess sleep onset and sleep maintenance difficulties, satisfaction with current sleep, daytime and quality of life impairment related to sleep difficulties, and degree of distress associated with sleep problems, over the previous two weeks. Each item on the ISI is rated on a scale ranging from *not at all* (0) to- *very much* (4). Total scores are calculated by summing individual questions' scores, with 0 being the lowest possible total score and 28 being the highest possible total score. A score of 0-7 reflects the absence of insomnia; a score of 8-14 reflects subthreshold insomnia; a score of 15-22 reflects moderately severe insomnia; and a score of 22-28 indicates severe insomnia. The ISI has demonstrated internal consistency reliability evidenced by a reported Cronbach's α of 0.74. For the current data set, the original study reported a Cronbach's α of 0.66 for the ISI, slightly lower than the criterion of > 0.70 (Sidani et al., 2007). The lower α is explained by low variability in participants' responses prior to intervention

initiation. Construct validity of the ISI was established through reported significant relationships between individual items on the ISI and both sleep diary and polysomnography measures (Bastien et al., 2001).

Quantity of sleep was assessed at baseline with a sleep diary, completed upon waking, over 14 days. Sleep diaries documented sleep onset latency, total time awake after sleep onset, total sleep time, and total time in bed, which were expressed in minutes, as well as sleep efficiency (Sidani et al., 2009). Sleep efficiency was calculated as the percentage of total sleep time, out of the total amount of time in bed. Higher percentages represented higher sleep efficiency. Sleep efficiency is usually considered the most significant parameter of disturbance in sleep quantity and was used to represent sleep quantity in later analyses (Lichstein et al., 2001). The literature indicates that sleep diaries provide a valid and reliable index of sleep patterns in individuals with insomnia (Buysse, Ancoli-Isreal, Edinger, Lichstein, & Morin, 2006). Monk et al. (1994) reported significant relationships between sleep diary and actigraphy measures of sleep timing and sleep quantity, which supported construct validity of sleep diaries. Construct validity was also established through the reported ability of sleep diaries to detect sleep pattern differences associated with weekends, age, gender, and circadian type. Reliability of sleep diaries was shown through reported significant relationships of both sleep timing and sleep quantity over time (mean 22 months).

Fatigue. Participant's perceived level of fatigue was assessed with the Vitality Subscale (VS) of the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) (Ware et al., 1993). The VS is comprised of four questions that reflect feelings of energy, "pep", tiredness, and being "worn out". A total score for the subscale is a calculated sum of the four questions scores and a transformed score is generated. The transformed score ranges between 0 and 100,

with lower scores reflecting higher levels of fatigue. Internal consistency reliability of the VS has been determined with a reported Cronbach's α of 0.87 (McHorney, Ware, Lu, & Sherbourne, 1994). In the original large scale study the Cronbach's α was 0.86, which supports the internal consistency reliability of the VS in the sample (Sidani et al., 2007). Construct validity was evidenced by differences in VS scores among patients with minor medical conditions, major medical conditions, and psychiatric conditions (McHorney, Ware, & Raczek, 1993).

Functional status. Three subscales of the SF-36 were used to measure the physical, psychological, and social domains of functional status (Ware et al., 1993). Physical functioning was assessed with 10 questions related to individuals' perception of their ability to perform vigorous and moderate activities, such as stair climbing, bending or kneeling, bathing, dressing, and walking various distances (e.g. a mile and several blocks). Psychological function was assessed with 5 items that captured an individual's perceived mood, that is, nervousness, calmness, down heartedness, and happiness, over the previous 4 weeks. Lastly, social functioning was assessed with 2 items inquiring about an individual's perception of the degree to which physical and emotional difficulties interfered with social activities, such as visiting friends and relatives, over the previous 4 weeks. A total transformed score is calculated for each subscale. The scores range from 0 to 100, with higher scores reflecting higher levels of functioning in the respective domain. Internal consistency of each subscale was demonstrated with a reported Cronbach's α of .93 for physical, 0.90 for psychological, and 0.85 for social function (McHorney et al., 1994). In the original study, the reported Cronbach's α was 0.78 for the physical function subscale, 0.78 for the psychological function subscale, and 0.86 for the social function subscale, all of which support the internal consistency of the subscales in the sample (Sidani et al., 2007). The reported ability of the physical, psychological, and social

function subscales to differentiate between patient populations, such as those with minor medical conditions, major medical conditions, psychiatric conditions, and both major medical and psychiatric conditions, through a comparison of scores across populations, established construct validity of each of the subscales (McHorney et al., 1993).

Depressive symptoms. Depressive symptoms were measured with the Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). The CES-D consists of 20 items. Each item is scored on a scale of 0-3. The total score on the CES-D is computed by summing the individual items' scores. The lowest possible score is 0 and the highest possible score is 60. Higher scores on the CES-D reflect greater depressive symptomology. Internal consistency of the CES-D was established with a reported Cronbach's α of 0.85. The original study reported a Cronbach's α of 0.88, supporting the internal consistency reliability of the CES-D in the sample (Sidani et al., 2007). Concurrent validity was established with significant correlations with the Hamilton Clinician's Rating Scale (0.69) and the Raskin Rating Scale (0.75) (Radloff, 1977).

Sample characteristics. Standard questions were used to obtain data on characteristics of participants related to: age, gender, insomnia duration, education level, marital status, ethnicity, and employment status (Sidani, et al., 2009).

Procedure

In the original study recruitment of persons with insomnia occurred through placement of advertisements in newspapers, referral by health care professionals, distribution of flyers to clinics, and community health centres, as well as website and radio announcements (Sidani et al., 2007). Interested persons contacted a research assistant (RA) in the study office by telephone.

During the initial phone contact the RA explained the study purpose and research activities in which participants were expected to engage. If an individual was interested in participating in the study, verbal consent was obtained for the RA to perform a preliminary screen for type and duration of insomnia and/or presence of sleep apnea to determine eligibility. If eligible, potential participants were mailed a sleep diary to complete over 14 days to further determine eligibility (relative to the experience of insomnia) for the study. Sleep diary entries were phoned in daily. Individuals who met eligibility for insomnia were invited to a face-to-face data collection session with an RA at the study office. At the beginning of the session the RA reiterated the study purpose, outlined any potential risks and/or benefits associated with participation, gave individuals an opportunity to ask questions, and obtained written informed consent. The RA then administered the MMSE and the BSI to establish further eligibility. If eligible, participants then completed the standard questions related to socio-demographic information and the instruments measuring study variables (Sidani, et al., 2009).

Data Analysis

Descriptive statistics, including measures of central tendency and dispersion, were used to characterize the sample in terms of socio-demographic profile and levels on the study variables. Pearson's product-moment correlations were calculated to identify preliminary relationships among study variables. Multiple regression was applied to examine the direct and mediated relationships among insomnia, fatigue, and functional status. The mediational analysis followed the procedural steps described by Baron and Kenny (1986). In the first step, regression analysis determined the relationship between insomnia and functional status, controlling for depressive symptoms. In the second step, the relationship between insomnia and fatigue, controlling for depressive symptoms, was tested. In the third step, regression analysis was

performed to examine the relationship between fatigue and functional status, again controlling for depressive symptoms. In the last step, the relationships between the independent variables (insomnia and fatigue) and the dependent variable (functional status) were tested while controlling for depressive symptoms.

Baron and Kenny (1986) suggest that a mediated relationship requires finding a significant, direct relationship between the independent variable and dependent variable in the first step, to proceed with the analysis. However, MacKinnon and Fairchild (2009) propose that a significant mediated effect can occur in the absence of a significant direct effect observed in the first step. As such, in this analysis a non-significant relationship between the independent variable (insomnia) and the dependent variable (functional status), controlling for depressive symptoms, in the first step, did not preclude continuation of the analysis. Baron and Kenny also suggest that complete mediation occurs when a significant relationship between the independent and dependent variables in the first step, becomes non-significant in the last step. They also propose that partial mediation occurs when the relationship between the independent and dependent variables weakens, but remains significant in the last step, in comparison to the relationship in the first step. Although the causal step approach as described by Baron and Kenny has been widely used to establish mediated relationships, Rucker, Preacher, Tormala, and Petty (2011) suggest that rather than describing mediated relationships as "complete" or "partial", it is more meaningful to identify the magnitude of the mediated relationship. As such, Rucker et al. recommend quantifying the indirect path as the product of 1) the relationship between the independent variable and the mediator (usually referred to as path "a") and 2) the relationship between the mediator and the dependent variable (usually referred to as path "b"). Further, Preacher and Kelley (2011) suggest comparing the magnitude of the indirect path (ab) to the

magnitude of the direct path, that is, the relationship between the independent and dependent variables, controlling for the mediator, usually referred to as path c'. Accordingly, this analysis examined the unstandardized indirect effect (ab) between insomnia and functional status, as mediated by fatigue, and determined the magnitude of the mediated path compared to the magnitude of the direct path (c'). Figure 2, depicts a model of mediated paths.

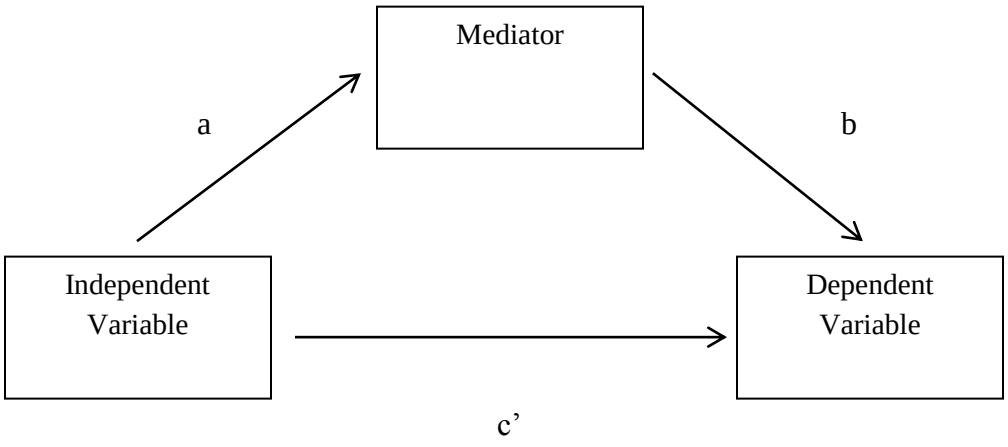

Figure 2. Model of pathways in a mediated relationship.

Chapter 4

Results

In this chapter results of the data analysis are presented. The sample characteristics are described first. Measures of central tendency for the study variables are presented, followed by the bivariate correlations reflecting relationships among them. Finally, the results of mediational analyses are presented to determine the extent to which fatigue mediates the relationship between insomnia severity operationalized with the Insomnia Severity Index and Sleep Efficiency, and each of the three domains of functional status (physical, social, and psychological function). All regression analyses controlled for depressive symptoms.

Sample Characteristics

The sample for the present study was a subgroup of participants (n=209), aged 65 years and older, obtained from a larger sample of 769 participants with chronic insomnia recruited for a large methodological study (Sidani et al., 2007). Table 1 summarizes the sociodemographic characteristics of participants in the present study. The age of participants ranged from 65 to 90 years. Most participants were women, white, married, and retired. The number of years of formal education varied between 3 and 35.

Table 1

Sample Characteristics

Characteristic	%	Mean	SD	Range
Gender (female)	51.2			
Age (years)		73.1	± 5.8	65 – 90
Marital status				
Married	52.4			
Widowed	20.7			
Divorced	13.5			
Single	12			
Separated	1.4			
Ethnic Origin				
White	87.3			
Asian	3.9			
Hispanic	3.4			
Black	2.0			

Native	0.5			
Other	2.9			
Education (years)		14.9	±3.6	3-35
Employment Status				
Retired	86.3			
Part-time	7.4			
Full-time	3.9			
Not Employed	2.5			

Insomnia Characteristics

The length of time participants experienced insomnia ranged from 3 months to 66 years, with a mean of 11.8 (± 14.2) years. About two-thirds (68.3%) of participants indicated they experienced difficulty falling asleep and 93.8% reported they experienced difficulty maintaining sleep. The mean Insomnia Severity Index score was 17.3 (± 4.3) implying that on average participants had clinical insomnia of moderate severity (Bastien et al., 2001). The mean scores on sleep parameters derived from sleep diaries are presented in Table 2. The mean scores for sleep onset latency, wake after sleep onset, and sleep efficiency, further indicate that participants had a moderate level of insomnia severity (Buysse et al., 2006).

Table 2

Sleep Parameters

Sleep Parameters	Range	Mean	SD
SOL (minutes)	3.72 - 186.4	44.5	34.9
WASO (minutes)	1.05 – 224.95	62.4	41.2
TST (minutes)	140 – 598	332.5	68.1
TSP (minutes)	305 – 691	496.2	62.1
SE (%)	22.6 – 93.05	67.3	12.9

Note. SOL = Sleep Onset Latency expressed in minutes, WASO = Wake After Sleep Onset expressed in minutes, TST = Total Sleep Time expressed in minutes, TSP = Total Sleep Period expressed in minutes, and SE = Sleep Efficiency expressed in percentage.

Fatigue and Functional Status

Scores on the Vitality Subscale of the Medical Outcomes Study Short-Form 36 varied between 0 and 100, with a mean of 51.1 (±21.0) reflecting a moderate level of fatigue (Ware et al., 1993). The scores on the physical function subscale ranged from 0 to 100, with a mean of 73.4 (±24.0), implying a moderate-high level of overall physical function. The mean score on the social function subscale was 80.6 (±22.6; range: 12.5 -100), representing a moderately high level of social functioning. The scores on the psychological function subscale ranged from 24 to 100,

with a mean of 75.1 (±16.0) indicating a moderately high level of psychological functioning.

Depressive Symptoms

Participants' scores on the Centre for Epidemiological Studies Depression Scale (CES-D) varied between 0 and 44. The mean score was 12.1 (±8.0) reflecting an overall low level of depressive symptomatology (Radloff, 1977).

Correlations Among Variables

Pearson's product-moment correlational coefficients were calculated to quantify the relationships among the study variables and are presented in Table 3. Overall, sleep parameters were significantly associated with each other with one exception; sleep onset latency (SOL) and wake after sleep onset (WASO) were not related. Both SOL and WASO were negatively and significantly related to sleep efficiency (SE), ($r = -.53$, and $r = -.49$; all p's $< .01$). Additionally, total sleep time (TST) was found to be highly and positively associated with SE ($r = .78$, $p < .01$). Overall, these findings indicate that lower levels of SE reflect longer periods of wakefulness (SOL and WASO) and decreased TST. These findings confirmed SE is an appropriate parameter that reflects overall level of sleep disturbance. Therefore, SE was used as an independent variable, representing sleep quantity or the objective indicator of insomnia, in the regression analysis.

In general the results indicated that sleep parameters were significantly related to sleep quality or perceived insomnia severity (measured with the ISI) although the magnitude of these relationships was small. SOL was positively associated with insomnia severity ($r = .19$, $p < .05$), as was WASO ($r = .15$, $p < .05$). These associations suggested that longer periods of SOL or WASO are associated with higher levels of self-reported insomnia severity. TST and SE were

negatively related to insomnia severity (r = -.26 and -.29, respectively; all p's < .01), indicating that longer periods of TST and higher levels of SE were reflective of less severe perceived insomnia. Total sleep period (TSP) was not significantly related to perceived insomnia severity.

Generally, sleep parameters were not significantly related to any of the functional status measures, although there were some exceptions. Weak, negative relationships were found between WASO and physical function (r = -.17, p < .05), as well as between TSP and physical function (r = -.17, p < .05). In addition TST was found to be positively related to social functioning (r = .19, p < .01), although the magnitude of this relationship was small.

Results indicated that sleep parameters were not significantly related to fatigue with one exception. A positive association of a small magnitude was found between SE and fatigue (r = .17, p < .05). This finding implied that individuals with high sleep efficiency experienced low levels of fatigue. Additionally, perceived insomnia severity was negatively but moderately associated with fatigue (r = -.45, p < .01), suggesting that individuals with severe insomnia experienced increased fatigue.

A moderately strong and positive relationship was found between fatigue and all three domains of functional status; physical function (r = .31, p < .01), social function (r = .53, p < .01), and psychological function (r = .54, p < .01). Increased fatigue levels were associated with decreased physical, social, and psychological function.

Depressive symptoms were not significantly associated with any sleep parameter. However, a positive relationship of a moderate magnitude was found between perceived insomnia severity and depressive symptoms (r = .37, p = .01); thus, individuals with high levels of insomnia severity also experienced severe depressive symptoms. In addition, depressive

symptoms were negatively and moderately associated with fatigue ($r = -.58$, $p < .01$), suggesting that high levels of depressive symptoms were accompanied by high fatigue levels. Finally, negative relationships were noted between depressive symptoms and all three domains of functional status. The inverse association between depressive symptoms and physical function was significant although weak ($r = -.29$, $p < .01$), while strong, significant relationships were observed between depressive symptoms and social function ($r = -.62$, $p < .01$), as well as psychological function ($r = -.74$, $p < .01$). The negative relationships indicate that high levels of depressive symptoms are associated with low levels of physical, social, and psychological functioning.

Table 3

Pearson's Product-Moment Correlations Among Study Variables

	SOL	WASO	TSP	TST	SE	ISI	CES-D	PF	SF	VS
WASO	-.09									
TSP	.26**	.24**								
TST	-.33**	-.30**	.43**							
SE	-.53**	-.49**	-.21**	.78**						
ISI	.19*	.15*	.02	-.26**	-.29**					
CES-D	.12	-.02	.01	-.10	-.12	.37**				
PF	-.03	-.17*	-.17*	-.07	.06	-.09	-.29**			
SF	-.04	-.02	.13	.19**	.12	-.31**	-.62**	.29**		
VS	.00	-.13	-.08	.10	.17*	-.45**	-.58**	.31**	.53**	
MF	-.07	-.03	.03	.10	.10	-.30**	-.74**	.21**	.56**	.54**

Note. N = 178. SOL = sleep onset latency, WASO = wake after sleep onset, TSP = total sleep period, TST = total sleep time, SE = sleep efficiency, ISI = Insomnia Severity Index, CES-D = Centre for Epidemiological Studies Depression Scale, PF = Physical Function, SF = Social Function, VS = Vitality Scale (fatigue), MF = Psychological Function.

* $p < 0.05$. ** $p < 0.01$.

Mediated Regression Analyses

The hypothesized mediated relationship was examined in four steps. The results of the mediational analyses are presented for each indicator of insomnia severity (perceived insomnia severity and sleep efficiency) and each domain of functional status (physical, social, and psychological). The confounding effect of depressive symptoms was controlled in each step of the analysis.

Perceived insomnia severity and physical function. Results of the mediation analysis for the dependent variable, physical function are summarized in Table 4. Step 1 in this analysis examined the relationship between perceived insomnia severity and physical function controlling for depressive symptoms. Insomnia did not significantly predict physical function directly. Step 2 examined the relationship between insomnia and fatigue controlling for depressive symptoms. Insomnia significantly predicted fatigue. In step 3, fatigue significantly predicted physical function after controlling for depressive symptoms. Step 4 re-examined the relationship between perceived insomnia severity and physical function controlling for both fatigue (i.e., the mediator) and depressive symptoms. The β value obtained in Step 1 ($\beta = -.07$, $p = .31$) was larger than the β value observed in Step 4 ($\beta = -.01$, $p = .9$), suggesting that fatigue partially mediates the relationship between insomnia and physical function. The computed value of the indirect path ($ab = -.35$) appears larger than the value of the direct path ($c' = -.05$). Preacher and Kelley (2011) suggest this finding is further evidence that fatigue mediates the relationship between insomnia and physical function. Overall, severe insomnia is associated with high fatigue levels, which in turn, are related to decreased physical function, controlling for depressive symptoms, as depicted in Figure 3.

Table 4

Summary of mediation regression analysis for perceived insomnia severity and fatigue predicting physical function, controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	SE B	β
Step 1:					
IV:					
Insomnia			-.41	.40	-.07
Depression			-.88	.22	-.30**
DV:					
Physical Function	.11	12.13**			
Step 2:					
IV:					
Insomnia			-1.31	.29	-.27**
Depression			-1.29	.15	-.50**
DV:					
Fatigue	.42	69.70**			
Step 3:					
IV:					
Fatigue			.35	.09	.31**
Depression			-.39	.24	-.13
DV:					
Physical Function	.16	18.88**			

Step 4:				
IV:				
Insomnia			-.05	.42	-.01
Fatigue			.27	.10	.24*
Depression			-.54	.25	-.18*
DV:				
Physical Function	.15	10.59**			

Note. IV = independent variables, DV = dependent variable.

** p < .001. * p < .05.

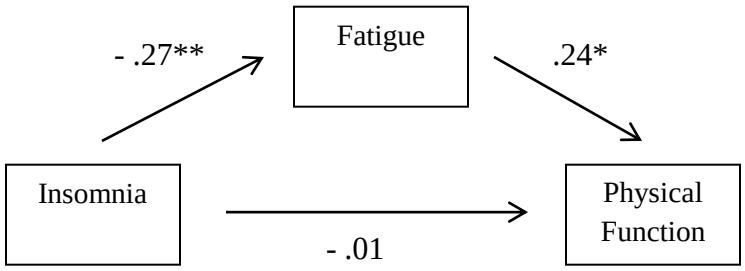

Figure 3. Final mediated model of relationships between insomnia, fatigue, and physical function controlling for depressive symptoms.

** p < .001. * p < .05.

Perceived insomnia and social function. Results of the second mediation analysis for the dependent variable social function are presented in Table 5. In Step 1 of this analysis, insomnia severity significantly predicted social function, controlling for depressive symptoms. In step 2, insomnia was found to be significantly associated with fatigue controlling for depressive symptoms. Step 3 examined the relationship between fatigue and social function controlling for

depressive symptoms. Fatigue was found to significantly predict social function. Step 4 re-examined the relationship between perceived insomnia and social function, controlling for both fatigue (i.e., the mediator) and depressive symptoms. Insomnia was no longer significant in predicting social function. A comparison of observed β values in Step 1 (β = - .13, $p < .05$) and in Step 4 (β = -.07, $p = .278$) revealed that the β value obtained in Step 4 was smaller and non-statistically significant, suggesting that fatigue completely mediates the relationship between insomnia and social function controlling for depressive symptoms. The computed indirect path (ab = -.33) was found to be very close to the value of the direct path (c' = -.34). This finding provides further evidence of a mediated relationship, where severe insomnia is associated with high levels of fatigue, which in turn, negatively impacts social function. Figure 4 presents a model depicting the association among insomnia, fatigue, and social function, controlling for depressive symptoms.

Table 5

Summary of mediation regression analysis for perceived insomnia severity and fatigue predicting social function, controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	SE B	β
Step 1:					
IV:					
Insomnia			-.68	.31	-.13*
Depression			-1.72	.16	-.61**
DV:					
Social Function	.45	76.49**			

Step 2:					
IV:					
Insomnia			-1.31	.29	-.27**
Depression			-1.29	.15	-.50**
DV:					
Fatigue	.42	69.70**			
Step 3:					
IV:					
Fatigue			.29	.07	.27**
Depression			-1.32	.18	-.47**
DV:					
Social Function	.44	79.90**			
Step 4:					
IV:					
Insomnia			-.34	.32	-.07
Fatigue			.25	.08	.23*
Depression			-1.39	.19	-.49**
DV:					
Social Function	.48	57.52**			

Note. IV = independent variables, DV = dependent variable.

** $p < .001$. * $p < .05$.

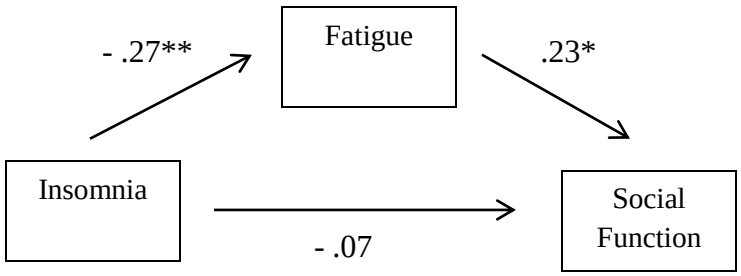

Figure 4. Final mediated model of relationships between insomnia, fatigue, and social function controlling for depressive symptoms.

** $p < .001$. * $p < .05$.

Perceived insomnia severity and psychological function. Results of the third mediation analysis for the dependent variable psychological function are presented in Table 6. Step 1 of this analysis determined that perceived insomnia severity did not predict psychological function directly, controlling for depressive symptoms. Step 2 examined the relationship between perceived insomnia and fatigue, controlling for depressive symptoms. Findings were consistent with the two previous models and indicated that perceived insomnia significantly predicted fatigue. In Step 3 fatigue was found to be significantly associated with psychological function, controlling for depressive symptoms. The relationship between perceived insomnia and psychological function, controlling for fatigue (i.e., the mediator) and depressive symptoms, was re-examined in Step 4. The β value observed in Step 4 ($\beta = .01$, $p > .05$) suggested no significant relationship between insomnia and psychological function when the mediator (i.e., fatigue) was controlled. Additionally, the computed value of the indirect path ($ab = -.18$) appeared larger than the value of the direct path ($c' = .04$). This finding indicates that fatigue mediates the relationship between insomnia and psychological function (Preacher and Kelley, 2011). Together these results suggest that severe insomnia results in high levels of fatigue that further results in

decreased psychological function, when depressive symptoms are controlled, as depicted in Figure 5.

Table 6

Summary of mediation regression analysis for perceived insomnia severity and fatigue predicting psychological function controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	SE B	β
Step 1:					
IV:					
Insomnia			-.14	.19	-.04
Depression			-1.49	.10	-.74**
DV:					
Psychological Function	.57	125.75**			
Step 2:					
IV:					
Insomnia			-1.31	.29	-.27**
Depression			-1.29	.15	-.50**
DV:					
Fatigue	.42	69.70**			

Step 3:					
IV:					
Fatigue			.13	.04	.17*
Depression			-1.27	.12	-.63**
DV:					
Psychological Function	.55	126.64**			
Step 4:					
IV:					
Insomnia			.04	.20	.01
Fatigue			.14	.05	.17*
Depression			-1.31	.12	-.65**
DV:					
Psychological Function	.59	89.52**			

Note. IV = independent variables, DV = dependent variable.

** p < .001. * p < .05.

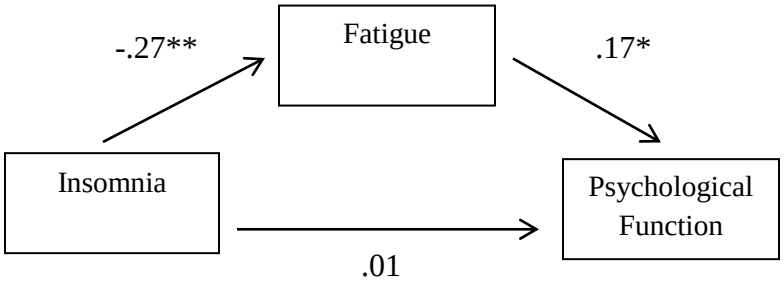

Figure 5. Final mediated model of relationships between insomnia, fatigue, and psychological function controlling for depressive symptoms.

** p < .001. * p < .05.

Sleep efficiency and physical function. Step 1 of the mediation analysis was to determine the direct relationship between sleep efficiency (SE) and physical function controlling for depressive symptoms. Results of the first regression analysis indicated that SE did not significantly predict physical function. Results of Step 2 suggested that SE did not significantly predict fatigue when depressive symptoms were controlled. Steps 3 and 4 found a positive relationship, of a moderate magnitude, between fatigue and physical function, controlling for depressive symptoms. However, given that SE must be significantly associated with fatigue to meet the requirements of mediation, these findings suggest that there is no mediated relationship between SE and physical function, as summarized in Table 7.

Table 7

Summary of mediation regression analysis for SE and fatigue predicting physical function controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	SE B	β
Step 1:					
IV:					
SE			-.01	.12	-.01
Depression			-.80	.21	-.27**
DV:					
Physical Function	.07	7.25*			

Step 2:					
IV:					
SE			.10	.10	.06
Depression			-1.55	.17	-.56**
DV:					
Fatigue:	.32	45.07**			
Step 3:					
IV:					
Fatigue			.35	.09	.31**
Depression			-.39	.24	-.13
DV:					
Physical Function	.16	18.88**			
Step 4:					
IV:					
SE			-.04	.20	-.01
Fatigue			.68	.15	.36**
Depression			-.79	.41	-.15
DV:					
Physical Function	.21	17.14**			

Note. SE = sleep efficiency, IV = independent variables, DV = dependent variable.

** $p < .001$. * $p < .05$.

Sleep efficiency and social function. Results of the second mediation analysis for the dependent variable social function are presented in Table 8. SE did not significantly predict social function when depressive symptoms were controlled in Step 1 of the analysis. Again in Step 2, SE did not significantly predict fatigue controlling for depressive symptoms. A positive association of small magnitude was found between fatigue and social function, controlling for depressive symptoms, in steps 3 and 4. Given that mediation requires a significant association between SE and fatigue, these findings indicate there is no mediated relationship between SE and social function.

Table 8

Summary of mediation regression analysis for SE and fatigue predicting social function controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	B SE	β
Step 1:					
IV:					
SE			.08	.10	.05
Depression			-1.64	.17	-.58**
DV:					
Social Function	.34	49.89**			

Step 2:					
IV:					
SE			.10	.10	.06
Depression			-1.55	.17	-.56**
DV:					
Fatigue:	.32	45.07**			
Step 3:					
IV:					
Fatigue			.29	.07	.27**
Depression			-1.32	.18	-.47**
DV:					
Social Function	.44	79.90**			
Step 4:					
IV:					
SE			.05	.09	.30
Fatigue			.27	.07	.27**
Depression			-1.22	.19	-.43**
DV:					
Social Function	.39	40.69**			

Note. SE = sleep efficiency, IV = independent variables, DV = dependent variable.

** $p < .001$. * $p < .05$.

Sleep efficiency and psychological function. Results of Step 1, examining the relationship between SE and psychological function, indicated that SE did not significantly predict psychological function controlling for depressive symptoms. The relationship between SE and fatigue, controlling for depressive symptoms, was examined in Step 2 and was not significant. Steps 3 and 4 found a weak positive association between fatigue and psychological function, controlling for depressive symptoms. However, given the requirement that SE be significantly related to fatigue to support mediation, these findings suggest there is no mediated relationship between SE and psychological function. Results of this mediation analysis are summarized in Table 9.

Table 9

Summary of mediation regression analysis for SE and fatigue predicting psychological function controlling for depressive symptoms (n = 193)

Variable	R^2	F	B	B SE	β
Step 1:					
IV:					
SE			.05	.06	.04
Depression			-1.49	.11	-.71**
DV:					
Psychological Function	.51	100.40**			

Step 2:					
IV:					
SE			.10	.10	.06
Depression			-1.55	.17	-.56**
DV:					
Fatigue:	.32	45.07**			
Step 3:					
IV:					
Fatigue			.13	.04	.17*
Depression			-1.27	.12	-.63**
DV:					
Psychological Function	.55	126.64**			
Step 4:					
IV:					
SE			.03	.06	.02
Fatigue			.12	.05	.16*
Depression			-1.31	.13	-.62**
DV:					
Psychological Function	.53	71.44**			

Note. SE = sleep efficiency, IV = independent variables, DV = dependent variable.

** $p < .001$. * $p < .05$.

Summary of Findings

In general, findings of the present study demonstrated that older, community-dwelling adults experienced moderately severe insomnia. Insomnia was directly associated with social function and indirectly related to physical and psychological function. Fatigue mediated the indirect relationship between insomnia and all three domains of functional status (physical, social, and psychological).

Chapter 5

Discussion

In this chapter results of the study are discussed. The purpose of this secondary analysis was threefold: 1) to examine the severity of insomnia in community-dwelling older adults, 2) to determine the relationship between insomnia and the physical, social, and psychological domains of functional status, controlling for depressive symptoms, and 3) to examine the role of fatigue as a mediator of the relationship between insomnia and physical, social, and psychological functioning. Characteristics of the sample are reviewed. Next, the relationship between insomnia and physical, social, and psychological functioning is interpreted relative to existing literature. The role of fatigue as a mediator within the relationship between insomnia and the three domains of functional status is discussed. Strengths and limitations of this study are identified. Lastly, implications for nursing practice and research are suggested.

Sample Characteristics

The sample for this study was obtained from a large methodological study, previously described (Sidani et al., 2007). The original sample consisted of persons with chronic insomnia, manifested as difficulty falling and/or staying asleep for at least 3 months. A subgroup of 209 community-dwelling older adults (aged ≥ 65) was selected from the larger study for this investigation. Overall, the demographic characteristics of the sample are representative of older adults with insomnia. The average age of participants in the current study was 73.1 years, which is comparable to that reported in other studies examining insomnia in older adults (Hidalgo et al., 2007). In addition, most participants were women, consistent with other studies targeting older persons with insomnia (Gureje et al., 2009; Hidalgo et al., 2007; Schubert et al., 2002). On

average, participants in the current study had experienced their insomnia for 11.8 years, which is comparable to the duration reported by Lichstein et al. (2001) and Byles et al. (2005). Together these findings highlight the long term nature of insomnia that is typical for older adults living in the community.

Findings from the present study indicate that overall participants experienced moderate levels of insomnia severity. This was consistent for both the subjective perception of insomnia severity or sleep quality (measured with the Insomnia Severity Index) and the objective sleep parameters reflecting sleep quantity (assessed with the daily sleep diary). The moderate level of insomnia severity observed in this study is comparable to that reported by other researchers examining insomnia in older adults (Byles et al., 2005; Lichstein, et al., 2001). These findings suggest that older community-dwelling adults with insomnia typically experience a moderately severe level of insomnia.

Insomnia and Functional Status

In this section findings of the present study are compared to findings of previous studies that have examined the relationship between insomnia and physical, social, and psychological functioning. The discussion that follows identifies possible explanations for inconsistent results found in this study and across studies that have examined insomnia and functional status.

Insomnia and physical function. Results of the regression analyses in the current study suggest that there is no direct relationship between insomnia, operationalized as either perceived insomnia severity (measured with the Insomnia Severity Index) or sleep efficiency (assessed with the daily sleep diary), and physical function when depressive symptoms were controlled. This finding is consistent with results reported by Byles et al. (2005) and Hidalgo et al. (2007).

Conversely several authors found an inverse relationship between insomnia and physical function implying that higher levels of insomnia are associated with lower levels of physical function (Gureje et al., 2009; Lichstein et al., 2001; Motivala et al., 2006; Reid et al., 2006; Schubert et al., 2002).

Insomnia and social function. A direct relationship between insomnia and social function, controlling for depressive symptoms, was partially supported by findings of this study. Sleep efficiency, reflecting sleep quantity, was not directly associated with social function. However, perceived insomnia severity was found to be directly associated with lower social functioning similar to previously reported findings (Hidalgo et al., 2007; Lichstein et al., 2001; Schubert et al., 2002). The results of three studies did not support the inverse relationship between insomnia and social function (Byles et al., 2005; Gureje et al., 2009; Motivala et al. 2006).

Insomnia and psychological function. No significant direct relationship was found between either perceived insomnia severity or sleep efficiency and psychological function when depressive symptoms were controlled. This finding is not congruent with existing literature that has examined this relationship and has consistently identified a negative relationship between insomnia and psychological functioning (Byles et al., 2005; Gureje et al., 2009; Hidalgo et al., 2007; Lichstein et al., 2001; Motivala et al., 2006; Reid et al., 2006; Schubert et al., 2002).

Overall findings of this study and prior research examining the relationship between insomnia and functional status, across all three domains, have produced inconsistent results. Several possible explanations are presented for the inconsistent findings.

First, insomnia and the three domains of functional status were not operationalized in the same/similar way across studies. Given that the psychometric properties of different instruments vary, it is possible that there were subtle differences in the constructs that were assessed across studies. Measuring different aspects of either insomnia or functional status may have impacted the accuracy in operationalizing the two concepts and therefore the consistency in the relationship observed between the two variables. Further, two studies failed to utilize reliable and valid instruments to assess insomnia (Reid et al., 2006; Schubert et al., 2002). Instead these studies utilized a limited number of sleep questions to identify the presence of insomnia. The use of insomnia measures of questionable psychometric properties would result in increased error of measurement. Error of measurement attenuates the relationship between insomnia and functional status, thereby reducing the power to detect significant association (Lipsey, 1990).

Second, studies have inconsistently controlled for sleep apnea, depressive symptoms, and/or comorbid chronic health conditions that may impact both insomnia and functional status and confound the relationship between the two. Russell and Duntley (2011) note that in older adults sleep apnea is a highly prevalent primary sleep disorder that is etiologically distinct from insomnia. Further, Buysse et al. (2006) have identified that the presence of sleep apnea in patients included in research studies evaluating insomnia may affect the reported levels of insomnia severity. Additionally, research evidence suggests that sleep apnea, resulting in fragmented sleep and daytime sleepiness, is associated with decreased functional status in older adults (Frohnhofen, Heuer, Pfundner, & Orth, 2007). As noted, prior research has inconsistently controlled for depressive symptoms that may also confound the relationship between insomnia and physical function. Empirical evidence suggests depressive symptoms are significantly associated with both insomnia (Jaussent et al., 2011) and functional status (Motivala et al., 2006)

in older adults. In addition, older adults frequently experience comorbid chronic health conditions that have been associated with increased levels of insomnia severity and decreased functional status (Fagerström & Hellström, 2011). The experience of comorbid conditions among a large number of patients included in a study and the interference of these conditions with functional status could limit the variability of functional status scores. Such restricted functional score ranges could reduce the chance of detecting significant associations. Inconsistent control for sleep apnea, depressive symptoms, and the presence of comorbid conditions explains the conflicting results reported across studies examining the relationship between insomnia and functional status. Future research should control for all three potentially confounding variables to enhance the validity of the relationship between insomnia and functional status.

Third, inconsistent results may be related to a failure to examine variables that mediate the association between insomnia and functional status. Finding a nonsignificant relationship between insomnia and physical and psychological function, suggests the presence of an intervening variable. In the current study, the mediating effect of fatigue was examined. Fatigue that is a consequence of poor sleep may limit the functional status of older adults and threaten independence and overall well-being. Reduced functional ability in older adults has been associated with institutionalization (Luppa et al., 2010), hospitalization (Miller & Weissert, 2000) and increased overall health care utilization (Gill et al., 2001) that reflect poorer overall health. Identifying factors such as insomnia and associated fatigue that may impact the functional status of older adults offers the possibility of intervening to improve functioning in this vulnerable population and has implications for nursing practice.

This study is unique in that it examined the relationship between functional status and perceived insomnia severity (a measure of sleep quality), as well as sleep efficiency (a measure of sleep quantity). Previous research has not examined both subjective sleep quality measures and objective sleep quantity measures and their relationship to functional status. Further the present study found a significant direct relationship between perceived insomnia severity and social functioning, but a nonsignificant relationship between sleep efficiency and social function. Together these findings suggest that subjective feelings of poor sleep quality and resulting fatigue are more relevant to social participation than objectively measured parameters of sleep quantity. The exact mechanism explaining the observed pattern of association between the subjective and objective indicators of insomnia and functional status is not clear and requires further exploration. Nonetheless, the current results indicate that older adults who perceive they have poor sleep may limit social activity thus increasing their risk of loneliness and social isolation that threatens overall health and quality of life (Segrin & Domschke, 2011).

Overall, variability in findings of studies examining insomnia and functional status in older adults may be related to several factors that should be investigated in future research. Future studies should overcome prior limitations through the consistent use of reliable and valid measures of insomnia and functional status, the control of potentially confounding variables, and continued examination of a potential mediating variable, such as fatigue. Finally, further examination of the subjective nature of insomnia and its relationship to functional status should be more fully explored.

Fatigue as a Mediator in the Relationship Between Insomnia and Functional Status

When insomnia was operationalized as sleep quality, fatigue was found to mediate the relationship between perceived insomnia severity and all three domains of functional status (i.e., physical, social, and psychological) controlling for depressive symptoms, in community-dwelling older adults. These findings indicate that severe insomnia is associated with high levels of fatigue that negatively impact physical, social, and psychological functioning. Prior research has not examined fatigue as a mediator in the relationship between perceived insomnia severity and functional status in older adults. However, there is evidence supporting the individual relationships within the mediated model. Empirical evidence has identified that insomnia is associated with cognitive (Bastien et al., 2003; Blackwell, et al., 2006; Edinger et al., 2008; Haimov et al., 2007; Nebes et al., 2009; Schmutte et al., 2007; Vignola et al., 2000) and physical fatigue (Dam et al., 2008; Goldman et al., 2007; Stenholm et al., 2010). A significant association was found between insomnia and general fatigue in older adults (Alapin, et al., 2000; Goldman et al., 2008). In addition, a negative association between high levels of fatigue and reduced physical functioning was reported (Avlund et al., 2003; Hardy & Studenski, 2008; Moreh et al., 2010). Similar to the current study, Fortier-Brochu et al. (2010) examined the relationships among insomnia, fatigue, and functional status in an adult population. They found that adults experiencing both severe insomnia and severe fatigue experienced significantly lower physical, social, and psychological functioning compared to individuals with severe insomnia and mild fatigue. This finding suggests fatigue as a mediator through which insomnia impacts functional status. In the latter study, insomnia was measured subjectively, as was also done in the current study.

Results of the present study indicated there was a nonsignificant relationship between sleep efficiency, reflecting sleep quantity, and fatigue. This finding suggests that for older adults fatigue does not mediate the relationship between insomnia, operationalized as sleep efficiency, and any of the domains of functional status, controlling for depressive symptoms. The finding is consistent with the results of Fortier-Brochu et al.'s (2010) study; these researchers examined insomnia and fatigue in adults over the age of 30. They found that subjectively reported insomnia, reflecting sleep quality, was significantly associated with fatigue, whereas there was no significant relationship found between objectively measured insomnia, reflecting sleep quantity, and fatigue. In contrast, the current study finding that sleep efficiency was not associated with fatigue is inconsistent with some previous empirical evidence. Goldman et al. (2008) reported an association between general fatigue and the sleep parameters, short duration total sleep time (≤ 6 hours), sleep onset latency, and wake after sleep onset. However Goldman et al. failed to use a reliable and valid measure of sleep parameters; sleep parameters were assessed with a limited number of sleep questions administered at one point in time. As such, participants' responses may have been affected by recall bias and may not have been reflective of true sleep parameters. Additional empirical evidence suggests sleep parameters are associated with cognitive (Bastien et al., 2003; Blackwell, 2006) and physical fatigue (Dam et al., 2008; Goldman et al., 2007). However, three of these studies assessed sleep parameters with wrist actigraphy (Blackwell et al., 2006; Dam et al., 2008; Goldman et al., 2007). Older adults with insomnia tend to report total sleep times that are shorter when documented in sleep diaries than those reported by actigraphy (Van Den Berg et al., 2008; Vallières & Morin, 2003). Given that sleep efficiency is calculated using total sleep time, it may be that participants' estimation of sleep efficiency is not comparable across studies and may account for the inconsistent results

found in the current study. Alternately, results from these studies reflect cognitive and physical fatigue, but given that the present study assessed general fatigue, results may not be comparable. The literature identifies that fatigue in older persons is a multifaceted concept (Yu et al., 2010), with cognitive and physical indicators. As such future research examining the association between insomnia and fatigue should include measures of cognitive, physical, and general fatigue to more fully understand the impact of insomnia on different types of fatigue.

Results of the current study suggest that fatigue mediates the relationship between subjective insomnia and functional status. Yu et al. (2010) reviewed quantitative and qualitative studies examining fatigue in older adults. Findings of this review provide insights into the possible mechanism by which fatigue mediates the relationship between insomnia and functional status. The authors described fatigue as a subjective, multidimensional concept that may be the result of multiple etiologies including poor sleep. They noted that research evidence suggests the effects of fatigue, including reduced energy reserve, are debilitating and distressing for older adults. Yu et al. further indicate that functional capacity limited by fatigue impairs both physical abilities and social participation; that is, persons who feel tired reduce their engagement in physical and social activity in an attempt to cope with fatigue. Additionally, Yu et al. explain that feelings of fatigue and lack of energy that limit activity may culminate in frustration and despair, threatening the psychological well-being of older adults.

In summary, results of the current study suggest it is the perception of poor sleep quality, rather than objective sleep quantity that influences feelings of fatigue and appears to reduce self-reported physical, social, and psychological function in older adults. This implies that total sleep quantity is less important than the non-restorative nature of poor quality sleep in affecting fatigue levels. Conflicting results suggest that insomnia may impact cognitive, physical, and general

fatigue differently. Further examination of the subjective experience of insomnia versus objective sleep parameters and their impact on fatigue and functional status is warranted.

Strengths and Limitations

The present study utilized a large sample size, compared to other studies examining insomnia in older adults, with sufficient power to detect relationships among variables. It has overcome some of the methodological short-comings of previous research examining the relationship between insomnia and functional status in community-dwelling older adults. The exclusion of individuals with sleep apnea and statistical control of depressive symptoms reduced the potential confounding effect of these variables, and is an improvement on some prior research. Finally, this study adds to the existing literature examining insomnia in older adults in that it examined the role of fatigue as a mediator in the relationship between insomnia and functional status. In spite of these strengths, the cross-sectional study design limits the reporting of causal relationships among variables and has implications for future research examining the relationship between study variables. While the present study did control for depressive symptoms there was no control for any other physical conditions known to be associated with insomnia including: arthritis, heart failure, pulmonary disease, gastrointestinal disorders (NIH, 2005), chronic pain (Chen, Hayman, Shmerling, Bean, & Leveille, 2011) and cancer (Jiménez et al., 2011). Failure to measure and control such conditions could have influenced the relationship between insomnia and functional status.

Implications

Findings from this study indicate that insomnia is associated with fatigue, which in turn negatively impacts physical, social, and psychological functioning in community-dwelling older adults. This finding has implications for nursing practice and research.

Nursing practice. Overall, insomnia and fatigue in older adults are determinants of functional status outcomes. This association highlights the importance of a comprehensive nursing assessment, inclusive of perceptions of sleep quality and associated fatigue, as an initial step in planning primary care in this population. Assessing and identifying insomnia, that may result in fatigue and consequently decrease functional status, is imperative as a first step for improving and/or maintaining functional status in older adults. There is no empirical evidence examining current nursing practice regarding sleep assessment in older adults within the context of day-to-day primary care practice. As such, educating nurses about the potential impact of insomnia on fatigue and functional status and the need for routine sleep assessments in this population may be warranted. Such assessments should use the Insomnia Severity Index, which is reliable, valid, and clinically meaningful. Second, it is important for nurses to develop awareness and understanding that management of both insomnia and fatigue in older adults may impede declines in functional status, which in turn, may impact independence and overall well-being. Research evidence supports the efficacy of different behavioural interventions that nurses can implement to decrease the severity of insomnia. Such behavioural approaches include educating older adults regarding good sleep hygiene, stimulus control, sleep restriction, relaxation techniques, and exercise to improve insomnia in older clients (Irwin, Cole, & Nicassio, 2006; Morin et al., 2006; Morin, Mimeault, & Gagné, 1999). In addition, engagement in regular physical activity has been shown to increase energy and reduce fatigue (Puetz,

O'Connor, & Dishman, 2006). Through a targeted approach of managing both insomnia and fatigue, nurses may improve functional status in community-dwelling older adults, contributing to their overall health and well-being.

Nursing research. Results of the current study have implications for future research. First, a mixed methods study may offer more insight into similarities and differences between the subjectively lived experience of insomnia and the objectively measured experience of insomnia. Conflicting results obtained in this study suggested that fatigue was associated with subjective perception of insomnia severity, but not objective measures of sleep parameters. MacKinnon, Fairchild, and Fritz (2007) suggest that mixed methodology studies may further clarify mediated relationships and enhance understanding of the mechanism underlying the relationship among variables. Collecting and interpreting data that are both quantitative and qualitative may provide a clearer understanding of older persons' subjective experiences of poor sleep quality and resulting fatigue. Qualitative data may reveal information related to how functional status is affected and limited by insomnia and fatigue. Future research that qualitatively explores the perceptions of older adults with insomnia and fatigue, relative to objective measures of insomnia and fatigue may help to clarify the inconsistent findings obtained in the current study.

Second, given the high correlation between depressive symptoms and insomnia, fatigue, and functional status additional research examining the potential moderator effect of depressive symptoms within the mediated relationship is warranted. MacKinnon and Fairchild (2009) suggest that examining potential moderators within a mediated relationship can be used to establish the stability of the mediated relationship across different populations, i.e., older adults with mild depressive symptoms versus those with moderate or severe depressive symptoms.

Further they suggest that evidence of "moderated mediation" enhances generalizability of reported findings.

Third, future research examining the relationships among insomnia, functional status, and fatigue in older adults should measure and control for existing comorbid chronic conditions that may confound these relationships. Many chronic conditions are prevalent in older adults. Some of these conditions, such as arthritis, heart failure, pulmonary disease, chronic pain and cancer, are known to be associated with insomnia (NIH, 2005). Controlling for such physical conditions would limit their potential to confound relationships between study variables and enhance interpretation of findings.

Fourth, given the multidimensional nature of fatigue, future research examining the relationships among insomnia, functional status, and fatigue, should assess not only general fatigue, but also cognitive and physical aspects of fatigue. Such an examination may more fully explain the nature of fatigue that is associated with insomnia, and may provide insights into additional interventions that can be implemented to reduce fatigue and improve functional status.

Fifth, investigation of the mediated relationship should be undertaken utilizing a repeated measure design. Such a design would determine if the indirect relationship between insomnia and functional status mediated by fatigue found in this study is stable over time (MacKinnon et al., 2007). Sequential data collection of each study variable over time, i.e., insomnia at time 1, fatigue at time 2, and functional status at time 3, may provide evidence of temporal order necessary for determining causality among study variables.

Conclusion

Results of this secondary analysis suggest that older adults living in the community may experience insomnia that results in fatigue, which in turn, negatively impacts physical, social, and psychological functioning. Despite some limitations, the findings have implications for both nursing practice and research. Primary care nurses working with older adults should routinely assess for insomnia and fatigue utilizing valid and reliable instruments. Further it is important to implement behavioural interventions targeting both insomnia and fatigue to maintain or improve functional status in this population. Future research should be focussed on developing a more complete understanding of the fatigue mediated relationship between insomnia and functional status in older adults. Approaches to future research should include: a mixed methods design, control of existing chronic conditions, an examination of the moderator effect of depressive symptoms, an examination of the relationship between insomnia and different types of fatigue, and a repeated measure design.

Appendices

Appendix A

Summary of Studies Examining Prevalence of Insomnia in Community-Dwelling Older Adults

Source	Purpose	Design	Population	Concepts	Instruments	Results	Critique
Foley et al. (1995)	To determine the prevalence of sleep complaints in three community based cohorts of older adults.	Comparative descriptive design.	9 282 community dwelling, men and women aged 65 years and older, residing in East Boston, MA, New Haven, CT, and Iowa. Stratified sample from census data.	-Insomnia	Insomnia: Subjective reports of difficulty falling asleep and/or early awakening most of the time.	Insomnia was prevalent in 23-34% of older adult participants. Women reported significantly more frequent sleep disturbance than men. There was no significant increase in frequency of insomnia associated with increasing age.	Did not use a valid and reliable instrument to assess insomnia.
Gureje, Kola, Ademola, & Olley (2009)	To determine the profile of insomnia and impact of insomnia on overall health and health related quality of life (HRQoL) a sub-Saharan older adult population.	Cross sectional survey.	2 152 community dwelling, men and women aged 65 years and older, residing in Nigeria. Stratified sample from census data.	-Insomnia -Depression -Chronic physical conditions -QoL	Insomnia: World Mental Health Survey version of the WHO Composite International Diagnostic Interview (CIDI). Depression: CIDI depression module Chronic Physical Conditions: Subjective report HRQol: WHO Quality of Life Brief Assessment	Insomnia defined as difficulty maintain sleep and/or difficulty maintaining sleep and/or early morning awakening for > 2 weeks was prevalent in 30.7% of participants. Insomnia was found to be significantly associated with depression and having any chronic medical condition. Controlling for gender, age, depression comorbidity and pain insomnia was	Sample is not representative of populations of older persons residing in Western countries.

						significantly related to decreased physical and psychological domains of HRQoL but not social domain of HRQoL.	
Hidalgo et al. (2007)	To assess the relationship between insomnia and: level of physical functioning, psychosocial well-being, depression and anxiety symptoms and consumption of psycho-pharmaceuticals of older adults.	Cross sectional, observational study.	424, community dwelling, men and women aged 65 years and older, residing in the province of Albacete, Spain. Stratified sample of public health card-holders.	-Insomnia -Depression and Anxiety -Cognition -Physical Function -Psychosocial well-being -Health problems	Insomnia: Diagnostic and Statistical manual of Mental Disorders IV criteria for insomnia Depression and Anxiety: Goldberg's Depression and anxiety Scale Cognition: Short Portable Mental Status Questionnaire Physical Function: ADL's The Katz Index, IADL's Instrumental Activities of Daily Living Scale Psychosocial well-being: The Philadelphia Geriatric Centre Morale Scale Health Problems: International Classification of Health Problems in Primary Care	34.2 % of participants had sleep problems, 20.3% met the criteria for insomnia. Insomnia was significantly higher in women (27.2%) than in men (11.4%). Insomnia was significantly higher in participants with depression and anxiety. There was no significant relationship between insomnia and cognitive status. There was no association between insomnia and either ADL's or IADL's. There was a significant relationship between insomnia and psychosocial functioning. Number of health problems was significantly higher in participants with insomnia.	No control for depressive symptoms. Findings may not be generalizable to North American population of older adults.

Jaussent et al. (2011)	To examine the factors associated with insomnia in community-dwelling older persons as a function of the nature and number of insomnia symptoms.	Cross sectional, correlational	5 886 men and women aged 65 years or older. Randomly selected from electoral polls of 3 French cities.	Insomnia Chronic Disease Depressive Symptoms	Insomnia questionnaire Chronic disease self-report Depressive symptoms: Centre for Epidemiological Studies-Depression Scale	More than 70% of participants reported 1 insomnia symptom. Significantly more women (75%) than men (70%) experienced insomnia. Factors significantly associated with insomnia in men and women included the use of sleeping medication, nightmares, sleepiness, chronic diseases and depression.	Study did not use a valid and reliable instrument to measure insomnia. No control for sleep apnea. Findings may not be generalizable to a North American older adult population.
Reid et al. (2006)	To determine the occurrence and recognition of common sleep-related problems and their relationship to health-related quality of life in older persons.	Cross sectional, descriptive	1 503 men and women aged 60-100 years from 11 primary care sites in Illinois.	Insomnia Health-related QoL	Insomnia: Sleep questionnaire HRQoL: MOS SF-12	68.9% of participants reported 1 sleep complaint and 39.6% had 2 or more sleep complaints. 45% of respondents indicated they had difficulty falling asleep, falling asleep or being able to sleep.	Study did not use a valid and reliable instrument to measure insomnia. No control for sleep apnea or depression. Questionable reliability and validity of SF-12.
Schubert et al. (2002)	To determine the prevalence of insomnia traits and the effects of these traits on health-related QoL (HRQoL)	Population based, cross sectional, correlational	2 800 men and women aged 53-97 years. Residing in the community in the township of Beaver Dam, Wisconsin	Insomnia HRQoL	Insomnia: 3 item sleep questionnaire. HRQoL: MOS SF-36	Overall, 49% of participants reported at 1 or more insomnia traits. 26% of participants reported one insomnia trait, 13% reported 2 or more insomnia traits, 10% reported 3	Study did not use a valid and reliable instrument to measure insomnia. No control for depression or sleep apnea.

						insomnia traits. Having 1 insomnia trait significantly decreased functioning in the physical, psychological and social domains of SF-36. When additional insomnia traits were present there was a further significant decrease in physical, social and psychological domains.	
Su, Huang, & Chou (2003)	To determine the prevalence and risk factors for self-reported insomnia in older adults.	Cross sectional survey.	2 045 men and women aged 65 years or older, residing in the Shi-Pai community in Taipei, Taiwan. Door to door survey.	Insomnia Cognition Depression	Insomnia: DSM IV criteria, Pittsburgh Sleep Quality Index Cognition: Mini-Mental State Exam Depression: Geriatric Depression Scale	6% of participants met the criteria for current insomnia. 8.9% of participants were found to have depression. There was significantly higher prevalence of depression in participants with insomnia. Significant risk factors for insomnia included, nocturnal micturition, lack of education, bodily pain, depressive symptoms and hypnotic use. 8.4% of participants regularly used hypnotics.	Door to door sampling with 45.4% refusal may not have been a representative sample. Sample may not be representative of older adult populations residing in North America. There was no control for other primary sleep disorders.

Appendix B

Summary of Studies Examining Insomnia and Cognitive Fatigue

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Bastien et al. (2003)	To evaluate the relationship between objective and subjective sleep quality and objective and subjective evaluation of cognitive performance in older adults with chronic insomnia or self-reported good sleepers.	Comparative correlational design	60 men and women age 55 and older. 3 groups: Insomniacs, insomniacs taking benzodiazepines, and good sleepers. Urban centre in Quebec.	Objective sleep Subjective sleep Insomnia Verbal and Visual Memory Psychomotor speed Attention and concentration Executive functions	Polysomnography Sleep diary Insomnia Severity Index Verbal paired associates I Verbal paired associates II Visual Reproduction I Visual reproduction II Digital symbol substitution test Purdue pegboard Trailmaking Tests A and B Wilkenson's four-choice reaction time Digit span forward Digit span backward Wisconsin card sorting test	In insomniacs difficulties initiating sleep were significantly related to decreased verbal memory, slower psychomotor speeds and reduced attention and concentration when compared to good sleepers.	Convenience sample may not be representative of population. Small number of participants. Participants were older adults in excellent physical and psychological health and may not be representative of all older adults.
Blackwell et al. (2006)	To examine the association between objectively measured sleep with cognitive function in older	Cross sectional, observational.	2 932 women aged 65 years and older, residing in the community. Recruited from population based listings in	Sleep Cognitive function	Actigraph measurement and self- report Mini-Mental State Exam Trail making B test	Poorer cognitive performance on both MMSE and Trail Making B, were associated with longer sleep latency, reduced	Limitations self -reporting of time spent in and out of bed may have been inaccurate and

	women.		Baltimore MA, Minneapolis MN, Portland OR, and Monongahela Valley, PA			sleep efficiency and longer wake after sleep onset	may have affected calculated sleep/wake times. Study only included women and is not generalizable to older adult population as a whole.
Edinger, Means, Carney, & Krystal (2008)	To examine psychomotor (reaction time) performance deficits and their relation to subjective and objective sleep measures among individuals with primary insomnia (PI).	Matched group, cross sectional design.	79 adults with PI (43 women), 84 adult normal sleepers (NS) (41 women), aged 20-79 years, in North Carolina	Objective sleep Subjective sleep Napping behaviour Daytime sleepiness Performance testing	3 consecutive nights polysomnography Sleep diary Multiple Sleep Latency Test Stanford Sleepiness Scale Simple Reaction Time Test (SRT) Continuous Performance Test (CPT) Switching Attention Test (SAT)	MANOVAs conducted with age as a covariate indicated that age was did not significantly influence findings. For all age groups there were no significant differences between PI and NS on simple SRT and CPT; however there were significantly longer response latencies for PI on more challenging SAT testing.	Small sample size. Convenience sample. 131 of 163 subjects were Caucasian. Overall sample may not be representative of general population.

Haimov, Hadad, & Shurkin (2007)	To assess whether late-life insomnia, independent of underlying etiology, may account for disproportionate declines in visual processing of global structure among older adults.	Group comparison	21 young adults without insomnia 11 older adults (age ≥ 65) without insomnia 11 older adults (age ≥ 65) with insomnia.	Subjective sleep Objective Sleep Cognition Depression Visual Processing	Mini Sleep Questionnaire Technion Sleep Questionnaire Actigraphy X 1 week Mini Mental State Exam Geriatric Depression Scale (older adults) Zung Self-Rating Depression Scale (younger adults) Global/local paradigm.	Older adults with insomnia experienced significantly lower ability to integrate global images.	Convenience sampling may not be representative of population. Small number of participants, may lack sufficient power. Subjective sleep parameters assessed with instruments with questionable reliability and validity
Nebes, Buysse, Halligan, Houck, & Monk (2009)	To examine the relationship between sleep quality and cognitive performance in older adults, controlling for common comorbidities.	Comparative	157 older adults, age 65-80 years, residing in the community. Divided into 2 groups: good sleepers N=108 and poor sleepers N=49	Sleep quality Depression Information Processing Speeds Working memory Inhibitory function Attention Shifting Abstract Reasoning Episodic Memory	Pittsburgh Sleep Quality Index Conceptual Geriatric Depression Scale Conceptual Comparison task N-Back test Letter-Numbering sequencing Stroop Test Hayling Test Trail Making B Test of Non-verbal Intelligence (TONI) The Logical Memory Test Repeatable Battery	Poor sleeper performed significantly worse than good sleepers on the RBANS (cognitive impairment), TONI (abstract reasoning) and Trail Making B (attention shifting) and on N-Back Test (working memory). After controlling for depression significant differences remained in all measures except N-Back.	Convenience sample, recruited through adverts, may not be representative of population. Sleep disordered breathing was not controlled, recognized association with cognitive impairment. Sleep quality may have been biased due to retrospective self-reporting.

				General Neuropsychological Status	for Assessment of Neuropsychological Status (RBAN)		
Schmutte et al. (2007)	To examine the relation between self-reported sleep complaints and cognitive abilities.	Cross sectional	375 men and women aged 75-85 years, Bronx, NY	Sleep Cognitive Status	54 item sleep questionnaire. Blessed Information-Memory-Concentration Test (BIMC) Fuld object-memory evaluation Selective reminding task Category fluency test Raven's progressive matrices, Set A Purdue pegboard test Verbal Subtests of the Wechsler Adult Intelligence Scale (WAIS)	Participants with sleep onset latencies greater than 30 minutes had significantly poorer scores on verbal measures indicating impaired memory (short and long term), , digit span and months backwards indicting impaired concentration, and similarities testing indicating poorer abstract reasoning.	Population sample was 90% Caucasian, not a representative sample. Convenience sample obtained through adverts and word of mouth.
Vignola, Lamoureux, Bastien, & Morin (2000)	To evaluate the impact of sleep disturbances and chronic use of benzodiazepines (BZ) on cognitive and psychomotor performance of older adults.	Comparative group	60 community dwelling older adults aged 55 years and older. 3 groups: 20 insomniacs drug free, 20 insomniacs taking BZ, 20 self-reported good sleepers	Objective Sleep Subjective Sleep Neuropsychological Measures	Polysomnography Sleep Diary Wechsler Adult Intelligence Scale Verbal Paired Associates Visual Reproduction Digit Span Symbol Digit Substitution Perdue Pegboard Test Trail Making Teat Wilkinson Four-Choice Reaction Time Test Wilkinson card Sorting Test	Insomnia group performed significantly worse on Digit Span testing that good sleepers indicating difficulties with attention, concentration and working memory. On most measures there were no significant differences between groups. However insomniacs subjectively rated	Convenience sampling through adverts. Small sample size may not have sufficient power to detect differences between groups.

						their performance as lower. This may reflect the increased compensatory efforts that individuals with insomnia put forth to maintain abilities.	

Appendix C

Summary of Studies Examining Insomnia and Physical Fatigue

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Dam et al. (2008)	To determine whether sleep quality is associated with physical function in older men.	Cross-sectional	2 862 community dwelling men aged ≥ 65, without bilat hip replacement and able to independently ambulate. Study pop. was a cohort of the Osteoporotic Fractures in Men Study. Subjects were recruited from 6 clinical centres in the U.S.	Objective sleep Physical function Daytime sleepiness Physical activity level	1 night polysomnography Wrist actigraphy X 5 consecutive 24 hour periods Grip strength Gait speed Narrow walking course Chair rise Epworth Sleepiness Scale Physical activity Score for the Elderly (PACE)	Actigraph measured sleep efficiency of <80% and wake after sleep onset ≥ 90 minutes were significantly associated with poorer performance on all physical function measures controlling for age. In addition, longer sleep latency was significantly associated with inability to perform a chair stand. Sleep apnea was not significantly related to poorer physical function measures	Convenience sampling. Study subjects all men, 90% Caucasian and in general healthy. As such, population may not be representative of the general older adult population.
Goldman et al. (2007)	To examine the association between disturbed sleep and poorer daytime function in older women.	Cross-sectional	2 889 community dwelling women aged ≥ 65 without bilat hip replacement. Study pop. was a cohort of The Study of Osteoporotic Fractures recruited from 4 clinical centres	Sleep Physical function Functional limitations Depression	Wrist actigraphy X 4 24 hour periods 6 meter usual pace test (gait speed) Ability to chair rise X 5 Time to complete 5 chair stands Grip strength Self-report of IADL difficulty (≥ one of six IADLs) Geriatric depression scale	Women with shorter total sleep time (TST) (<6 hours and wake after sleep onset (WASO > 1.6 hr.) had slower gait speeds, were less likely to be able to perform 5 chair stands and if able to do chair stands were slower than others. There was no association between	Convenience sampling. Study subjects all women, 90% Caucasian and 75% reported good-excellent health. As such, population may not be representative of older adult population in general.

			in the U.S.	Anxiety Cognitive function Comorbidity	Goldberg Anxiety Scale Mini-Mental Status Exam Comorbidity index (0, 1, 2, 3+)	grip strength and TST. However WASO ≥ 1.6 hr. was associated with decreased grip strength. TST < 6 hr. and > 7.5 hr. had higher odds of functional limitations than those who sleep 6.8-7.5 hr.	
Stenholm et al. (2010)	To examine the association between sleep-related factors and measured and self-reported mobility in older adults.	Cross-sectional survey	2 825 men and women (w 1693) aged ≥ 55 residing in Finland.	Sleep duration Insomnia Fatigue Mobility Measures	Self-report Sleep related questions from Symptom Checklist (SCL-90) Fatigue related questions from Symptom Checklist (SCL-90) Maximal walking speed (6.1 m) Questions related to ability to walk .5 km and ability to climb a flight of stairs	Analysis compared 2 groups age 55-64 and ≥ 65. Short sleep ≤ 6 hr. and long sleep ≥ 9 hrs. was more prevalent in indiv. ≥ 65. After adjusting for covariates short sleep was associated with higher odds of decreased walking speeds in women ≥ 65. And in men 55-64. Sleeping disorders or insomnia were independently associated with slower walking speeds and mobility limitation in men ≥ 65, but only mobility limitation in women ≥ 65 Sleep related daytime "weakness" or "tiredness" was	Questionable reliability of instruments to measure insomnia and fatigue. Self-reporting of sleep duration may be inaccurate. Study was conducted in Finland and as such, may not be representative of North American older adult population.

						associated with decreased walking speeds and higher odds for mobility limitations in men and women ≥ 65.	

Appendix D

Summary of Studies Examining Insomnia and General Fatigue

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Alapin et al. (2000)	To investigate subjective perceptions of daytime functioning in both young and older good and poor sleepers. To compare subjective perceptions of daytime functioning of highly distressed poor sleepers and poor sleepers who manifest little distress about their sleep. To explore the relationship between various aspects of daytime functioning and sleep parameters, psychologically laden sleep variables and psychological adjustment	Cross-sectional, group comparison	194 (145 women) community dwelling older adults aged 57-96, living in Montreal 136 (73 women) second year university students aged 17-47, living in Montreal	Sleep Tension related to falling sleeping Daytime Sleepiness Difficulty in concentrating due to lack of sleep Fatigue Neuroticism Anxiety Depression	Brief sleep questionnaire One question Stanford Sleepiness Scale One question Fatigue Eysenck Personality Inventory-neuroticism subscale Spielberger State-Trait Anxiety Inventory Test Anxiety Scale Beck Depression Inventory	Regardless of age subjects complaining of insomnia experience significantly worse night time sleep and perceive more daytime impairments than good sleepers. Highly distressed poor sleepers reported significantly more fatigue, sleepiness and difficulty concentrating during the day. Highly distressed poor sleepers were less well- adjusted psychologically than either good sleepers or low-distress poor sleepers. High and low distress sleepers did not vary significantly on sleep parameters, however highly distressed poor sleepers reported significantly more daytime sleepiness and poorer concentration. In the older adult group	Approximately 75% of older adults in study were members of a university affiliated seniors group and were in good-excellent health, were as the younger age group were all university students, as such study population may not be representative of the wider population. Utilization of instruments that may not be reliable and valid to measure concepts of sleep, daytime concentration and fatigue. No control for other primary sleep disorders.

						sleep parameters were significantly related to both daytime fatigue and concentration, but not daytime sleepiness. Depression and anxiety were moderately associated with daytime sleepiness and weakly associated with fatigue and concentration in the older adult group.	
Goldman et al. (2008)	To examine the contribution of night time sleep quality (duration and complaints) to fatigue symptoms.	Cross-sectional	2 264 community dwelling older adults (48.4% women) residing in Pittsburgh, PA and Memphis TN	Sleep/napping Insomnia Fatigue Depression	2 questions related to usual sleep and nap duration 4 questions related to typical night time sleep patterns Revised Piper Fatigue Scale Centre for Epidemiological Studies Depression Scale	Daytime fatigue was significantly related to short (≤ 6 hr) and long (≥ 8 hr) sleep duration Daytime fatigue was significantly related to sleep latency, night time and early morning awakening and use of sleeping medications Women had significantly higher fatigue levels than men after controlling for potentially cofounding variables	Concepts of sleep/napping and insomnia were not measured with reliable and valid instruments. Sample population was noted to be high functioning and may not be representative of general older adult population. No control for other primary sleep disorders.

Appendix E

Summary of Studies Examining Insomnia and Functional Status

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Byles, Mishra and Harris (2005)	To measure sleeping difficulty, explore experience and attitudes towards sleep, and test for negative association between sleeping and health-related quality of life.	4 year longitudinal, Cohort comparison This study drew data from 3rd survey of women participating in the Australian Longitudinal Study of Women's Health (ALSWH)	1 011 community dwelling women aged 74 – 80 years, randomly selected from the Australian Longitudinal Study of Women's Health. Participants were divided into 4 groups (1) sleeping badly and taking sleeping meds (n=125), (2) not sleeping badly and taking sleeping meds (n=376), (3) sleeping badly not taking sleeping meds (n= 258), (4) not sleeping badly and not taking sleeping meds (n=252)	Sleep Daytime Sleepiness Health Related Quality of Life Social Support Depression Life Events Comorbidities Symptoms interfering with sleep	Nottingham Health Profile – Sleep Subscale (NHP-SS) (Survey 2 and 3) Pittsburgh Sleep Quality Index (PSQI)(Survey 3) Epworth Sleepiness Scale (ESS) SF-36 (Survey 1 and 3) Duke Social Support Index Geriatric Depression Scale Life Event Scale Self-report Self-report	There were significant differences between groups in terms of mean scores on NHP-SS, PSQI and ESS. Women with sleeping difficulty reported a range of symptoms including pain, breathing discomfort, coughing, snoring and bad dreams as contributors to sleeping difficulties. Most women with sleeping difficulties or med use reported it is harder to sleep with aging. 76% of women in group 4 indicated they get enough sleep, while only 35%-52% of individuals in other groups felt their sleep was adequate. Initially, PSQI was negatively associated with all 8 subscales of the SF-36, however the relationships between PSQI and the physical and social subscales of the SF-36 were no longer	Although the NHP and PSQI are reliable and valid measures of sleep there was no measure of insomnia symptoms per se. Subjects of this study were already participants in the ALSWH study and were chosen for participation based on poor sleep or medication use and may not be representative of the general population of older women.

						significant after controlling for baseline sf-36 scores, comorbidities, symptoms, GDS, life events, and use of sleeping medications. A significant negative effect remaining for the psychological subscale of the SF-36 after controlling for confounding variables.	
Gureje, Kola, Ademola and Olley (2009)	To provide information on the profile, comorbidity and impact of insomnia among an understudied group of elderly Nigerians.	Cross-sectional, stratified	2 152 community dwelling older adults aged ≥ 65, (1 157 women), residing in south-western and north-central regions of Nigeria	Insomnia Depression Chronic physical conditions Quality of life (QoL, functional status)	World Mental Health survey of the WHO Composite International Diagnostic Interview (CIDI) Depression module of CIDI Checklist of common conditions experienced in past 12 months by self-report WHO Quality of Life Assessment Instrument (WHOQOL-Bref)	Insomnia defined as having difficulty initiating sleep (DIS), difficulty maintaining sleep (DMS) and/or early morning awakening (EMA) for ≥ 2 weeks in past 12 months was present in 30.7% of sample. Reported prevalence: DMS (24.4%), DIS (22.9%), EMA (22.9%). Women had an elevated risk for all forms of insomnia. Pain, heart disease hypertension and asthma were significantly higher in individuals with insomnia. Controlling for age and gender individuals with insomnia were at greater risk for falls. Controlling for age,	Participants were selected using a multi-stage stratified area probability sampling of households. However, the study was undertaken in Nigeria and as such, may not be representative of older adults living in North America. Most concepts measured with valid and reliable instrument that were translated using iterative back-translation method with cultural adaptation. However, both

						gender pain medical conditions and depression both DIS and DMS were significantly related to the physical and psychological domains of functional status , but not the social domain.	insomnia and chronic physical conditions were based on self-report which may not have been accurate. Further, insomnia was assessed over past 12 months, while QoL (functional status) was only assessed over last few weeks, as such insomnia may not have overlapped with QoL measured.
Hidalgo et al. (2007)	To evaluate the relationship between primary insomnia in the elderly patient and the following variables: physical functioning, depression, anxiety symptoms, psychological well-being and consumption of psychopharmaceutics.	Cross-sectional	424 community dwelling older adults aged ≥ 65 (58.3% women), residing in Albacete province, Spain.	Primary Insomnia	DSM-IV criteria: DIS, DMS or non-restorative sleep X 1 month -sleep disturbance (SD) causes clinically sig, distress or impairment in social, occupational or other areas of functioning -SD does not occur with other primary sleep disorder (e.g. SDB) -SD does not occur	34.2% of individuals had sleep problems, 20.3% met criteria for PI. PI was significantly higher in elderly with anxiety or depressive symptoms. There was no significant associating between PI and cognitive impairment. 76.7% of subjects were independent for ADLs. The remaining 22.9% were considered dependent for ≥ 1 ADL.	Sample was randomly selected from register of public health card holders, however the population resides in south eastern Spain and may not be representative of North American older adults. Although the overall sample size was 424, only 86 subjects

				Depression and anxiety Cognitive state Physical function Life satisfaction (social functioning and mental well-being) Health problems	exclusively with another mental disorder -SD is not due to the direct effect of substances or a general medical condition Goldberg's Depression and Anxiety Scale Short Portable Mental Status Questionnaire Katz Index (ADLs) Instrumental Activities of Daily Living Scale The Philadelphia Geriatric Centre Morale Scale (PGCMS) International Classification of Health Problems in Primary Care	Dependent subjects did not experience higher rates of PI, than independent subjects. 48.1% of subjects had some IADL impairment, there was no signif. Association between IADL impairment and PI. Scores on the PGCMS (social and psychological function) were significantly lower in subjects with PI. 26.9 % of all subjects consumed psychopharmaceuticals regularly. In general PI subjects consumed signif. more medications than those without PI. Overall, variables found to be associated with PI through regression were existence of an anxiety disorder, a score below the 50th percentile on the PGCMS (social and psychological function) and intake of hypnotics, anxiolytics and/or neuroleptics.	met the criteria for PI. A sample of 86 may have lacked statistical power to detect significant relationships between PI and study variables through regression.

Lichstein, Durrence, Bayen and Riedel, (2001)	To compare daytime and night time functioning of older adults with primary insomnia, secondary insomnia and no insomnia	Cross-sectional cohort comparison	189 older adults aged ≥ 58 years, residing in the Southern United States. Three groups: Primary Insomnia n=82 (58 women), Secondary Insomnia n=46 (23 women) No insomnia (NS) n=61 (35 women)	Primary Insomnia (PI) Secondary Insomnia (SI) Depression Anxiety Sleep Measure Daytime Functioning Overall Health (comorbidity) General Health (functional status)	a)-sleep latency and/or awake during the night > 30 minutes, 3/week AND b) self-report of dissatisfaction with sleep AND c) sleep problem duration > 6 months a, b and c and a determination that sleep disorder was caused by another disorder Geriatric Depression Scale (GDS) State-Trait Anxiety Inventory (STAI) Sleep diary, 2 weeks Insomnia Impact Scale (IIS) Epworth Sleepiness Scale (ESS) Fatigue Severity Scale (FSS) Cornell Medical Index (CMI) SF-36	For overall sleep measures both PI and SI experienced worse sleep than NI on all sleep variables except daytime napping. There were no significant differences in sleep measures for PI and SI. Daytime functioning: IIS: SI significantly worse than PI and NS, and PI was signif. worse than NI. FSS: SI signif. worse than PI and NI, no difference between PI an NI. ESS: PI signif. sleepier than SI and NI, no difference between SI and NI. STAI and GDS: SI signif. worse anxiety and depression than PI and NI, PI signif. worse than NI. Overall health: SI was signif. worse than PI and NI, PI was signif. worse than NI. General Health (functional status): physical, social and psychological subscales all had the same pattern of findings: SI was signif. worse than PI and NI,	Individuals with PI were screened for sleep apnea, individuals included in the SI group were not screened for sleep apnea, may have resulted in poorer sleep for this group. Differentiating between PI and SI can be difficult, some individuals may have been placed in the wrong group. Overall, study sample was small and may lacked power to detect differences between groups.

						however PI and NI did not signif. differ. Vitality subscale (fatigue) SI signif. worse than PI and NI, and PI signif. worse than NI. Additionally, 2 sleep variables predicted daytime impairment, NAP in PI group, and SOL in SI group. Sleep efficiency was not significantly related to any measures (STAI, GDS, SF-36 or CMI).	
Motivala, Levin, Oxman and Irwin (2006)	To determine whether older adults with a history of depression show impairments in health functioning and sleep quality at a gradient between older adults with no history of depression and those with current major depression and to examine whether poor sleep quality contributes to declines in health functioning in addition to the contribution of depressive symptoms.	Cross-sectional	400 community dwelling older adults aged ≥ 60 years, residing in the western United States. Participants recruited were part of a larger study, The depression Substudy of the Shingles Prevention Study. Three groups: History of depression (HD) (n=143) (women 60.1%), Current Depression (CD) (n=67)	Depression Sleep Quality Comorbidity Health Functioning	Psychiatric DSM-IV diagnosis Beck Depression Inventory (BDI) Pittsburgh Sleep Quality Index (PSQI) Chronic Disease Score (CDS) SF-36	BDI scores indicated that the CD group had significantly worse depressive symptoms than HD and ND groups. Those with HD had significantly more depressive symptoms than ND group. PSQI scores indicated that CD group had significantly worse sleep quality than HD and ND groups. The HD group had significantly worse sleep quality than ND group. There were no significant group differences for chronic disease (CDS). Results from the SF-36	As participants were part of larger shingles study, it was noted that overall the study sample was in very good health. Although not directly reported the authors noted that the sample population was predominantly white. For these reasons the study population may not be representative of the general older adult population. Sleep was only

			(women=61.2%) Control (no depression) (ND) (n=200) (women=50.5%)			indicated that on the physical and pain subscales of the SF-36 there were no significant differences between the HD and ND groups. However, the group with CD had significantly poorer scores in these subscales than both HD and ND. For the remaining subscales (role physical, general health, vitality, social function, role emotional and mental health) The CD group scores indicated signif. lower scores than both HD and ND groups. Additionally, HD group scored significantly lower than ND on all 6 of these subscales. Regression: Controlling for depression (BDI), age, CDS, education and marital status, sleep quality (PSQI) was a significant predictor of decreased health functioning (functional status) on the physical and psychological subscales but not the social subscale of the SF-36.	measured subjectively through self-report on PSQI.

Reid et al. (2006)	To determine the occurrence and recognition of common sleep-related problems and their relationship to health-related quality of life (functional status) measures in the elderly.	Cross-sectional	1 503 community dwelling older adults (61.9% women), aged 62-100 years residing in Chicago and southern Illinois.	Sleep/sleep problems Health-related quality of life (functional status)	5 item sleep questionnaire (SQ5) SF-12 Physical and Mental Component Scores	70% of participants had at least 1 sleep complaint, 39.6% had 2 or more sleep complaints. 45% reported difficulty falling asleep, staying asleep or being able to sleep. 33% identified snoring interfered with sleeping. Sleep complaints of daytime sleepiness, difficulty sleeping, unrefreshed sleep, and involuntary sleep were all significantly related to lower SF-12 physical component scores, snoring was not. Sleep complaints of daytime sleepiness, difficulty sleeping, unrefreshed sleep, and involuntary sleep and snoring were all significantly related to lower SF-12 mental component scores.	Sample population was ethnically diverse but females were over represented in the sample as such may not be representative of general older adult population. Did not use a reliable and valid instrument to measure sleep complaints. No criteria to define insomnia. Questionable reliability and validity of SF-12 in this population. No control or measurement for other primary sleep disorders or depression.
Schubert et al. (2002)	To determine the prevalence of insomnia traits in a population and the effect of these traits on health-related quality of life (HRQoL).	Cross-sectional	2 800 community dwelling older adults (58.6% women), aged 53-97 years, residing in Wisconsin. Subjects were participants in the	Sleep difficulty HRQoL (functional status) Comorbidity	3 questions SF-36 Self-report	49% reported 1 insomnia trait, 10% reported 3 insomnia traits, based on often or almost always re: sleep questions. Overall, increasing number of insomnia traits resulted in significant decreases in all domains of SF-36,	Measure of sleep difficulty/quality did not utilize a reliable and valid tool. Comorbidity relied on self-reporting as did sleep may not be accurate. No control for depression or

			Epidemiology of Hearing Loss Study.			including physical, social and psychological function.	other primary sleep disorders i.e. SDB

Appendix F

Summary of Studies Examining Fatigue and Functional Status

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Avlund, Pedersen and Schroll (2003)	To analyse whether functional decline from age 80-85 is influenced by changes in self-reported tiredness in daily activities in the preceding 5-year period.	Longitudinal within group comparison	226 older adults aged 75 years (50% women), 5 and 10 year follow up, residing in the western region of Copenhagen County	Tiredness in daily activities Functional ability Cognitive function Depressive symptoms Chronic disease	Mob-T scale Mob-H Scale Clinical assessment by a psychologist Centre for Epidemiological Studies Depression Scale (CES-D) Physical assessment	Approximately 35% of subjects sustained good functional ability from age 75-80, 13% of men and 32% of women deteriorated but stayed alive while 32% of men and 17% of women died. 44% of men and 36% of women who were not tired at baseline remained not tired at age 80. 17% of men and 12% of women had developed tiredness, while 19% of men and 22% of women had resolved tiredness. 19% of men and 29% of women tired at baseline had sustained tiredness. Regression analysis revealed that sustained tiredness from age 75-80 predicted functional decline at age 85 controlling for covariates. In	Sample may not be representative of North American older adults. Small sample size.

						addition sustained tiredness from age 75-80 was associated with occurrence of death by age 85.	
Hardy and Studenski (2008)	To determine the association of general fatigue with functional trajectories over 3 years in older primary care patients.	3 year longitudinal study	496 community dwelling, older adults aged ≥ 65 (279 women) (80% white), residing in Pittsburgh PA.	Tiredness (fatigue) Functional status Depressive symptoms	Two questions related to tiredness over previous month FS-36 Physical Function Index National health Interview Survey Activities of Daily Living (NHIS) Gait speed over 4 m Geriatric Depression Scale (GDS)	At baseline 43% of participants reported feeling tired most of the time. Of those who reported tiredness 16% indicated it did not affect function, 29% indicated it affected their functioning "a little", 29% reported moderate limitation d/t tiredness and 26% indicated tiredness affected function 'quite a lot". Tiredness was associated with being female, white, comorbidity and having higher GDS score. Fatigue at baseline was associated with significantly worse baseline measures for all 3 functional outcomes (SF-36 PI, NHIS and gait speed) at baseline, controlling for age, gender, race, education, cognition, BMI, comorbidity and depressive	Sample population was predominantly white and may not be representative of older adult population overall. Conceptually, the authors indicated they were interested in general fatigue, but noted they were using synonym 'tiredness', slightly confusing. Did not measure fatigue/tiredness with a valid and reliable instrument.

						symptoms. Persons with tiredness had persistently worse functional status than those not tired over 3 year follow-up.	
Moreh, Jacobs and Stessman (2010)	To evaluate whether fatigue is associated with mortality at increasing ages up to and including the oldest old (> 85 years) and to evaluate if fatigue at progressively increasing ages is associated with subsequent health and functional status, from age 70 to age 85.	Longitudinal Cohort	Phase I – 460, 70 year old men and women, Phase II 858, 78 year old men and women, Phase III: 1162 85 year old men and women Deterioration in functional status and health measures was measured in two populations a) participants assessed at age 70 and 78 (n=312) and b) participants assessed at age 78 and 85 (n=545)	Fatigue Functional status Self-rated health Cognitive status Depression Chronic back or joint pain Global sleep satisfaction Major diseases Physical activity	One question, Do you feel generally tired? Performance on 6 ADLs One question Mini-Mental State Examination (MMSE) Brief Symptom Inventory (BSI) One question identifying pain > 1 month One question related to sleep satisfaction over previous month Self-report One question	At age 70 29% of participants reported baseline fatigue, at age 78, 53% of participants reported fatigue, at age 85, 65% of participants reported fatigue. Participants with baseline fatigue at age 70 had significantly more loneliness, poorer self-rated health, more ADL dependence and difficulty, lower physical activity and poorer sleep satisfaction than individuals with no fatigue at baseline. Participants with baseline fatigue at age 78, had significantly more loneliness, depression, ADL dependence and lower physical activity than participants with no fatigue at age 78	Measurement of fatigue was based one fatigue related question. Limitation on ADLs was dependent on self-report and may not have been reliable. Self-rated heath, global sleep satisfaction, major diseases and physical activity measures utilized only one question and were dependent on self-report which may not have yielded reliable and valid results.

						baseline. Regression analysis: after controlling for confounding variables, fatigue at age 70 significantly predicted poor self-rated health, ADL difficulty, low physical activity and poor sleep quality at age 78. After controlling for confounding variables fatigue at age 78 significantly predicted depression and loneliness at age 85.	

Appendix G

Summary of Study Examining Insomnia, Fatigue, and Functional Status in an Adult Population

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Fortier-Brochu, Beaulieu-Bonneau, Ivers and Morin (2010)	To explore the relations between sleep, fatigue, and health-related quality of life in a sample of individuals with chronic insomnia	Cross-sectional cohort comparison	160 individuals aged (97 women) ≥ 30 years (mean = 50.3 years [SD ± 10.1]), with primary insomnia (difficulty initiating and/or maintaining sleep, 3 or more times per week for greater than 6 months, accompanied by significant distress or functional impairment.	Objective sleep Subjective sleep Insomnia Fatigue Health-related quality of life (HRQoL) Depression Anxiety	3 consecutive nights of polysomnography (PSG) recording Sleep diaries for 2 weeks Insomnia Severity Index (ISI) Multidimensional Fatigue Inventory (MFI) SF-36 Beck Depression Inventory (BDI) Beck Anxiety Inventory (BAI)	The majority of participants (73.8%) reported mixed insomnia (sleep onset and maintenance). Average insomnia duration was 16.4 years (SD±13.6). Participants were divided into 4 groups based on MFI and PSG: a) severe sleep disturbance and severe fatigue (n=15), b) severe sleep disturbance and milder fatigue (n=15), c) milder sleep disturbance but severe fatigue (n=68) and d) milder sleep disturbance and milder fatigue. Overall, participants within the severe sleep disturbance groups presented with greater subjective sleep disturbances (sleep diaries). Participants classified within	The clustering of subjects into sleep disturbance/fatigue groups was based on PSG recording of sleep disturbance in a laboratory setting and may not be reflective of true sleep patterns in home settings.

						either cluster with severe fatigue generally exhibited lower HRQoL. Specifically, in the physical domain of the SF-36, individuals with severe sleep disturbance and severe fatigue had significantly poorer physical function than other 3 groups. Additionally, both groups with more significant fatigue had lower scores on the vitality domain (fatigue) of SF-36. On the social subscale of the SF-36 , both groups with severe fatigue had poorer social functioning than those with milder fatigue and milder sleep disturbance and those with severe fatigue and severe sleep disturbance had significantly poorer social functioning than those with severe sleep disturbance and milder fatigue. The group with less	

						severe insomnia and less severe fatigue had significantly better mental health scores on the SF-36 than both groups with severe fatigue. Results of linear regression indicated that poorer sleep disturbance composite scores from sleep diaries, higher levels of depressive symptoms on BDI and younger age predicted higher fatigue scores. Poorer composite physical health scores were predicted age, number of medical conditions and BAI scores. Composite mental health scores were predicted by BDI, age number of medical conditions and frequency of physical activity.	

Appendix H

Summary of Studies Examining Depressive Symptoms and Functional Status

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Gallegos-Carrillo et al. (2009)	To examine the influence of depressive symptoms on health-related quality of life among community dwelling older adults suffering from various categories of chronic comorbidity.	Population survey, cohort comparison	1 085 community dwelling older adults, aged ≥ 60 years residing in Mexico City. Subjects were randomly selected from social security lists.	Depressive symptoms Comorbid chronic medical illness Health-related quality of life (HRQoL)	Geriatric Depression Scale (Spanish) Self-report of medical diagnosis SF-36	26.8% of participants had depressive symptoms (GDS ≥ 6), 20.4% had no chronic diseases, 38.4% reported 1 chronic disease, 41.1% reported having 2 or more chronic diseases. Results of linear regression found associations between depressive symptoms and all subscales of the SF-36. Depressive symptoms in combination with chronic comorbidities were associated with the lowest HRQoL scores, independent of covariates.	Study conducted in Mexico City, as such study population may not be representative of older adult populations in Canada or the U.S. Comorbidity data was dependent on self-report of previous medical diagnosis of chronic disease and may not have been accurate.
Hybels, Pieper and Blazer, (2009)	To examine the impact of sub-threshold depression on change in functional status in a sample of community dwelling older adults over 10 years.	Longitudinal	4 162 older adults aged ≥ 65 years at baseline. Participants resided in 5 centres in North Carolina, 1 urban 4 rural. Approximately	Depressive symptoms (modified) Physical function: ADLs	Centre for Epidemiologic Studies Depression Scale (CES-D) Katz ADL Index (KAI)	19.9% of sample had several depressive symptoms, 11.1% had sub-threshold depression (GDS ≥ 6), and 8.8% were classified as having depression (GDS > 9) at baseline.	Examined only physical function decline over time. High percentage of participants died during study period, may have influenced results.

			50% of participants were deceased at 10 years.	IADLs Mobility Cognitive function Health status Perceived social support	Older Americans Resources and Services Survey (OARSS) 3 items, heavy work, stair climbing ability, ½ mile walk ability Short Portable Mental Status Questionnaire (SPMSQ) Number and impact of chronic conditions 1 question	Controlling for covariates, having GDS ≥ 6 at baseline predicted a significant increase of IADL limitations 3-4 years later. However, there was no significant difference in IADLs between individuals with 6-8 dep. Sym compared to those with GDS ≥ 9. Controlling for covariates GDS scores at baseline did not predict ADL or mobility limitations over time.	
Iwasa et al., (2009)	To examine longitudinal relationship between depression status and functional decline among Japanese community dwelling older adults.	Longitudinal, 12 year population based, prospective cohort study design.	710 community dwelling, older adults, aged ≥ 65 years, residing in the rural town of Akita in northern Japan	Functional capacity Higher level functional competence Usual walking speed Depression status	Four items related to basic ADLs Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) Timed 11m walk Geriatric Depression Scale (GDS) (Japanese)	At baseline depressed participants had significantly higher females, chronic disease, lived alone, hearing problems, physical pain, slower walking speeds and more dependence in both basic ADLs and higher level functioning, than non-depressed participants. Controlling for confounding variables depression	Study population was Japanese, as such the study population may not be representative of older adults residing in Canada or the U.S.

						status was significantly associated with basic ADL and higher level functioning decline over 12 years at all points of follow-up.	
Morala, Shiomi and Maruyama, (2006)	To examine the extent to which the functional status of older adults is explained by gender, age, geographical residence, level of cognitive function and depression.	Cross-sectional	Random sampling of 200 community dwelling, older adults (61.5% female) aged 65-80 years, residing in two communities in Southern Mindanao, Philippines.	Functional status Cognitive status Depressive symptoms	7 item Physical Performance Test (PPT) Mini-Mental State Examination (MMSE) Geriatric Depression Scale	33% of participants had mild cognitive impairment and 8% had severe cognitive impairment. 84.5% of subjects had possible depression based on GDS scores. PPT scores indicated that overall functional status was moderate. Multiple regression analysis found that controlling for confounding variables age, cognitive status, and depressive symptoms predicted functional status decline.	Sample population resided in the Philippines and may not be representative of older adult population residing in Canada and the U.S.
Motivala, Levin, Oxman and Irwin (2006)	To determine whether older adults with a history of depression show impairments in health functioning and sleep quality at a gradient between older adults with no history of	Cross-sectional	400 community dwelling older adults aged ≥ 60 years, residing in the western United States. Participants recruited were part of a larger	Depression Sleep Quality	-psychiatric DSM-IV diagnosis Beck Depression Inventory (BDI) Pittsburgh Sleep Quality Index (PSQI)	BDI scores indicated that the CD group had significantly worse depressive symptoms than HD and ND groups. Those with HD had significantly more depressive	As participants were part of larger shingles study, it was noted that overall the study sample was in very good health. Although not directly

	depression and those with current major depression and to examine whether poor sleep quality contributes to declines in health functioning in addition to the contribution of depressive symptoms.		study, The depression Substudy of the Shingles Prevention Study. Three groups: History of depression (HD) (n=143) (women 60.1%), Current Depression (CD) (n=67) (women=61.2%) Control (no depression) (ND) (n=200) (women=50.5%)	Comorbidity Health Functioning	Chronic Disease Score (CDS) SF-36	symptoms than ND group. PSQI scores indicated that CD group had significantly worse sleep quality than HD and ND groups. The HD group had significantly worse sleep quality than ND group. There were no significant group differences for chronic disease (CDS). Results from the SF-36 indicated that on the physical and pain subscales of the SF-36 there were no significant differences between the HD and ND groups. However, the group with CD had significantly poorer scores in these subscales than both HD and ND. For the remaining subscales (role physical, general health, vitality, social function, role emotional and mental health) The CD group scores indicated signif. lower scores than both HD and ND groups.	reported the authors noted that the sample population was predominantly white. For these reasons the study population may not be representative of the general older adult population. Sleep was only measured subjectively through self-report on PSQI.

						Additionally, HD group scored significantly lower than ND on all 6 of these subscales. Regression: Controlling for depression (BDI), age, CDS, education and marital status, sleep quality (PSQI) was a significant predictor of decreased health functioning on the physical and psychological subscales but not the social subscale of the SF-36.	
Schulman, Gaiola, Kuder and McCulloch, (2002)	To determine the association of depression with various demographic, medical, mental, physical functionality and social factors among community based older persons.	Cross-sectional, cohort comparison	117 (95 women) community dwelling older adults, aged ≥ 65 years, residing in rural and urban Kentucky	Cognitive function Depression status Physical function	Mini-Mental State Exam (MMSE) Geriatric Depression Scale (GDS) Katz Activities of Daily Living Scale including ADLs and IADLs	GDS scores (≥ 11) indicated that 31.6% of participants were depressed. Results of the regression analysis found significant relationships between depression and living in an urban setting, living alone, and IADL dependence.	Convenience sample of patients from health clinic, predominantly white and female may not be representative of older adult population in general.
Wada et al. (2005)	To examine the prevalence of screening based depression and the association of depression with activities of daily	Cross-sectional	2 695 community dwelling older adults aged ≥ 60 years, residing in Indonesia, Vietnam and	Depressive symptoms Functional status	Geriatric Depression Scale (GDS) 7 item Activities of daily Living Scale (ADLs)	Depression was prevalent in 33.8% of participants in Indonesia, 17.2% in Vietnam and 30.3% in Japan. Depressed participants in all 3	Sample was drawn from 3 Asian countries and as such may not be representative of older adult

	living (ADL) and quality of life (QoL) in community dwelling elderly in the developing and developed countries.		Japan.	Quality of Life	Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) 100 mm visual analogue scale (VAS) for 5 items, health, family relationships, friend relationships, financial status and subjective happiness	countries had significantly lower ADLs, IADLs and QoL than non-depressed participants.	population residing in Canada or the U.S. Instruments have not been validated in Indonesian and Vietnamese populations, and may not accurately assess concepts.
Wada et al. (2004)	To examine the prevalence of screening based depression and compared scores of activities of daily living (ADL) and quality of life (QoL) between community dwelling elderly subjects with and without depression in Japan.	Cross-sectional, cohort comparison	5 363 (58.3% women) community dwelling older adults, aged ≥ 65 years, residing in 4 Japanese communities	Depressive symptoms Functional status Quality of Life	Geriatric Depression Scale (GDS) 7 item Activities of daily Living Scale (ADLs) Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) 100 mm visual analogue scale (VAS) for 5 items, health, family relationships, friend relationships, financial status and subjective happiness	Approximately 1/3 of participants experienced mild depression while 10% had severe depression. Regression analysis found a significant relationship between depression and lower ADL functioning. Additionally, a comparison between non-depressed and depressed participants found that those who were depressed experienced significantly lower ADL independence and quality of life.	Sample population was drawn from older adults living in Japan. Although a developed country, the sample population is likely not representative of older adults residing in the U.S. and Canada.

Appendix I

Summary of Studies Examining Depressive Symptoms and Insomnia

Source	Purpose	Study Design	Population	Concepts	Instruments	Results	Critique
Cole & Dendukuri, (2003)	To determine risk factors for depression among elderly community subjects.	Systematic review and meta-analysis.	Inclusion of 20 studies: 23 058 subjects at baseline, 20 678 subjects at follow up and 1 694 with incident depression.			5 factors (bereavement, sleep disturbance, disability, prior depression and female gender) were identified as significant risk factors for the development of depression. The median interval between determination of risk factor status and depression status was 24 months.	Findings of this meta-analysis are dependent on the quality of studies used in the meta-analysis. Conceptual and methodological differences across studies examined may have impacted findings.
Jaussent et al., (2011)	To examine factors associated with insomnia in community-dwelling elderly as a function of the nature and number of insomnia symptoms.	Cross sectional survey	5 883 adults aged ≥ 65. 3 213 female residing in the community of 3 French cities.	Sleep complaints Existing medical conditions Life style factors Depressive symptoms	Self-report questionnaire Self-report of medical diagnosis Self-report questionnaire Centre for Epidemiological Studies Depression Scale (CES-D)	Insomnia complaints were found to be highly prevalent with 70% of subjects having at least 1 insomnia complaint. Difficulty maintaining sleep was the most common sleep complaint and was associated with increasing age. Difficulty initiating sleep was more prevalent in women and was associated with the use of sleep	Did not utilize a valid and reliable measure of insomnia. Self-report of medical conditions and lifestyle may not have been accurate. No control for other primary sleep disorders.

						meds. Women more frequently reported 2 or 3 insomnia complaints compared to men. Regression analysis found an independent association between insomnia and the use of sleeping medications, nightmares, sleepiness, chronic disease and depression.	
Mallon, Broman, & Hetta, (2000)	To investigate the natural history of insomnia and its association with depression and mortality in community-dwelling older adults.	Longitudinal survey.	2 663 adults aged 45-65 at baseline. 1 244 adults (659 female) aged 57-77 at 12 year follow up. Participants resided in County of Dalarna, Sweden.	Sleep difficulties Anxiety and depression	Uppsala Sleep Inventory Hospital Anxiety and Depression Scale (follow up only)	Chronic insomnia was reported by 36.0% of women and 25.4% of men. About 75% of subjects who had insomnia at baseline continued to have insomnia at follow up. Insomnia was found to be a significant risk factor for depression, but not mortality. Depression at baseline was associated with increased risk of mortality at follow up for men.	Baseline depression was not measured with a reliable and valid instrument. Long interval between baseline and follow up may not reflect continuity of events.
Motivala, Levin, Oxman and	To determine whether older adults with a history of	Cross-sectional	400 community dwelling older adults aged ≥ 60	Depression	Psychiatric DSM-IV diagnosis Beck Depression	BDI scores indicated that the CD group had significantly	As participants were part of larger shingles

Irwin (2006)	depression show impairments in health functioning and sleep quality at a gradient between older adults with no history of depression and those with current major depression and to examine whether poor sleep quality contributes to declines in health functioning in addition to the contribution of depressive symptoms		years, residing in the western United States. Participants recruited were part of a larger study, The depression Substudy of the Shingles Prevention Study. Three groups: History of depression (HD) (n=143) (women 60.1%), Current Depression (CD) (n=67) (women=61.2%) Control (no depression) (ND) (n=200) (women=50.5%)	Sleep Quality Comorbidity Health Functioning	Inventory (BDI) Pittsburgh Sleep Quality Index (PSQI) Chronic Disease Score (CDS) SF-36	worse depressive symptoms than HD and ND groups. Those with HD had significantly more depressive symptoms than ND group. PSQI scores indicated that CD group had significantly worse sleep quality than HD and ND groups. The HD group had significantly worse sleep quality than ND group. There were no significant group differences for chronic disease (CDS). Results from the SF-36 indicated that on the physical and pain subscales of the SF-36 there were no significant differences between the HD and ND groups. However, the group with CD had significantly poorer scores in these subscales than both HD and ND. For the remaining subscales (role physical, general health, vitality, social function, role emotional and	study, it was noted that overall the study sample was in very good health. Although not directly reported the authors noted that the sample population was predominantly white. For these reasons the study population may not be representative of the general older adult population. Sleep was only measured subjectively through self-report on PSQI.

						mental health) The CD group scores indicated signif. lower scores than both HD and ND groups. Additionally, HD group scored significantly lower than ND on all 6 of these subscales. Regression: Controlling for depression (BDI), age, CDS, education and marital status, sleep quality (PSQI) was a significant predictor of decreased health functioning (functional status) on the physical and psychological subscales but not the social subscale of the SF-36.	
Paudel et al., (2008)	To examine the association between depressive symptoms and subjective and objective measures of sleep in community-dwelling older men.	Cross-sectional	3 051 older men aged ≥ 60. Residing in 6 areas of the U.S. All were participants in a larger study: the prospective Osteoporotic Fractures in Men Study.	Depression Objective Sleep Parameters Subjective Sleep Quality Daytime Sleepiness	Geriatric Depression Scale Wrist actigraphy Pittsburgh Sleep Quality Index (PSQI) Epworth Sleepiness Scale (ESS)	Level of depressive symptoms in community-dwelling older men had a strong graded association with subjective sleep measures (PSQI and ESS), after controlling for potential confounding variables.	Sample included only men who were primarily white as such findings may not be applicable to other populations.

				Health Status Physical Activity	SF-12 Physical Activity Scale for the Elderly	Depressive symptoms were moderately associated with objective sleep measure (actigraphy) however after controlling for confounding variables this relationship was nonsignificant.	
Perlis et al., (2006)	To examine insomnia as a risk factor of depression and to determine whether sex and type of insomnia moderate the association between insomnia and depression.	Secondary analysis	147 older adults aged ≥ 60, residing in Rochester NY. 57% were women.	Depression Insomnia	Structured Clinical Interview for DSM-III-R (SCID) Hamilton Rating Scale for Depression (HAMD) Sleep questions of HAMD	Participants experiencing chronic insomnia were about 6 times more likely to develop a first episode of major depression within one year than those who did not have chronic insomnia at baseline. Middle insomnia is associated with greater risk of development of depression than late insomnia. Overall, women experienced significantly more insomnia and depression than men.	Limited assessment of insomnia, only three questions from HAMD. Indicated "middle" and "late" insomnia, but did not define terms.
Pigeon et al., (2008)	To examine the relationship of insomnia to the continuation of depression in elderly	Prospective	544 older adults aged ≥ 60 years from 18 clinical sites in the US. Participants	Insomnia Depression	Hopkins Symptom Checklist (3 questions) Structured Clinical	Participants with persistent insomnia were 1.8-3.5 times more likely to remain depressed	Limited assessment of insomnia status with three questions.

	subjects.		were part of a larger intervention study r/t depression.		Interview for DSM-III-R (SCID)	compared to participants with no insomnia. Enhanced care (intervention) partially mitigated the effect of insomnia on depression.	
Quan et al., (2005)	To determine the relative importance of somatic factors and mood in the development and persistence of sleep disturbance in an elderly cohort.	Longitudinal	4 467 community-dwelling older adults, aged ≥ 65. Participants were enrolled in the Cardiovascular Health Study. Participants resided in 4 communities in the U.S.	Sleep disturbance and snoring. Health status Cardiac status Activities of Daily Living and Instrumental Activities of Daily Living Depression	4 sleep related questions. Health questionnaire ECG Questionnaire Centre for Epidemiological Studies Depression Scale (CES-D)	Annualized incidence and non-remission rate of sleep problems were: trouble falling asleep (2.8%, 15.4%), frequent awakening (12.3%, 22.7%), excessive daytime sleepiness (4.4%, 13.4%). Depression was the primary factor predicting the incidence of all three sleep symptoms. Also contributing to sleep problems were cardiovascular disease, respiratory symptoms and limitation of ADL, although their impact was more limited. Depression was also the most significant factor contributing to the persistence of sleep problems.	Assessment of sleep, ADL's and IADL's did not utilize reliable and valid instruments. Individuals were not screened for insomnia and sleep impairment may have been related to another primary sleep disorder.
Yokoyama et al., (2010)	To examine the association between	Cross sectional and	4 028 community-	Depression	Center for Epidemiological	At baseline DIS and EMA were	Did not utilize a valid and reliable

	depression and three subtypes of insomnia, difficulty initiating sleep (DIS), early morning awakening (EMA), difficulty maintaining sleep (DMS).	longitudinal.	dwelling older adults, aged ≥ 65 (55.0% female). Participants resided in Japan.	Insomnia Symptoms Perceived Health Status (PHS) Activities of Daily Living (ADL)	Studies Depression Scale (CES-D). 7 questions r/t type of sleep disturbance, duration, and daytime sleepiness. 1 question Self-report of difficulty performing any 1 of 7 ADL's.	significantly associated with depression. DIS at baseline was significantly associated with depression at follow-up (1 year) after controlling for confounding variables. However, EMA and DMS at baseline were not significantly associated with depression at follow-up.	instrument to assess insomnia, PHS or ADL.

Appendix J

E-mail Communication Clarifying Requirement for Research Ethics Board Review

From Nancy Walton <rebchair@ryerson.ca>
Sent Monday, April 23, 2012 12:24 am
To Penney Deratnay <penney.deratnay@ryerson.ca> , Souraya Sidani <ssidani@ryerson.ca>
Subject REB review

Dear Penney and Dr. Sidani,

This email is to provide documentation of an e-mail discussion that Penney and I had in April of 2011, when she contacted me with the question of whether or not she required formal Research Ethics Board (REB) review and approval for the secondary analysis of a data set on insomnia to which Dr. Sidani was providing access.

At that time, I pointed out a relevant passage in the Tri Council Policy Statement, Canada's federal guidelines for the ethical conduct of research.

Article 2.4 of the TCPS indicates the following:

"REB review is not required for research that relies exclusively on secondary use
of anonymous information, or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information."

Anonymized information used in a secondary analysis would not require formal REB review. At that time, however, the information was still "coded", i.e. there was a possibility of re-identifying specific participants through the use of a coding list. With anonymized information, codes are removed and data are irrevocably stripped of direct identifiers or links back to identifying information.

Penney has confirmed that the data, in her secondary analysis, were de-coded and, therefore through that process, effectively anonymized. In that case, as per the federal guidelines, REB review and approval was not required.

Please do not hesitate to contact me if further clarification is necessary.

Best,

Dr. Nancy Walton, PhD
Chair, Research Ethics Board
Associate Professor, Daphne Cockwell School of Nursing
nwalton@ryerson.ca

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