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Characterizing Frailty among Homeless Adults

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Characterizing Frailty among Homeless Adults

A dissertation submitted in partial satisfaction of the
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in Nursing

by

Benissa Elias Salem

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ABSTRACT OF THE DISSERTATION

Characterizing Frailty among Homeless Adults

by

Benissa Elias Salem
Doctor of Philosophy in Nursing
University of California, Los Angeles, 2013
Professor Adeline M. Nyamathi, Chair

Frailty, a public health challenge may be a significant issue among homeless and disenfranchised populations in urban and rural cities across the United States (U.S.). The purpose of this dissertation is to characterize frailty among a sample of 150 homeless men and women. The first manuscript developed a theoretical framework, the Frailty Framework among Homeless and Vulnerable Populations (FFHVP), based on previous models and empirical literature in order to guide two data based papers, namely correlates of frailty and to test a modified FFHVP in order to determine predictors using structural equation modeling (SEM).

The second manuscript utilized descriptive, univariate, and multiple regressions to understand predictors. A Pearson (r) bivariate correlation revealed a weak relationship between frailty and being female ($r = .230$, $p < .01$). Significant moderate negative correlations were found between frailty and resilience ($r = -.395$, $p < .01$), social support ($r = -.377$, $p < .01$), and nutrition ($r = -.652$, $p < .01$). Further, Spearman *rho* (r_s) bivariate correlations revealed a moderate positive relationship between frailty and health care utilization ($r_s = .444$, $p < .01$). A stepwise backward

linear regression analysis was conducted and in the final model, age, female gender, health care utilization, nutrition and resilience were significantly related to frailty. The multiple correlation squared was .542, indicating that 54.2% of the variance in frailty could be explained by the variables in the model.

The third manuscript examined situational, behavioral, health-related and resource indicators in terms of their direct impact on frailty, hypothesized as a latent variable construct. Using SEM, a model was tested with 150 homeless men and women, ages 40 to 73. Except for age and drugs, all of the independent variables were significantly associated with frailty in the confirmatory factor analysis (CFA); these included months homeless ($p<.01$), female gender ($p<.05$), education ($p<.05$), comorbid conditions ($p<.001$), nutrition ($p<.001$), resilience ($p<.001$), health care utilization ($p<.01$), and falls ($p<.001$). In the final path model, significant predictors of frailty included educational attainment ($p<.01$), comorbid conditions ($p<.001$), nutrition ($p<.001$), resilience ($p<.001$), and falls ($p<.01$). However, age, gender, length of time homeless, health care utilization and drug use did not emerge as significant in the path model. These findings reframe concepts; specifically, physical, psychological and social frailty domains which investigators have been independently and collaboratively researching for decades with the ultimate goal of developing future nurse-led intervention initiatives.

The dissertation of Benissa Elias Salem is approved.

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DEDICATION

I dedicate this scholarly work to my family.

I honor and thank my parents, Annette Hadjian and Elias Salem, for their unwavering commitment to academia and for the sacrifices they have made to enable this moment in time.

I honor and thank my sisters, Nancy and Iris, for being my kindred spirits; for filling my days with laughter, love, and support.

I also dedicate this dissertation to those who find themselves homeless. I thank you for generously giving of your time and entrusting me with your life stories – a most powerful ember.

It is my resolve that this be one of many scholarly works to shed light on the human condition in an effort to give a voice to the vulnerable.

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The following dissertation is the culmination of over a decade-long engagement with academia. It has been birthed from opportunity and curiosity, inspired by the merriment of naturalistic observation and didactic training, nurtured and guided by positive mentorship, maintained by dedicated and committed educators, and rebirthed by study participants' willingness to share their life stories.

Illustrated within these pages and threaded between these words is a product which has not been developed in a vacuum; but rather, birthed through the experiences which homeless men and women have generously shared with me, developed through pedagogy, and even, intuition. Granted these pages have emerged in space and time to produce three manuscripts - motivated by the sole desire to address needs of this vulnerable and often hard-to-reach population. This success is shared, and is not4 claimed as mine alone.

I first offer my wholehearted and sincere gratitude to my committee chair and mentor, Dr. Adey Nyamathi-who has changed the course of my life. She demonstrates exemplary work ethic, integrity, dedication to the art of positive mentorship. Dr. Nyamathi has inspired me and I have been abundantly blessed to know such a rare human being.

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I am grateful to the homeless men and women, along with the community-based agencies, i.e. Downtown Women's Center (DWC), Midnight Mission (MM), Union Rescue Mission (URM) and Amistad De Los Angeles (ALA) which partnered with me. I am also fortunate to have been supported by the National Institutes of Health/National Institute of Nursing Research (NIH/NINR) T32 NR007077; the UCLA Dissertation Year Fellowship Award; the UCLA Community Academic Partnership for Research in Aging Center NIH Grant 1RC4AG038182-01; and the Center for Gerontological Nursing at the UCLA School of Nursing.

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I thank God for sprinkling my life with angels, shepherding me through the multitude of valleys, giving me peace through the storms and wisdom to see beyond the scope of my human understanding.

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Introduction to Dissertation

Frailty has been characterized by Saints, Theologians, Playwrights, Philosophers and Scientists in Aramaic, Latin, New and Old-World English for decades (Avila, 1957; Webster's Dictionary, 2010; Woodward & Mattingly, 1967). Saint John of Damascus stated that man was frail by nature (Webster's Dictionary, 2010; Woodward & Mattingly, 1967) while Saint Teresa of Avila, likened frailty to misery (Avila, 1957). In 1590, William Shakespeare emphatically stated that men who were frail had black beards, scorched cheeks and smoky eyebrows and requested the disease to leave at once (Shakespeare & Brooke, 1908; 1918). It is apparent that well respected men and women of their time believed that frailty was inherent in human nature, which set the tone and pace for belief patterns. However, since Shakespeare espoused his beliefs about frailty, our scientific understanding of the condition has evolved.

Currently, frailty can be described as a public health challenge and defined as a dynamic state affecting an individual who experiences an accumulation of deficits (Rockwood & Mitnitski, 2007; 2011) in physical, psychological, and social domains, leading to adverse outcomes such as disability and mortality (Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010; Gobbens, van Assen, Luijkx, Schols, 2011). Data suggest that homeless populations have a panoply of issues related to comorbidities (Lundy, 1999), including drug and alcohol use (Christiani, Hudson, Nyamathi, Mutere, & Sweat, 2008; Fountain, Howes, Marsden, Taylor & Strang, 2003), overweight and obesity (Smith & Richards, 2008; Tsai & Rosenheck, 2013), low received social support (Hwang et al., 2009), depression (Nyamathi et al., 2011), pscyhotic illnesses (Fazel, Khosla, Doll & Geddes, 2008), physical disabilities (Los Angeles Housing

Services Administration [LAHSA], 2011) and intellectual disabilities (Oakes & Davies, 2008), which may place them at risk for frailty.

In metropolitan cities like Los Angeles, homelessness is a considerable challenge and racial and ethnic communities are disproportionately impacted. According to LAHSA (2011), the majority of homeless persons are African American followed by Hispanic and Caucasian (43.7% vs 27.7% vs 24.9%). On any given night, there are between nearly 40,000 to 51,000 homeless adults on the streets of Los Angeles (LAHSA, 2011; Morrison, 2011). Urban cities like Los Angeles will face high numbers of aging homeless adults as over one third are over 55 years of age (LAHSA, 2011). These individuals have unique health and social service delivery needs, one of which may be frailty.

There is a paucity of data which explores the nexus between frailty and homelessness. Indeed, the literature, to date, is sparse in addressing frailty among homeless populations. In an effort to begin to address this gap, this dissertation has focused upon the development of the first manuscript which proposes the Frailty Framework among Homeless and Vulnerable Populations (FFHVP) which will guide the research. The second manuscript is a data-based paper which is focused on identifying correlates of frailty among homeless adults, and the third utilized structural equation modeling (SEM) to test the modified FFHVP framework. Each manuscript will be submitted for independent publication.

To accomplish the aims of the dissertation, the sample consisted of 150 homeless adults, ages 40 to 73, which were eligible for the study if they were aged 40 or over, did not have evidence of acute psychotic hallucinations and psychosis, spoke English, and were homeless. Participants were recruited from participating homeless day center drop-in sites on Skid Row and

one residential drug treatment (RDT) facility which provides temporary shelter for homeless adults on parole or probation within the same perimeter in urban Los Angeles.

Chapter one, the first manuscript, which is entitled, "Development of a Frailty Framework among Homeless and Vulnerable Populations – A Life Course Perspective" has been developed by the investigator, and adapted from the Integrated Conceptual Model of Frailty (Gobbens, van Assen, Luijkx, & Schols, 2011), the Working Framework for Understanding Frailty (Bergman et al., 2004) and biological models of frailty (Fried & Walston, 2003), along with empirical research and consultation with frailty experts. The model depicts situational, health-related, behavioral, resource, biological, and environmental factors which contribute to domains which encompass physical, psychological and social dimensions that ultimately contribute to disability, hospitalization, health care dependency and death.

Chapter two, the second manuscript, entitled, "Correlates of Frailty among Homeless Adults" assessed frailty with the targeted sample. A structured instrument was administered by the principal investigator (PI) which measured sociodemographic data, comorbid conditions, depressive symptomology, disability, physical functioning, drug use and dependency, nutrition, body mass index, health care utilization, social support, resilience, and frailty.

Chapter three, the third manuscript, entitled, "Constructing and Identifying Predictors of Frailty among Homeless Adults-A Latent Variable Structural Equations Model Approach" used SEM to test the modified FFHVP with the targeted sample. The study examined situational, behavioral, health-related and resource indicators in terms of their direct impact on frailty, a latent variable construct. Taken together, these papers serve as a foundation and guide for multidisciplinary researchers to develop future nurse-led, health promotion interventions.

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Chapter I

Development of a Frailty Framework among Homeless and Vulnerable Populations – A Life Course Perspective

Abstract

Frailty, a significant public health issue experienced by homeless and other vulnerable adults is not well understood. To date, a frailty framework has not been proposed to guide researchers who study this hard-to-reach population. The Frailty Framework among Homeless and Vulnerable Populations (FFHVP) has therefore been developed by this investigator, adapted from the Integrated Conceptual Model of Frailty (Gobbens, van Assen, Luijkx, & Schols, 2011), the Working Framework for Understanding Frailty (Bergman et al., 2004) and biological models of frailty (Fried & Walston, 2003). The FFHVP has also evolved from consultation with frailty experts (R. Gobbens, personal communication, September 23, 2012) and empirical research in an effort to characterize antecedent variables, such as situational, health-related, behavioral, resource, biological, and environmental factors which contribute to physical, psychological and social frailty domains and ultimately impact adverse outcomes such as disability, hospitalization, health care dependency and death. As the homeless and vulnerable populations continue to age, a greater understanding of frailty will enable the development of social and clinical services.

Keywords: Frailty, framework, aging, older homeless, vulnerable populations

Introduction

The concept of frailty is not well characterized among homeless and vulnerable populations. Frailty models have been devised to explain the physiological, biological and molecular pathways of the syndrome (Bergman et al., 2004; Fried & Walston, 2003). However, for specific populations, namely, those who are homeless, specific risk factors and life course determinants for frailty may be pronounced. However, the challenge with identification of frailty among homeless populations is the inability to disentangle the phenomenon of frailty from vulnerability itself, along with disability and multi-morbidity. Consequently, it is necessary to develop a framework which addresses unique antecedents for the population. Thus, the purpose of this paper is to propose the Frailty Framework among Homeless and Vulnerable Populations (FFHVP) in order to provide a life course perspective which will ultimately enable the development of community-based translational research and nursing practice.

Defined as a dynamic state affecting an individual who experiences an accumulation of deficits (Rockwood & Mitnitski, 2007; 2011) in physical, psychological, and social domains, frailty leads to adverse outcomes such as disability and mortality (Gobbens et al., 2011). From a practical perspective, over the next 30 years, the number of older homeless adults will increase (Cohen, Sokolovsky & Crane, 2001; National Coalition for the Homeless [NCH], 2007), as well as those who are chronically homeless (Los Angeles Housing Services Administration [LAHSA], 2011). As a consequence, frailty will become more pervasive and costly demanding greater prevention strategies for marginalized populations. Unfortunately, there is a paucity of data which explores the nexus between frailty and homelessness. Indeed, the predictors, mediators and adverse outcomes of frailty among homeless adults are not well understood.

Models of Frailty

Previous models of frailty have described the clinical pathways of frailty such as underlying alterations, clinical features and adverse outcomes (Fried & Walston, 2003). Models likewise showcase age-related physiologic changes which include sarcopenia, neuroendocrine dysregulation, and immune dysfunction (Fried & Walston, 2003). Bergman et al. (2004) developed a working framework for understanding frailty with a life course perspective. Antecedents to frailty included biological, psychological, social, societal, and environmental factors; further, disease and a decline in physiologic reserve were conceptualized to lead to weight loss, under nutrition, weakness, decreased endurance and physical activity, slowness, cognitive decline, and depressive symptoms. Thus, frailty was described as leading to lead to adverse outcomes, namely disability, morbidity, hospitalization, institutionalization and death (Bergman et al., 2004).

In 2010, Gobbens et al. refined the Bergman et al. (2004) model, labeling it the Integral Conceptual Frailty Model, and apportioning frailty into three respective components, namely, physical, psychological and social domains. The physical domain included a decline in nutrition, mobility, physical activity, strength, endurance, balance and sensory functions (Gobbens et al., 2011). Psychological frailty included a decline in cognition, mood, and coping, whereas social frailty integrated a decline in social relations and social support (Gobbens et al., 2011). However, a limitation of this model was that it was not specific to homeless or vulnerable populations which have specific antecedents and life course determinants.

Modifying the Integral Conceptual Frailty Model

The Frailty Framework among Homeless and Vulnerable Populations (FFHVP), developed by this investigator is a modification of the Integral Conceptual Model of frailty (Gobbens et al., 2010; 2011), the Working Frailty Framework model (Bergman et al., 2004) along with other clinical pathways of frailty (Fried & Walston, 2003). The FFHVP has evolved from empirical research and consultation with frailty experts (R. Gobbens, personal communication, September 23, 2012).

The FFHVP was developed to guide researchers who work with vulnerable populations, and in particular, homeless adults, a hard-to-reach population. The model involves a conceptual triad that includes physical, psychological and social domains that affect adverse outcomes, namely, disability, hospitalization, health care dependency, and death which are unique to vulnerable populations. There are several assumptions which guide this multidimensional framework.

FFHVP Assumptions

Figure 1 depicts the multidimensional FFHVP framework designed to understand situational, health-related, behavioral, resource, biological and environmental predictors as they are conceptualized to affect frailty and adverse outcomes over the life course. It is important to note that some of these assumptions can be hypotheses and statistically tested:

1. Frailty occurs across the life continuum, regardless of age.
2. Situational, health-related, behavioral, resource, biological and environmental factors may influence frailty.
3. Frailty domains form a triad: (a) physical, (b) psychological, and (c) social.

4. Frailty leads to disability, increased health care utilization, hospitalization, health care dependency and death.
5. There is an opportunity for health promotion/prevention and clinical case management across this life continuum.

In the model, we have identified several variables which influence frailty. These include situational, health-related, behavioral, resource, biological and environmental factors (Table 1).

Situational Factors

Situational factors are variables which an individual has over the life course. Situational variables include race/ethnicity, gender, income, education, marital status, physical, sexual, verbal victimization. Being a part of a specific race or ethnicity may result in similarities regarding geographic origin, ethnic origin, or sociocultural group. In addition, income or the amount of monetary currency (*based on country*) exchanged (*daily, weekly, monthly or yearly*) for types of services rendered is an important situational variable.

In one study, findings revealed that African Americans, those with lower education and income are more likely to be frail compared to those who do not have these characteristics ($p<.001$) (Fried et al., 2001). Riley et al. (2007) studied homeless adults in San Francisco County (N=324) and found that women had less median income when compared to men. Additionally, 74% of men graduated from high school, compared with 82% of women (Riley et al., 2007). Furthermore, women are more likely to be frail when compared to men (Alvarado, Zunzunegui, Beland, & Bamvita, 2008).

Physical, sexual or verbal victimization can be defined as having experienced *i.e. shootings, beatings, stabbings, battery, assault, and gang violence,* sexual assault or verbal victimization during childhood or in adulthood. Certain life experiences, in particular, incarceration, a state of being confined, or being on probation or parole may lead to physical trauma. Both conditions represent being conditionally released as a prisoner without having served a complete sentence (California Department of Corrections and Rehabilitation [CDCR], 2012; Garner & Black, 2011). One of the main undercurrents of incarceration is violence; behind bars data suggest that individuals are exposed to rape (Butler & Kariminia, 2006; Lahm, 2008; Richters et al., 2012), beatings, stabbings which may affect health-related factors and contribute to frailty.

Another significant issue is the condition of a history of homelessness, defined as an individual who lacks a fixed, regular, and adequate nighttime residence, and who has a primary nighttime residence that is a supervised publicly or privately operated shelter designed to provide temporary living accommodations (United States Department of Housing and Urban Development [USDHUD], 1995). In 2011, Brown et al. studied older homeless adults (N=247) at risk for geriatric syndromes and found the prevalence of frailty was 16 percent (Brown et al., 2011).

Health-Related Factors

Health-related factors are defined as self-reported health conditions and nutritional deficiencies. In one study, nearly 85% of homeless adults over 50 years of age reported having at least one chronic health condition (Garibaldi et al., 2005). Data suggest that correlates of frailty may include chronic kidney disease (Wilhelm-Leen, Hall, Tamura, & Chertow, 2009),

diabetes mellitus (Cacciatore et al., 2012), cognitive impairment (Boyle, Buchman, Wilson, Leurgans, & Bennett, 2010; Buchman, Boyle, Wilson, Tang & Bennett, 2007; Ni Mhaolain et al., 2011), obesity (Hubbard, Lang, Llewellyn, & Rockwood, 2010) and human immunodeficiency virus (HIV) (Piggott et a., 2013; Shah et al., 2012); these represent some, but not all of the significant health factors in this population.

Nutritional deficiencies are also a significant issue among homeless populations. For many acquiring food is usually done in soup kitchens or other charitable programs; however, it is likely that food is acquired by other means, *i.e. theft, sex trade work, selling items, or paid employment*. In one cross sectional study in Germany, 29% of the homeless population sampled (N=75, 19-62) was malnourished and data suggest it was related to drug use and other chronic disease problems (Langnase & Muller, 2001). Among older adults, malnutrition is similarly a significant issue; some authors have indicated that there is a malnutrition-sarcopenia syndrome which leads to lean body mass loss, strength and functionality (Vandewoude et al., 2012)

Behavioral Factors

Certain behavioral factors which may be significant among this population, *i.e. alcohol, drug use, smoking, violence and health care utilization,* may affect health-related factors and may be influenced by biological factors and the environmental factors. Alcohol and illicit drugs include opioids, psychedelics, psycho-stimulants, general central nervous system depressants, and a combination of other drugs (Lehne, 2007). Researchers have detailed that alcohol and illicit drug use are significant to homeless adults (Gomez, Thompson, & Barczyk, 2010; Nyamathi, Leake, & Gelberg, 2000), and may influence homelessness (Riley et al., 2007). Riley et al. (2007) found that among homeless adults (N=324), men were more likely to report crack

cocaine in the last 30 days, heroin use, methamphetamine and heavy alcohol use when compared to women. In particular, among women, 27% of the population reported crack cocaine use compared to 34% of men, while 7% of women reported heroin use when compared to 16% of men (Riley et al., 2007). In terms of heavy alcohol use, approximately 53% of women reported such use in the last 30 days compared to 58% of men (Riley et al., 2007). Data suggest that for both men and women, individuals who smoked heavily were more likely to have higher frailty scores (Hubbard, Searle, Mitnitski, & Rockwood, 2009). Among homeless adults, smoking is a considerable challenge (Goldade et al., 2011); in fact, one study found that nearly 80% of chronically homeless adults (n=754) were current cigarette smokers (Tsai & Rosenheck, 2012).

Health care utilization is a significant issue among both frail adults (Hoeck et al., 2011) and homeless adults (Hahn, Kushel, Bangsberg, Riley, & Moss, 2006; Stein, Andersen, Robertson, & Gelberg, 2012). Unmanaged chronic conditions increase hospital expenditures and care. Hahn et al. (2006) found that for homeless populations emergency department visits were prevalent.

Resource Factors

Resource factors such as resilience may be protective over the life course; in fact, higher levels of resilience may encourage stress reduction. A study among homeless youth (N=47) found that increased time living on the street may affect resilience and increase psychological distress; however, perceived resilience may be related to lower suicidal ideation and lower psychological distress (Cleverley & Kidd, 2011). Resilience may be a key resource factor for homeless populations; however, this relationship has not been explicated among homeless adults and is not well understood in terms of its relationship with frailty.

Biological Factors

Biologic factors are modifiable risk factors which may be composed of generalized inflammation, oxidative DNA damage and telomere shortening. Generalized inflammation includes the presence of inflammatory cytokines, *i.e. interleukin- 6, interleukin IB, and tumor necrosis factor (TNF).* Biological factors caused by changes in gene expression and oxidative DNA damage may affect situational factors and health-related factors. In particular, decreased oxidative DNA damage leads to the decreased ability to build macromolecules, decreased protein synthesis, and decreased lean body mass, which may lead to a decrease in muscle function, strength and oxygen consumption (Fried & Walston, 2003). Telomeres, known as biomarkers of cellular senescence have been studied in relation to frailty. While one study found no correlation between telomere length, age and sex among community dwelling older adults (Woo et al., 2008) this has not been studied among homeless populations and may be a promising area for future exploration.

Environmental Factors

The built environment is composed of the physical environment which may encompass broken windows and crime, lack of proper sanitation, pollution, and high density of fast food restaurants. These variables may be influenced by behavioral factors*, i.e. alcohol and illicit drug use.* In fact, broken windows of neighborhoods may be an indication of lack of safety and poor economic conditions. The built environment may have a positive or negative affect on health (DeGuzman & Kulbok, 2012; Heath & Troped, 2012). Further, improper sanitation may have adverse effects on health; namely transmission of communicable diseases, *i.e. Hepatitis A virus infection* (Centers for Disease Control and Prevention, 2012; United States Health and Human

Services National Digestive Diseases Information Clearinghouse, 2012) which may affect biological systems, along with health-related factors. Additionally, excess fast food restaurants and lack of supermarkets make it challenging to obtain appropriate nutrition, ultimately affecting and leading to health related factors, such as comorbid and multi morbid conditions.

Frailty Domains

Frailty encompasses physical, psychological and social domains.

Physical frailty. Characterized by a decline in physical functioning, walking speed, and grip strength, physical frailty may be influenced by psychological and social frailty. Physical functioning is closely tied to mobility and research findings reveal that homeless populations are at risk for impairments in this domain (Brown et al., 2011). One study found that among homeless adults (N=247) impaired mobility affected 41% (102/247) of homeless adults over 50 (Brown et al., 2011). Further, 37% (90/247) of older homeless adults reported difficulty with balance (Brown et al., 2011) and over half of the population reported that they had fallen in the previous year (Brown et al., 2011).

Decreased grip strength may be closely related with disability, morbidity, mortality and frailty; in a cross-sectional study among men (n=411) and women (n=306) between 64-74 years of age, findings revealed that grip strength may be a more accurate predictor of frailty than chronological age (Syddall, Cooper, Martin, Briggs, & Aihie Sayer, 2003).

Psychological frailty. Composed of depression and a decline in cognition, psychological frailty may affect physical, as well as, social frailty. Investigators have found that frail individuals who have cognitive impairment are less likely to rebound (Cano et al., 2011). A study among a community dwelling sample of older adults in Dublin, found that both pre-frail

and frail elderly were more likely to have both anxiety and depression when compared to those who were robust (Ni Mhaolain et al., 2012). Among homeless populations, data suggest that depression is similarly a significant issue; in particular, Brown et al. (2011) found that 39% of the homeless population experienced depressed feelings for more than seven days.

Social frailty. A decline in social support may influence physical and psychological frailty; social frailty may predict increasing frailty, and for homeless adults, this may be a significant antecedent. One study investigated social determinants of frailty among a Chinese cohort of men (n=999) and women (n=1033) (Woo, Goggins, Sham, & Ho, 2005). Data reveal that women had a higher frailty index when compared to men (Woo et al., 2005). Number of relatives and neighbors, and frequency of participation in helping others all influence frailty scores; in fact, authors argue that individuals who have more social support similarly have lower frailty (Woo et al., 2005).

Homeless populations can be socially isolated, which often predisposes them to serious health problems and while not studied and may exacerbate frailty. Hwang et al. (2009) studied multidimensional social support among homeless adults (N=544) and found that only seven percent of participants were able to be accompanied to a health care provider by a family or friend. Data reveal that this population may have high needs, however, a low amount of received social support (Hwang et al., 2009) all of which may have implications for healthcare.

Adverse Outcomes

Adverse outcomes of frailty may include disability, hospitalization, health care dependency and death.

Disability. A disability is defined as having a physical and/or mental impairment which limits daily activities which may include mobility, cognitive, hearing, and visual or speech impairments (Americans with Disabilities Act [ADA], 1990). While disability is not synonymous with frailty (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004) both homelessness and frailty may place individuals at risk for disability. Homelessness may exacerbate physical disabilities or place individuals at high risk for acquiring a disability. In a study with homeless adults, both impairment with activities of daily living (ADL) and independent activities of daily living (IADL) were pronounced; in particular, approximately 30% (74/247) of the population reported an impairment with ADLs while 57% (140/247) reported difficulties with IADLs (Brown et al., 2011). Fried & Walston (2003) contend that disability can be an outcome of frailty or even a contributor to the condition. According to LAHSA (2011), approximately 22% of those surveyed suffer from physical disabilities.

Hospitalization. Hospitalization can be defined as being admitted to the hospital for a physical, medical or emotional problem over a 24-hour period. Both frail adults (Fried & Mor, 1997; Puts, Lips, Ribbe & Deeg, 2005) and homeless adults utilize larger percentages of health care resources (Hahn et al., 2006).

Health care dependency and death. For frail adults who stay for more than one night in an institution servicing health care needs, *i.e. hospital, nursing home or long term care facility,* health care dependency may be a critical issue. Health care dependency can be defined as being dependent on an institution for nursing or long term care. Frail adults are at high risk for hospitalizations (Fried & Mor, 1997; Hoeck et al., 2011) and institutionalizations (Puts et al., 2005). Frail adults are similarly at higher risk for death, which may be defined as the end of one's physical life on earth.

Summary of Derived Theory

The FFHVP represents a framework which will help guide nursing researchers in the field of vulnerable population's research. Based on this framework, situational, health- related, behavioral, resource, biological and environmental factors are conceptualized to affect the outcome, namely, frailty and subsequent adverse outcomes, such as disability, hospitalization, health care dependency and death. It is presumed that effective interventions would encompass health promotion, prevention, case management and wraparound health services. The FFHVP framework is designed to provide a greater understanding of how these intervening variables impact the health outcomes of vulnerable populations in order to develop effective interventions.

Implications for Theory Testing and Advancement of Nursing Practice

For the discipline of nursing, understanding frailty among the United States-based burgeoning older, homeless population is necessary in order to create and sustain targeted clinical interventions. As the homeless population continues to age, it will become increasingly necessary to focus on identification of frailty. Research related to predictors, mediators and adverse outcomes of frailty among homeless adults are not well understood. Developing targeted interventions to prevent exacerbations of frailty necessitates a clear understanding of these antecedents and outcomes.

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Figure 1

Frailty Framework among Homeless and Vulnerable Populations (FFHVP)

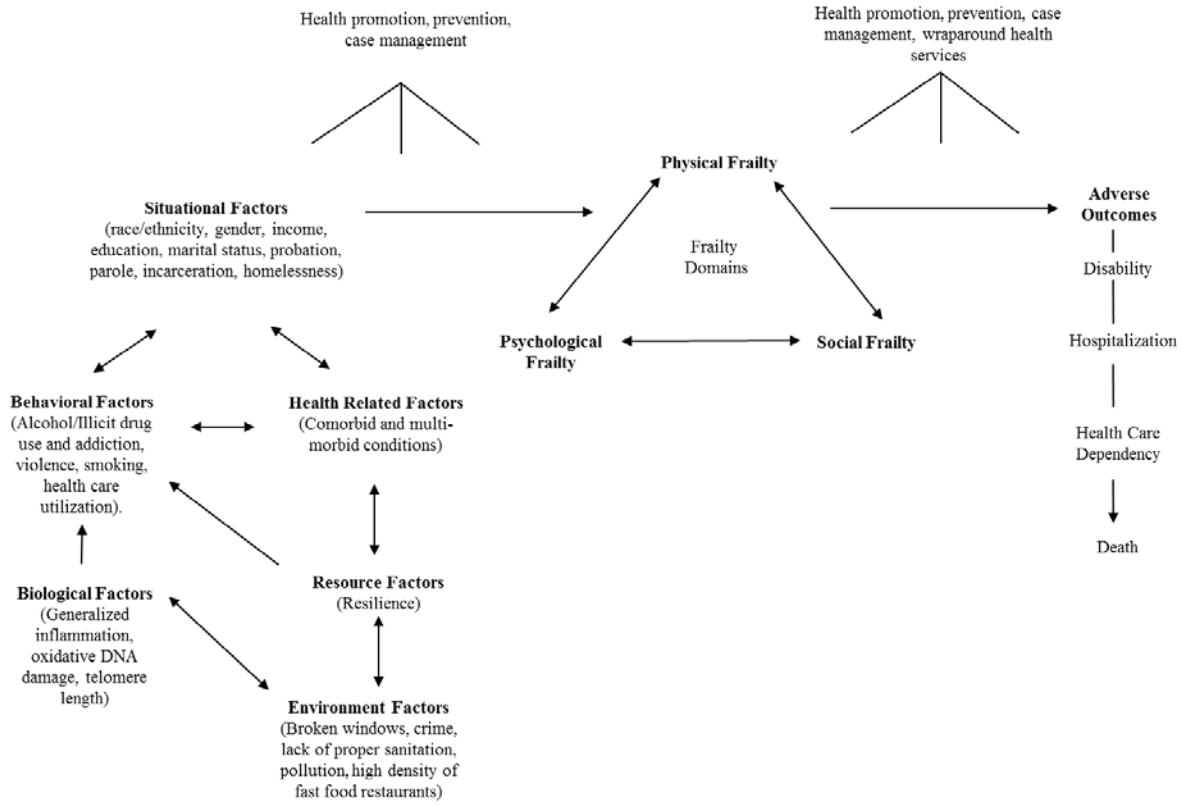

Table 1

Definitions of Variables in Frailty Framework among Homeless and Vulnerable Populations

Factor	Variable	Definition
Situational Factors	Race/Ethnicity	Identifying with being part of a larger group which may have similarities regarding geographic origin, ethnic origin, or sociocultural group, i.e. Caucasian, African American, Asian, American Indian, Middle Eastern, Armenian, Indian etcetera (United States Census, 2012).
	Gender	Self-identified as being male or female.
	Income	Reporting the amount of monetary currency (based on country) exchanged (daily, weekly, monthly or yearly) for types of services rendered.
	Education	Reporting the completion of formal public and/or private education (K-12, GED, some college, college completion).
	Experienced or witnessing physical, sexual or verbal victimization (childhood/adult).	Having experienced physical (shootings, beatings, stabbings, battery, assault, and gang violence), sexual (rape) or verbal victimization during childhood or in adulthood.

Table 1

Definitions of Variables in Frailty Framework among Homeless and Vulnerable Populations

Factor	Variable	Definition
	Incarceration	Being placed in either prison or jail for having committed a criminal or civil offense.
	Parole	"The conditional release of a prisoner from imprisonment before the full sentence has been served" (Garner & Black, 2011).
	Probation	"A court imposed sentence that, subject to state conditions, releases a convicted person into the community instead of jail or prison, i.e. bench or shock probation" (Garner & Black, 2011).
	Homelessness	An individual who lacks a fixed, regular, and adequate nighttime residence, and who has a primary nighttime residence that is a supervised publicly or privately operated shelter designed to provide temporary living accommodations (USDHUD, 1995).

Table 1

Definitions of Variables in Frailty Framework among Homeless and Vulnerable Populations

Factor	Variable	Definition
Health Related Factors	Comorbid health condition	Self-reported medical conditions, e.g. cardiovascular disease, diabetes mellitus, hypertension, overweight/obesity, HIV/AIDS.
	Nutrition	Not having adequate nutrition; considered at nutritional risk.
Behavioral Factors	Alcohol/illicit drug use	Using alcohol, opioids, psychedelics, psycho-stimulants, general central nervous system depressants, and/or a combination of different types of drugs (Lehne, 2007).
	Alcohol/illicit drug addiction	Being addicted (having a primary, chronic disease of brain reward, motivation, memory and related circuitry) to a substance, alcohol or an illicit drug." (ASAM, 2012)
	Smoking	Current use of nicotine.
	Health care utilization	Use of medical, i.e. emergency room, clinical medical/nursing services.
Environmental Factors	Witnessing systems-based / structural violence.	Being a witness to violence in neighborhoods/communities/prisons, i.e. shootings,

Table 1

Definitions of Variables in Frailty Framework among Homeless and Vulnerable Populations

Factor	Variable	Definition
		beatings, stabbings, rape, battery, assault, gang violence.
Resource Factors	Built environment	The physical environment which includes broken windows and crime, lack of proper sanitation, pollution, and high density of fast food restaurants.
	Resilience	Ability to rebound from stressors.
Biological Factors	Generalized Inflammation	Presence of inflammatory cytokines, i.e. Interleukin – 6, Interleukin IB, Tumor Necrosis Factor (TNF).
	Oxidative DNA damage	Oxidative DNA damage leads to the decreased ability to build macromolecules, decreased protein synthesis, decreased lean body mass which may lead to a decrease in muscle function, strength and oxygen consumption (Fried & Walston, 2003).
	Telomere shortening	A biomarker of cellular senescence (Woo et al., 2008)
Frailty Domains	Physical frailty	A decline in physical functioning, walking speed, and grip strength (Gobbens et al., 2010).
	Psychological frailty	Presence of depression, decline in cognition and coping

Table 1

Definitions of Variables in Frailty Framework among Homeless and Vulnerable Populations

Factor	Variable	Definition
		(Gobbens et al., 2010).
	Social frailty	Decline in social support (Gobbens et al., 2010).
Adverse Outcomes	Disability	Having a physical and/or mental impairment which limits daily activities (ADA, 1990).
	Hospitalization	Being admitted to the hospital for a physical, medical or emotional problem over a 24-hour period.
	Health care dependency	Staying for more than one night in an institution servicing health care needs, i.e. hospital, nursing home or long term care facility.
	Death	The end of one's physical life on earth.

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Chapter II

Correlates of Frailty among Homeless Adults

Abstract

Frailty, a relatively unexplored concept among vulnerable populations, may be a significant issue for homeless adults. The purpose of this cross-sectional study was to assess correlates of frailty among middle age and older homeless adults (N=150, 40-73). Slightly over half of the participants (59.3%) were over 50, and the sample was equally distributed by gender. A Pearson (r) bivariate correlation revealed a weak relationship between frailty and being female (r =.230, p<.01). Significant moderate negative correlations were found between frailty and resilience (r = -.395, p<.01), social support (r = -.377, p<.01), and nutrition (r = -.652, p<.01). Further, Spearman *rho* (r_s) bivariate correlations revealed a moderate positive relationship between frailty and health care utilization (r_s =.444, p<.01). A stepwise backward linear regression analysis was conducted and in the final model, age, gender, health care utilization, nutrition and resilience were significantly related to frailty. The multiple correlation squared was .542, indicating that 54.2% of the variance in frailty could be explained by the variables in the model. Over the next two decades the number of older homeless adults will exponentially increase which will necessitate a greater understanding of the health and social service delivery needs of this hard-to-reach population.

Keywords: Middle age and older homeless adults, frailty, gerontology

Introduction

The landscape of the United States (US) population is aging (Saxon, Etten, & Perkins, 2010; Sermons & Henry, 2010) and emerging evidence suggests homeless populations will double by 2050 (Sermons & Henry, 2010). Economic vulnerability of the elderly (Sermons & Henry, 2010) and aging of the baby boomer generation may be two root causes for this exponential increase (Culhane, Metraux, Bainbridge, & Byrne, 2010). Authors contend that homelessness among older adults is a symptom that denotes our safety net is failing (Sermons & Henry, 2010); in fact, aging trends among homelessness and aging of racial and ethnic minorities has been described as a double jeopardy (Carreon & Noymer, 2011; Rich, Rich, & Mullins, 1995), which can be seen in several urban cities.

Aging and Homelessness

Large urban cities are facing an aging population; in San Francisco, 33% of the homeless population is over 50 years of age (Hahn, Kushel, Bangsberg, Riley, & Moss, 2006). In Los Angeles, there were over 51,000 homeless adults, nearly one quarter of which were 55 to 61 years of age (Los Angeles Housing Services Administration [LAHSA], 2011). Rapid population aging will give rise to a greater prevalence of clinical geriatric disorders, namely, *frailty,* as an already overburdened healthcare system will need to provide care for a rapidly growing older adult population.

A Conceptual Understanding of Frailty

The concept of frailty has been aptly described in the literature for decades; more recently, it has been defined as a decline in multiple physiological systems, a geriatric syndrome

(Gielen et al., 2012), or a non-specific state of vulnerability (Fulop et al., 2010). There is extensive literature to operationalize frailty measures based on conceptual differences (Fried et al., 2001; Searle, Mitnitski, Gahbauer, Gill, & Rockwood, 2008). Two popular schools of thought predominate the literature; one identifies frailty as a clinical syndrome with specific hallmark characteristics (Fried et al., 2001), whereas others define frailty as an accumulation of deficits which include symptoms, signs, and disease classifications, often leading to adverse outcomes (Mitnitski, Mogilner, MacKnight, & Rockwood, 2002). Based on the Fried phenotype, pre-frailty is presence of two out of five frailty signs (shrinking, weakness, exhaustion, slowness, low activity, whereas frailty is the presence of at least three or more of those signs (Fried et al., 2001).

Frailty Prevalence Rates

Frailty prevalence rates differ between populations. In a secondary analysis of relative fitness of individuals in Canada across the lifespan (N=14,713, 15-102 years of age), findings revealed that 7.2% of the population was frail at baseline and the frail segment was more likely to be hospitalized when compared to their non-frail counterparts (Rockwood, Song, & Mitnitski, 2011). In another population-based study using a modified frailty index among older Mexican Americans, 37.1% of the population was frail, 33.3% of the population was pre frail and 29.6% of the population was not frail (Aranda, Ray, Snih, Ottenbacher, & Markides, 2011).

The Cardiovascular Health Study group found that the prevalence of frailty was nearly 7% among community dwelling older adults (Fried et al., 2001), and when applying the same criteria to a Boston-based homeless sample, aged 50-69, the frailty prevalence was 16% (Brown, Kiely, Bharel, & Mitchell, 2012).

Understanding frailty among homeless population necessitates clarification regarding frameworks as previous models have described clinical pathways of frailty such as underlying alterations, clinical features and adverse outcomes (Fried & Walston, 2003). Further, some focus on age-related physiologic changes which include sarcopenia, neuroendocrine dysregulation, and immune dysfunction (Fried & Walston, 2003). Some aspects which are lacking in the literature include a guiding framework for homeless and otherwise vulnerable populations.

Frailty Framework among Homeless and Vulnerable Populations (FFHVP)

The Frailty Framework among Homeless and Vulnerable Populations (FFHVP), which was developed by this investigator, is the theoretical framework which has evolved from empirical research and consultation from frailty experts (R. Gobbens, personal communication, September 23, 2012) in an effort to characterize situational, health-related, behavioral, resource, biological, and environmental factors which contribute to physical, psychological and social frailty domains and ultimately contribute to adverse outcomes such as disability, hospitalization, health care dependency and death.

In this model, situational variables included race/ethnicity, gender, income, education, marital status, physical, sexual, verbal victimization and homelessness. Behavioral factors such as drug and alcohol use may likewise be significant issues among this population (Nyamathi, Hudson, Greengold, & Leake, 2012; Nyamathi, Leake, & Gelberg, 2000) affecting health-related factors and increasing healthcare utilization (Hahn et al., 2006; Stein, Andersen, Robertson, & Gelberg, 2012). Resource factors include resilience which may influence the aforementioned antecedents.

The domain of frailty is composed of physical, psychological and social domains which may impact each other. Physical frailty may encompass slow walking, decreased grip strength, and an overall decline in physical functioning, whereas psychological frailty may be composed of a decline in cognition, and coping; all of which may affect physical and social frailty. Alternatively, social frailty may affect physical and psychological frailty. Adverse outcomes of frailty included disability, hospitalization, health care dependency and premature mortality.

Homelessness, Health and Nutrition

Investigators have noted that homeless populations have a substantial disease burden (Garibaldi, Conde-Martel, & O'Toole, 2005). Health conditions related to aging; namely, chronic health conditions (Garibaldi et al., 2005), depression, and disabilities are all significant issues (LAHSA, 2011). Further, visual and hearing impairment, functional limitations, and cognitive impairments (Brown et al., 2012) may likewise place older adults at greater vulnerability.

Research suggests that food insecurity is a formidable challenge among homeless populations, compromising nutrient intake due to lack of sufficient food (Dachner & Tarasuk, 2002). Baggett et al. (2010) studied food insufficiency and health service utilization among a national sample of homeless adults and found that 25% did not get enough to eat. In addition, among those who were chronically homeless, prevalence of food insufficiency was 45.5% and 37.5% among those who had been physically or sexually abused in the past year (Baggett et al., 2011). Food insufficiency was similarly linked to increased healthcare utilization; in particular, those who were food insufficient were more likely to be hospitalized in the last year when compared to those who were not food insufficient (46.3% vs 30.3%) (Baggett et al., 2011).

Homelessness, Social Support, and Health Care Utilization

Poor social support and social vulnerability may lead to increasing frailty (Woo, Goggins, Sham, & Ho, 2005). Research indicates that homeless populations can similarly be socially isolated (Hwang et al., 2009). One study focused on multidimensional social support among homeless adults (N=544) in Canada and 62% perceived access to financial support, 51% perceived access to instrumental support, and 60% perceived access to emotional support; however, only seven percent were accompanied to a health care provider by a family or friend. Understanding the influence of social support and frailty among homeless persons will enable a greater understanding of the dimensional and intersecting relationships.

Frail adults and homeless adults utilize a large majority of healthcare services (Hahn et al., 2006). Hahn et al. (2006) studied aging trends over 14 years among homeless adults (N=3,534) and found that median age increased, along with emergency department visits (p=.01), staying overnight in a hospital (p<.001) and mental health hospitalization (p<.001). Authors assert that due to aging, chronic health conditions will be predominant among homeless adults (Hahn et al., 2006). Most published data concentrate on describing geriatric frailty among housed men and women 65 years and older; however, limited data exists on homeless adult men and women who may have other determinants, predictors and risk factors for frailty. While chronological age may serve as a proxy of a person's vulnerability to frailty (Bergman et al., 2007), in effect, age often becomes a principle risk factor for disease. Seminal authors have indicated that homeless populations age prematurely; in fact, generally 10-20 years older than their chronological age (Gelberg, Linn, & Mayer-Oakes, 1990).

Prolonged exposure to stress may induce premature aging (Epel et al., 2004) described as weathering which may be of significant concern for those homeless or otherwise living in poverty (Geronimus, Hicken, Keene, & Bound, 2006; Geronimus et al., 2010) or on the streets. One author compared immune markers of homeless (n=40) and non-homeless housed counterparts (n=40) in Spain and found that when compared to non-homeless counterparts, homeless adults had impaired interleukin – 2 and lower plasma total antioxidant capacity (Arranz, de Vicente, Munoz, & De la Fuente, 2009). Homeless adults may have altered immune systems and increased oxidative stress (Arranz et al., 2009).

One biological marker, telomere length, may serve as an indicator of cellular senescence and may be affected by consistent stress activation (Epel et al., 2004; Kotrschal, Ilmonen, & Penn, 2007). Some data suggest that telomere length is affected by chronic stress in socially and economically vulnerable adults (Geronimus et al., 2010). Examining the association between telomere length and phenotypic measures of frailty is an important goal that has yet to be explored in this population.

There is a paucity of data which focuses on frailty among homeless populations; in fact, only one study has been published. Thus, the purpose of this cross-sectional study is to understand correlates of frailty among middle age and older homeless adults which will enable a greater understanding of variables which contribute to this phenomenon.

Methods

Design

In this cross-sectional study, homeless adults from Los Angeles were enrolled and administered a survey designed to assess correlates of frailty. The study was approved by the

University Human Subjects Protection committee, with data collected from February to May 2012.

Sample and Site

The sample included 150 homeless adults who were eligible for the study if they were: a) aged 40 or over; b) free of evidence of acute psychotic hallucinations and psychosis; c) English-speaking; and d) considered homeless. "Homeless" was operationally defined as an individual who lacks a fixed, regular, and adequate nighttime residence, and who has a primary nighttime residence that was a supervised publicly- or privately-operated shelter designed to provide temporary living accommodations (United States Department of Housing and Urban Development (USDHUD, 1994). Participants were recruited from three participating homeless day center drop-in sites on skid row and one residential drug treatment (RDT) facility which provides temporary shelter for homeless adults on parole or probation within the same perimeter.

Procedures

The principal investigator (PI) established partnerships with the research sites and upon obtaining human subjects institutional board approval, flyers were posted in common areas at the sites. The PI made frequent announcements in the research sites during the recruitment period. In total, 313 homeless adults showed interest and approached the PI in a private and confidential area of each respective agency. If interest continued, a brief screening questionnaire was administered by the PI to assess birth year, homeless status and sleeping arrangements in the previous night. If determined eligible, the PI set an appointment with the potential participant and subsequently completed informed consent in a quiet screened area of the facility. The PI administered the questionnaires and other assessments; sessions lasted approximately one hour

and thirty minutes. At the end of the session, each participant was compensated with a $25 gift card that could be utilized at a neighboring food vendor.

Instruments

Sociodemographic data obtained were related to chronological age, gender, birthplace, race/ethnicity, educational history, marital status, education, current monthly income, number of times homeless in their lifetime, living arrangements, and length of time homeless.

Comorbid conditions were assessed using the self-reported comorbidity index (SCQ) for medical conditions, treatment and physical limitations (Sangha, Stucki, Liang, Fossel, & Katz, 2003). The total problem subscale consisted of 13 questions and two open-ended spaces. Responses were coded as "yes/no" along with the presence of a condition. Higher numbers meant higher comorbid scores. The alpha coefficient for the total problem score was .91 in this sample.

Depressive symptomology was assessed using the Center for Epidemiologic Scale (CES-D) scale to evaluate depressed mood (McDowell, 2006; Radloff, 1977). The scale consisted of 20 items with a 4-point response scale; responses ranged from "rarely or none of the time" to "most of the time." Items 4, 8, 14 and 16 were reverse scored. Scores of $\geq$ 16 indicate a need for psychiatric evaluation for depressive symptoms (Weissman, Sholomskas, Pottenger, Prusoff, & Locke, 1977). The alpha coefficient for the CES-D in this sample was .89.

Disability was assessed using the Katz activities of daily living (ADL) scale (Katz & Akpom, 1976). The 6-item scale takes into account bathing, dressing, toileting, transfer, continence, and feeding. The instrument employs "yes/no" items, with 1 point given for each ADL in which the participant is independent and 0 points otherwise. Higher scores mean a greater level of independence.

Physical functioning was assessed using the Medical Outcomes Study (MOS) Physical Functioning Measure (McDowell, 2006). This 10-item self-report instrument was used to determine functioning and item scores ranged from 1 "limited a lot" to 3 "not limited at all." Individuals with higher scores have better functioning. The alpha coefficient for part 1 (10 items) of physical functioning was .94.

Falls were assessed by three self-report questions about having fallen in the last year, in the last 30 days and having a fear of falls. Responses had a "yes/no" format. The alpha coefficient for falls was .71.

Drug use and dependency were assessed using the Texas Christian University (TCU) Drug Screen II (Knight, 2002). The 15-item self-report screening test provides an understanding of a history of heavy drug use or dependency within the last 12 months. Responses were "yes/no" to each drug mentioned. The total score ranges from 0 to 9; higher scores ($\geq$ 3 or greater) indicate relatively severe drug-related problems and corresponds approximately to DSM drug dependence diagnosis. The alpha coefficient for drug use and dependency was .95.

Nutrition was assessed using the mini nutritional assessment (MNA) (DiMaria-Ghalili & Guenter, 2008; Vellas et al., 1999). The screen includes questions related to weight loss in the last 3 months, mobility, psychological distress, neuropsychological problems and body mass index. If a client scores 11 points or less in the screening (6 items; part I), they then need to proceed to the nutritional assessment (12 items; part II), which includes questions related to types of protein intake, use of prescription pills, pressure sores, and mid-arm and calf circumference. A total score is derived that indicates if the participant is malnourished (< 17), at risk for malnutrition (17-23.5) or has a normal nutritional status (24-30). The alpha coefficient for nutrition was.70.

Body Mass Index (BMI) was evaluated by measuring height and weight. Weight was assessed in pounds while height was assessed in inches.

Health care utilization was assessed with data on health insurance, places where participants received healthcare, having a regular healthcare provider, being seen by a healthcare clinician within the last year and emergency room use. Respondents answered "yes/no" and number of times they sought healthcare services; a total score was generated from items 3-7, and 10. A higher score was interpreted as utilizing more health care.

Social support was assessed using the Medical Outcomes Study Social Support Survey (MOS-SSS) (Sherbourne & Stewart, 1991). Items in the 4 subscales were evaluated on a 5-point scale ranging from 1) "none of the time" to 5) "all of the time." The data were transformed to a 0-100 scale. The subscales included emotional support (8 items, α =.95), tangible support (4 items, α =.93), positive social interaction (4 items, α =.94) and affectionate support (3 items, α =.91). The overall alpha coefficient for the social support scale was .97.

Resilience was assessed using the resilience scale (Wagnild & Young, 1993; Wagnild, 2009). The 25-item index evaluates a purposeful life, perseverance, equanimity, self-reliance and existential aloneness on a 7-point scale ranging from 1) "strong disagree" to 7) "strongly agree"; the total score ranges from 25-175 (Wagnild & Young, 1993; Wagnild, 2009). A higher score means greater resilience. The alpha coefficient for resilience was .94.

Frailty was assessed using the frailty index (FI) (Rockwood et al., 2011), which measures symptoms, signs, and disease classifications. The PI consulted with primary developmental investigators related to the FI items (K. Rockwood, personal communication, July 30, 2010; A. Mitnitski, personal communication, November 3, 2011), coding and analysis (A. Mitnitski, personal communication, July 13, 2011; June 26, 2011; March 2, 2012). This study utilized an

established cut point assignment as relatively fit (FI ≤ 0.03, i.e., no or only one deficit), less fit (0.03 < FI ≤ 0.10), least fit (0.10 < FI ≤ 0.21), frail (0.21 < FI < .44), and most frail (FI ≥ 0.45) (Rockwood et al., 2011). The alpha coefficient for the 42-item FI was .88.

Data Analysis

Frequencies and percents were used to describe the sample characteristics of age, gender, educational level, socioeconomic status, marital status, and length of time homeless. Variables that were not normally distributed were suitably log-transformed; they included healthcare utilization, drug use, and length of time homeless. To evaluate bivariate associations between frailty and possible predictors, Pearson correlations assessed relationships between frailty and normally distributed variables, while Spearman *rho* correlations assessed the same relationships for variables that were not normally distributed. Stepwise backward linear regression was selected as the method to identify independent correlates of frailty. The resulting model was confirmed using a stepwise forward regression.

To avoid tautological error and overlap with the dependent variable, several variables were excluded as independent variables from both bivariate and multivariate analysis, *i.e.* comorbid conditions, physical functioning, depressive symptomology, falls, body mass index (BMI), and activities of daily living (ADLs). Assumptions of linearity and normal distribution were checked and met. In particular, the histogram illustrated a normal distribution for the dependent variable. Likewise, scatterplots depicted linear relationship between frailty and each continuous independent variable and homoscedasticity with the points being randomly and evenly dispersed throughout the plot.

Multicollinearity diagnostics were checked by determining if the variance inflation factor (VIF) and tolerance (1/VIF) which determines if predictors have strong linear relationships; based on collinearity diagnostics, values were not problematic and within range (Field, 2009).

Results

Sociodemographic and Behavioral Characteristics

Table 1 presents demographic characteristics for the sample. The mean age was 52.4 (40-73; SD 6.80). Slightly over half of the participants (59.3%) were over the age of 50 and gender was equally distributed. With respect to race/ethnicity, the majority of participants were African American (63.3%), followed by Anglo/White/Caucasian (12%), and Hispanic/Latino (10.7%). The majority of participants was unmarried (48%) or divorced (34.7%) and most completed grades 9-12 (53.3%). About one third of the sample completed some college (32%).

Number of years homeless ranged from less than one year to greater than 30 years. Nearly 46.0% of the sample had been homeless for 1 to 6 years of their life; 19.3% had been homeless less than 1 year. The remainder of the sample, 34.6% have been homeless longer than 7 years. In terms of living arrangements within the last 30 days, 45.3% lived in a shelter and 22.7% were unsheltered and lived in the streets or other outdoor areas.

In terms of substance use, the most frequent type of drug used in the last 12 months, which was perceived by the participant as causing the most serious problem, included crack/freebase (23.3%), followed by alcohol (20.7%), cocaine (7.3%) and methamphetamine (4.0%) (Table 2). Alcohol was consumed by 14.7% of the sample every day. About a third (32.7%) denied drug or alcohol use.

Table 3 presents findings related to the sample mobility profile. About two-thirds (67.3%) reported ability to walk independently; while about one third (32.7%) reported the need to use an assistive device, such as a cane (19.3%), a walker (5.3%), or a wheelchair (2.7%). Falls within the last 30 days were reported by 22% of the population.

Self-Reported Health Conditions

Over half (57.3%) of the participants reported that they experienced depression, followed by back pain (54.7%), hypertension (46.3%), rheumatoid arthritis (24.0%), osteoarthritis/degenerative arthritis (14.0%), asthma (12.7%), diabetes (11.3%), and bipolar/schizoaffective disorder (10.7%). Other more commonly reported conditions included heart disease (9.3%), hepatitis C virus infection (9.3%), anemia or other blood diseases (8.0%) (Table not shown).

Descriptive Statistics for Selected Variables

Table 4 presents means, and standard deviations of variables. The mean days homeless was 2413 (SD 2896) and the mean number for health care utilization was 7.28 (SD 7.12). In addition, the mean resilience score was 134 (SD 28.64) and the mean frailty index was 0.26 (SD 0.15).

Bivariate Analysis

A Pearson (r) bivariate correlation revealed a weak relationship between frailty and being female ($r = .230$, $p < .01$). Significant moderate negative correlations were found between frailty and resilience ($r = -.395$, $p < .01$), social support ($r = -.377$, $p < .01$), and nutrition ($r = -.652$, $p < .01$).

Further, Spearman *rho* (r_s) bivariate correlations revealed a moderate positive relationship between frailty and health care utilization (r_s =.444, p<.01).

Multivariate Analysis

Table 6 describes the stepwise backward linear regression among variables which have been selected based on lack of redundancy and overlap in the model. In the final model, age, gender, health care utilization, nutrition and resilience were significantly related to frailty. At each step, the variable with the smallest non-significant F ratio was deleted (Halinski & Feldt, 1970). In step 1, age, gender, days homeless, nutrition, drug use, health care utilization, resilience and social support were all entered into the regression equation, F(8,140) = 21.000, p<.001 and the multiple correlation coefficient was .545, indicating approximately 54.5% of the variance in frailty can be predicted by the variables in frailty. In the last step, length of time homeless was removed, F(5,143) = 33.859, p<.001 and age, gender, healthcare utilization, nutrition and resilience were significantly related to frailty. The squared multiple correlation coefficients was .542 explaining 54.2% of the variance in frailty can be predicted by the variables.

Discussion

The purpose of this study was to identify correlates of frailty among homeless adults. Our findings revealed that approximately 54% of the sample was considered frail, and 10% were considered most frail. Moreover, significant positive correlates of frailty included age, female gender, and health care utilization, and significant negative relationships were found between frailty, nutrition, and resilience.

Chronological age was found to be predictive of frailty. The frailty index (FI) counts deficits including symptoms, signs, illnesses and disabilities (Rockwood & Mitnitski, 2011); thus, it is reasonable that as the population ages, chronic diseases will similarly increase. Published literature supports the contention that as age increases frailty levels increase (Crews & Zavotka, 2006; Song, Mitnitski, & Rockwood, 2010; Yu et al., 2012). Currently, nearly one-third of chronically homeless adults are over the age of 55 (LAHSA, 2011). As the homeless population continues to age, it will become increasingly necessary to focus on translational research which will address frailty.

Gender was also significantly related to frailty; more specifically, women were found to be frailer than men. In fact, regardless of type of frailty measure used, data reveal that women are at greater risk for frailty when compared to men (Goggins et al., 2005; Woo et al., 2005), live a greater number of years and may have greater functional limitations (Graham et al., 2009). This area warrants further study as it relates to homeless women.

Our study also found that increased health care utilization was significantly related to increased levels of frailty. Among homeless populations, health care utilization is a significant issue as many homeless adults utilize emergency departments frequently (Hahn et al., 2006; Kushel, Perry, Bangsberg, Clark, & Moss, 2002). One study examining factors of emergency department utilization among homeless adults (N=2578) found that 40.4% had one or more emergency department visits (Kushel et al., 2002). In our sample, 48% had visited the emergency department for at least one night, about one in five self-reported having an illness as a contributing factor to becoming homeless, and about half did not have health insurance. This area necessitates further exploration as it has significant health care cost and quality of life implications.

Among homeless populations, a greater degree of chronic disease burden may be one of the contributing factors relating to increased emergency department utilization (Sadowski, Kee, VanderWeele, & Buchanan, 2009). The most common conditions reported by our participants included depression, followed by back pain, hypertension, rheumatoid arthritis, and osteoarthritis /degenerative arthritis. We know that chronic health conditions are frequently reported by homeless populations (Garibaldi et al., 2005; Wiersma et al., 2010). In fact, one study found that nearly 85% of homeless adults older than 50 years of age had at least one chronic condition and the top three conditions were hypertension, arthritis/musculoskeletal disorders and psychiatric conditions (Garibaldi et al., 2005).

We also found that poorer nutrition scores were related to higher frailty scores. Authors acknowledge that one of the key issues related to frailty is an impairment of nutritional status, which is a critical issue among older adults (Bartali et al., 2006; Fulop et al., 2010; Kaiser, Bandinelli, & Lunenfeld, 2010), as well as homeless adults. In a secondary study among homeless adults in this sample, data revealed that 25% were food insufficient and not having adequate quantity to eat (Baggett et al., 2011). For some homeless adults, scavenging dumpsters, stealing food, and pawning personal belongings (Richards & Smith, 2006) were means by which to obtain food. Future research should focus on identifying nutritional deficiencies and intervening with supplementation and measuring effectiveness among this population.

This study yielded several variables that were not associated with frailty. First, length of time homeless was not related to frailty; to our knowledge, no previous research has investigated the relationship between frailty and length of time homeless. Approximately 76% of our sample was homeless greater than one year and among that population 65% were frail. Due to the lack of variability with this measure, it is difficult to determine the role of length of time homeless and

frailty. However, it seems logical that homeless persons should have higher degrees of frailty. Moreover, transition between frailty states may be improved if resources became more accessible.

No relationships were noted with respect to frailty and either drug use or social support. Previous studies in the general population have found that social vulnerability is related to frailty (Bilotta et al., 2010). It is plausible that in this sample that participant's perceive support rather than receive support. Among older adults (N=2032), decreased social support was related to increasing frailty; further, one strategy to delaying onset of frailty is active participation in the community (Woo et al., 2005). In a study of multidimensional social support among homeless adults (N=544), Hwang et al. found that the sample included had high levels of emotional and instrumental social support. Our findings may be related to the fact that while this population self-reports high levels of emotional/information support, tangible support, affectionate support, or positive social interaction, they may not actually receive support. This area necessitates further exploration. Data suggest that substance use is a significant issue among homeless populations (Christiani, Hudson, Nyamathi, Mutere, & Sweat, 2008; Nyamathi et al., 2012b); however, substance use was not found to be correlated with frailty in the multiple regression analyses. It is possible that self-reported drug use was not accurate. It is also the case that a portion of the homeless sample was living in a substance abuse treatment facility; thus, substance abuse may have been under control for some participants.

Conclusions

Frailty is a public health challenge and beckons us to reconsider the way we should care for homeless adults, especially as they age. Clearly this community has a greater burden of disease and challenges abound in terms of comorbid conditions, physical functioning and nutrition. As this population has unique physical, mental and social needs, it is imperative that targeted services are developed. Without a doubt, this population has to manage the condition of homelessness and aging (Hahn et al., 2006).

Indeed, these study findings raise several research questions and encourage us to contemplate different models of care. First, it may be necessary that service agencies have frontline geriatric nursing triage in order to accurately case manage clients, especially those who need higher acuity care. It may also be necessary to develop shelter-based convalescence (van Laere et al., 2009) facilities for homeless populations. In addition to nurse case management, another promising component of an intervention program may be to utilize a chronic disease self-management program (CDSMP), initially established for helping patients manage arthritis (Lorig, Laurin, & Holman, 1984; Lorig & Holman, 2003; Lorig, Ritter, & Plant, 2005).

It may also be beneficial for service agencies to provide health promotion activities in day centers and to have nutritionists on staff guiding and planning meals. Among an already vulnerable population, it remains to be seen if utilizing a frailty index would enable a clearer identification of issues and subsequent rendering of services or care. Taken together, it will be critical that clinicians and service providers work together and begin to consider clinical applications of frailty screening. It may also be necessary to triangulate services focusing on nutrition, exercise and case management of chronic disease processes in an effort to care for the most vulnerable. In essence, these findings serve as an impetus and a foundation for

understanding frailty which will undoubtedly inform future nurse-led larger replicative studies that will lead to interventions.

Limitations

A discussion of limitations is warranted; first, the study is limited to homeless men and women between 40-73 years of age in Los Angeles and cannot be generalized to other homeless populations. Similarly, cross-sectional studies cannot be used to infer causality. In fact, due to the nature of this design, it is not possible that we are able to completely understand the nature of the relationship between longer time spent on the street and frailty. Further, self-report data are prone to errors and may cause bias in the data. Despite the potential limitations, it is important to highlight that this research was designed to provide information which will direct nurse-led community based interventions.

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Table 1

Sociodemographic Characteristics (N=150 Homeless Adults)

Characteristic	N	%
Age		
≤ 50	61	40.7
> 50	89	59.3
Gender		
Male	75	50.0
Female	75	50.0
Children		
Yes	97	64.7
No	53	35.3
Birthplace		
United States	143	96.0
Mexico	1	0.7
Other	6	3.3
Race/Ethnicity		
African American	95	63.3
Angle/White/Caucasian	18	12.0
Hispanic/Latino	16	10.76
Mixed	11	7.3
African American/American Indian	5	3.3
Other	2	1.3
American Indian	1	0.7

Table 1

Sociodemographic Characteristics (N=150 Homeless Adults)

Characteristic	N	%
Marital Status		
Never married of unmarried	72	48.0
Divorced	52	34.7
Separated	10	6.7
Widowed	10	6.7
Legally married	4	2.6
Living with partner	2	1.3
Highest Level of Education		
$\leq 8^{th}$ Grade	11	7.3
9^{th} Grade-12^{th} Grade/GED	80	53.3
Some College	48	32.0
College Completion	8	5.3
Graduate Degree and Professional School	3	2.0
Types of Financial Support Received (Last Year)		
Pension	1	0.7
Savings	1	0.7
Job	2	1.3
Casual Work	6	4.0
Unemployment Check	5	3.3
Social Security Insurance/Social Security Disability	53	35.3
Money or financial support from support network	13	8.7

Table 1

Sociodemographic Characteristics (N=150 Homeless Adults)

Characteristic	N	%
General Relief (Welfare)	62	41.3
Food Stamps	1	0.7
None	6	4.0
Current Monthly Income		
$0-$100.00	47	31.3
$100-$500	55	36.7
$500-$2,000	48	32.0
Lifetime Years Homeless		
Less than 1 year	29	19.3
1-6 years	69	46.0
7-13 years	29	19.3
14-23 years	14	9.3
24 to $\geq$ 30 years	9	6.0
Living Arrangements (Last 30 days)		
Shelter	68	45.3
Unsheltered	34	22.7
Institution or residential treatment facility	37	24.7
Own/Rent/Apartment or House	2	1.3
Someone else's apartment, room or house	6	4.0
Car/Commercial Building	3	2.0

Table 2

Substance Use Past 12 Months (N=150)

Characteristic	N	%
Self-Report for Drug Causes the Most Serious Problem		
None	49	32.7
Crack/Freebase	35	23.3
Alcohol	31	20.7
Cocaine (by itself)	11	7.3
Methamphetamine	6	4.0
Heroin (by itself)	5	3.3
More than one drug causes a problem	5	3.3
Heroin and cocaine (mixed together as speedball)	4	2.7
Marijuana/Hashish/Hallucinogens	4	2.7
Types of Illicit Drugs Used About Every Day[a]		
Alcohol	22	14.7
Crack/Freebase	16	10.5
Cocaine	9	5.9
Methamphetamine	2	1.3
Marijuana	2	1.3
Current Smoker (yes)	102	68.0

[a] Drug use in the last 12 months

Table 3

Mobility Profile (N=150)

Characteristic	N	%
Walking independently		
Yes	101	67.3
No	49	32.7
Utilization of assistive devices		
None	109	72.7
Cane	29	19.3
Walker	8	5.3
Wheelchair	4	2.7
Falls in the last 30 days		
Yes	33	22.0
No	117	78.0

Table 4

Descriptive Statistics for Selected Variables(N=150)

Variable	*M*	*SD*	Range
Age	52.4	6.80	40-73
Days Homeless	2413	2896	21-14,965
Number of times homeless	13.3	12.75	1-31
Comorbidity Index Problem Score Only	3.48	2.20	0-13
Depressive Symptomology (CES-D)*	25.7	12.64	4-58
Nutrition	22.10	4.41	11-30
Physical Functioning Score (Part 1)	57.1	31.89	0-100
Body Mass Index (BMI)	29.3	6.370	17-51
Activities of Daily Living	5.80	0.54	2-6
Texas Christian Drug Screen Score	3.70	3.568	0-9
Healthcare Utilization	7.28	7.12	0-35
Social Support Total Score	54.88	20.91	19-95
Resilience Scale Total Score	134	28.64	45-175
Frailty Index	0.26	0.15	0-0.76

Note. Comorbidity index: higher scores mean higher number of conditions; CES-D: higher scores mean greater depressive symptoms; Nutrition: higher scores mean better nutrition; Physical Functioning: higher scores mean poorer functioning; Activities of Daily Living: higher scores mean better functioning; Texas Christian Drug Screen: higher scores mean greater drug dependency; Social support: higher scores mean greater social support; Resilience scale: higher scores means greater resilience; Frailty Index: higher scores mean greater frailty.

Table 5

Bivariate Analysis of Variables and Frailty (N=150)

	Age	Days Homeless	Gender	HCU	MNA	TCU	SS	RS
Correlation	.098[b]	.044[a]	.230** [b]	.444** [a]	-.652**[b]	.001[a]	-.377[b]**	-.395**[b]

Note. HCU=Health Care Utilization; MNA=Mini Nutritional Status; TCU=Texas Christian Drug Screen; SS=Social Support; RS=Resilience scale. [a]=Spearman correlation. [b]=Pearson correlation.
* $p<.05$. ** $p<.01$.

Table 6

Results of Stepwise Backward Linear Analysis (N=150).

Variable	B	SEB	β	p	R^2
Step 1					
Age	.003	.001	.125	.043*	.545
Female	.049	.019	.166	.012*	
Days Homeless	.007	.021	.021	.731	
Nutrition	-.017	.002	-.498	<.001**	
Drug use	.007	.024	.020	.773	
Health care utilization	.086	.024	.215	.001*	
Resilience	-.001	.000	-.165	.014*	
Social Support	.000	.000	-.059	.377	
Step 2					
Age	.003	.001	.120	.042*	.545
Female	.046	.017	.158	.008*	
Days Homeless	.009	.020	.026	.657	
Nutrition	-.017	.002	-.501	<.001**	
Healthcare utilization	.087	.024	.216	<.001**	
Resilience	-.001	.000	-.166	.012*	
Social Support	.000	.000	-.055	.398	

Table 6

Results of Stepwise Backward Linear Analysis Continued (N=150).

Variable	B	SEB	β	p	R^2
Step 3					
Age	.003	.001	.119	.042*	.545
Female	.045	.017	.155	.008*	
Nutrition	-.017	.002	-.499	<.001**	
Health care utilization	.088	.024	.219	<.001**	
Resilience	-.001	.000	-.168	.011*	
Social Support	.000	.000	-.057	.385	
Step 4					
Age	.003	.001	.125	.032*	.542
Female	.045	.017	.152	.009*	
Nutrition	-.017	.002	-.517	<.001**	
Health care utilization	.092	.023	.229	<.001**	
Resilience	-.001	.000	-.178	.006*	

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

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Chapter III

Constructing and Identifying Predictors of Frailty among Homeless Adults- A Latent Variable Structural Equations Model Approach

Abstract

Homeless urbanites are a heterogeneous population with unique health and social service needs. The study examined situational, behavioral, health-related and resource indicators in terms of their direct impact on frailty, hypothesized as a latent variable. Using structural equation modeling (SEM), a model was tested with 150 homeless men and women, ages 40 to 73, from three homeless day center drop-in sites on Skid Row and one residential drug treatment (RDT) facility that works with homeless parolees and probationers. In bivariate analyses with the latent construct frailty, months homeless ($p< .01$), female gender ($p< .05$), education ($p< .05$), comorbid conditions ($p< .001$), nutrition ($p< .001$), resilience ($p< .001$), health care utilization ($p< .01$), and falls ($p< .001$) were significantly associated with frailty. In the final path model, significant predictors of frailty included educational attainment ($p<.01$), comorbid conditions ($p<.001$), nutrition ($p<.001$), resilience ($p<.001$), and falls ($p<.01$). The transient and hard to reach nature of homeless populations creates a perfect storm for frailty and beckons us to use these findings as a foundation for future nurse-led, community-based initiatives that focus on key predictors of frailty among the homeless.

Keywords: Frailty, homeless, structural equation modeling

Introduction

Frailty, a public health challenge, may be a significant issue among homeless and disenfranchised populations in urban and rural cities across the United States (US). Defined as an accumulation of deficits (Rockwood & Mitnitski, 2007; 2011) across physical, psychological, and social domains (Gobbens, van Assen, Luijkx, & Schols., 2011), this elusive phenomenon may be a major contributor to disability, morbidity, and premature mortality.

Los Angeles, a large metropolis denoted as the homeless capital of the US, faces consistently high rates of homelessness. On any given night, over 40,000 homeless adults are on the streets (Morrison, 2011). Similar to domestic and international aging trends, homeless adults are similarly aging and experts believe will double within the next several decades (Brown, Kiely, Bharel, & Mitchell, 2011; DiMassa, 2008; Kushel, 2012; Los Angeles Services Housing Administration [LAHSA], 2011; Sermons & Henry, 2010). Urban cities like Los Angeles will face high rates of aging homeless adults as over one third are over 55 years of age (LAHSA 2011) and those over 62 are described as one of the fastest growing segments (DiMassa, 2008), who often have unique health and social service delivery needs, one of which may be frailty.

Among an already vulnerable population, frailty may be hard to ascertain in relation to other covariates. Previous frailty models have been aptly described and focus on physiological, biological and molecular exploratory frameworks (Bergman et al., 2004; Fried & Walston, 2003). In fact, at the nucleus of many models is a decline in physiological reserve which leads to adverse outcomes (Bergman et al., 2004). The literature to date is sparse in addressing predictors of frailty among homeless populations. Thus, the purpose of our study was to test a latent variable, "frailty" which encompasses physical, psychological and social domains and then utilize structural equation modeling (SEM) to assess the relative impact of predictors among a

sample of 150 homeless adults in Los Angeles, California. This study will enable a better understanding of frailty among homeless adults in order to help identify areas for intervention.

The Structural Model

The variables in this study are guided by the hypothesized Frailty Framework among Homeless and Vulnerable Populations (FFHVP), a theoretical framework which serves as a guide in working with hard-to-reach populations. The model itself was developed by the investigator and adapted from the Integrated Conceptual Model of Frailty (Gobbens et al., 2011), the Working Framework for Understanding frailty (Bergman et al., 2004) and biological models of frailty (Fried & Walston, 2003). Although no prior research has used the FFHVP, variables within the framework are based on empirical research.

The indicators present in this study include situational, behavioral, and health-related and resource factors. Situational factors include *race/ethnicity, gender, income, education, marital status, homelessness,* while behavioral factors include *alcohol and illicit drug use, smoking, health care utilization and nutrition*. Health-related factors include *comorbid conditions,* such as hypertension, diabetes, hepatitis and HIV. In addition, resource factors include resilience. These variables are illustrated as contributing factors to physical, psychological and social frailty domains. Examining the relationships between these factors will contribute to the emerging body of literature about antecedents to frailty among homeless adults in an effort to understand pathways for nurse-led interventions.

The Hypothesized Model

Figure 1 illustrates how specific **situational factors**, i.e. race/ethnicity, gender, income and education may influence frailty. While it is difficult to report frailty prevalence rates due to the variety of measures used, one study found that by using the five-item Fried frailty index among a sample of 247 homeless adults, age 50-69, that the prevalence of frailty was 16% (Brown et al., 2011).

Findings from another study revealed that women, African Americans, those with lower education and income were more likely to be frail compared to those who do not have these characteristics ($p<.001$) (Fried et al., 2001). Among Latin American older men and women, findings revealed that women were more likely to be frail when compared to men (Alvarado, Zunzunegui, Beland, & Bamvita, 2008).

Illicit drug and alcohol use and smoking are prevalent **behavioral factors** among homeless adults (Gomez, Thompson, & Barczyk, 2010; National Coalition for the Homeless [NCH], 2009) and may further exacerbate health-related problems and frailty. Data suggest that there is a bidirectional relationship between substance abuse and homelessness (NCH, 2009); in fact, illicit drug use is a pervasive issue among domestic and international homeless populations (Fountain, Howes, & Strang, 2003; Grinman et al., 2010; NCH, 2009; Robbins, Wenger, Lorvick, Shiboski, & Kral, 2010). One study among homeless adults (N=1191) in Toronto found that both marijuana and cocaine were frequently used (Grinman et al., 2010). In one study, nearly 80% of chronically homeless adults (n=754) were current cigarette smokers (Tsai & Rosenheck, 2012). These substance use behaviors influence health care utilization among homeless populations. Further, studies have found that emergency room use and hospital visits

are common for homeless adults (Stein, Andersen, Robertson, & Gelberg, 2012) and significant issues for frail adults (Hoeck et al., 2012).

While there is minimal research which focuses on resilience among homeless populations, individuals who are more **resilient** may be more likely to rebound from stressors and mitigate frailty. One study found that among high risk homeless youth (N=47) between the ages of 15 to 21 years of age that those who have been on the street less than six months were more resilient when compared to those who have been on the street greater than six months (Cleverley & Kidd, 2011). This relationship has not been investigated in terms of its relationship with frailty.

Previous research has also found that **health-related factors**, namely, chronic conditions, such as cardiovascular disease, hypertension, diabetes mellitus and communicable diseases may be significant issues among homeless populations (Hahn et al., 2006; Hwang & Bugeja, 2000; Lee et al., 2005; Nyamathi et al., 2012a) which have been attributed to frailty (Cacciatore et al., 2012; Fries, 2005; Pathai et al., 2012), regardless of frailty instrument used.

Poor **nutrition** is also a significant issue among homeless populations, as receipt of food may be problematic along with amount of nutritional content received. Tarasuk et al. (2005) found that among homeless youth (N=261), food acquisition patterns differed; in particular, some obtained food from charitable meal programs, while others obtained food via panhandling, theft, sex trade work, selling items, or paid employment. Approximately 75.8% of the homeless male youth had a vitamin C inadequacy, followed by folate (75.6%) and vitamin B-6 (32.9%) (Tarasuk, Dachner, & Li, 2005).

Methods

Design

Cross-sectional data were collected from a sample of 150 homeless men and women in Los Angeles from February to May 2012. This study was approved by the University Human Subjects Protection Committee.

Sample and Site

Homeless men and women comprised the sample (N=150; 50% female) and were found eligible if they were: a) aged 40 or over; b) free of evidence of acute psychotic hallucinations and psychosis; c) English-speaking; and d) homeless. Participants were recruited from three homeless day center drop in sites on Skid Row and one residential drug treatment (RDT) facility which provides temporary shelter for homeless adults on parole or probation within the same perimeter. The average age of the participants was 52.3 years (SD 6.8); the sample is 67% African-American, 12% White, and 10% Hispanic.

Procedures

Community-based partnerships were established by the principal investigator (PI) upon obtaining UCLA Human Subjects Institutional Board approval. Flyers were posted in common day center sites during the recruitment period, and numerous announcements were made in day centers by the PI. In total, 313 homeless adults showed interest in participating. After further discussion, if interest continued, a brief screening questionnaire to assess birth year, homelessness status, and sleeping arrangements in the previous night. Upon determination of eligibility, the PI set an appointment with the potential participant and subsequently completed

informed consent in a quiet screened area of each facility. Each participant interview lasted one hour and thirty minutes. During that time, the PI administered the questionnaires and other assessments. At the completion of session, each participant was compensated with a $25 gift card to a food vendor.

Measures

The instrumentation was composed of a number of measures chosen based on the Frailty Framework among Homeless and Vulnerable Populations (FFHVP). Antecedent indicator factors were developed which included situational, behavioral, health related and resource factors.

Antecedent Indicators

Situational factors. These indicators were composed of chronological age, gender (male = 1, female = 2), race/ethnicity (dummy coded for White, African-American, and Hispanic), education (in years), marital status (in a relationship vs. not), current monthly income ($0.00 - > $2,000), and length of time homeless (in months).

Behavioral factors. Drug use was measured using the Texas Christian University (TCU) Drug Screen II (Knight, 2002) which provides data about a history of heavy drug use or dependency within the last 12 months. Responses included "yes/no" to each drug mentioned with a total score ranging from 0 to 9. Higher scores ($\geq$ 3 or greater) indicate relatively severe drug-related problems and corresponds approximately to DSM drug dependence diagnosis. An alpha coefficient for drug use in this population was .95. Smoking was also assessed using a "yes/no" response.

Health-related factors. This indicator was represented by the self-reported comorbidity index (SCQ) for medical conditions, treatment and physical limitations (Sangha, Stucki, Liang, Fossel, & Katz, 2003). The total problem score was used which consisted of 13 questions and open-ended responses. Responses were coded as "yes/no" along with the presence of a condition. Higher numbers meant higher comorbid scores. The alpha coefficient for the problem score in this sample was .91.

Nutrition was assessed using the mini nutritional assessment (MNA) (DiMaria-Ghalili & Guenter, 2008; Vellas et al., 1999). A total score is derived which indicates if the participant is malnourished, at risk for malnutrition or normal nutritional status. The alpha coefficient in this sample was .70.

Falls were assessed using a self-report question related to having experienced a fall within the last year. Responses included "yes/no" to the question.

Resilience was assessed using the Resilience Scale (Wagnild & Young, 1993; Wagnild, 2009). The 25-item index evaluates a purposeful life, perseverance, equanimity, self-reliance and existential aloneness on a 7-point scale ranging from 1) "strong disagree" to 7) "strongly agree"; the total score ranges from 25-175 (Wagnild & Young, 1993; Wagnild, 2009). A higher score meant greater resilience. The alpha coefficient for resilience was .94.

Frailty latent construct. This construct is represented by three indicators which include: physical (9 items, α=.917), psychological (7 items, α=.733) and social (8 items, α=.823) domains. These were derived from the Medical Outcomes Study (MOS) Physical Functioning Measure (McDowell, 2006), the Medical Outcomes Study Social Support Survey (MOS-SSS) (Sherbourne & Stewart, 1991), the Frailty Index (FI) (Rockwood, Song, & Mitnitski, 2011) and

the Tilburg Frailty Index (TFI) (Gobbens, van Assen, Luijkx, Wijnen-Sponselee, & Schols, 2010).

Data Analysis

Prior to the confirmatory factor analysis (CFA) for the frailty latent construct, a preliminary analysis included a six –pronged approach: (1) selecting variables based on the domains of frailty: physical, psychological and social, (2) determining lack of redundancy between items; (3) a principal components analysis (PCA) to establish what linear components exist within the data (Field, 2009) using IBM Statistical Package for the Social Sciences (SPSS) Version 20 (SPSS, 2012); (4) scanning Pearson correlation coefficients between 0.3 to 0.9; and (5) computing Haitovsky's equation to determine multicollinearity: Haitovsky's $\chi^2_H = [1 + (2p+5)/6\text{-}N]\ ln\ (1\text{-}|R|)$; and (6) determining Cronbach's alpha for the subscales.

The confirmatory analytic method selected was Structural Equation Modeling (SEM) and was performed using the EQS structural equations program (Bentler, 2006). As a first step, a CFA was performed in which all variables, e.g. length of time homeless and other socio-demographic characteristics, comorbidities, health care utilization, resilience, and drug use/dependency, were correlated among themselves and with the hypothesized latent variable of frailty without any supposition of directionality. In addition, the viability of the frailty construct was assessed simultaneously by examining the factor loadings of the individual indicators (physical, psychological, and social) on the latent variable. As a second step, a path model was tested in which the independent variables predicted the outcome latent variable of frailty.

Model fit was evaluated with the comparative fit index (CFI), the maximum likelihood $\chi 2$, the more robust Satorra-Bentler χ^2 (S-B χ^2), the Robust Comparative Fit Index (RCFI), and the root-mean-square error of approximation (RMSEA). The CFI and RCFI range from 0 to 1

and reflect the improvement in fit of a hypothesized model over a model of complete independence among the measured variables. Values at .95 or greater are desirable, indicating that the hypothesized model reproduces 95% or more of the co-variation in the data (Hu & Bentler, 1999). The RMSEA is a measure of fit per degrees of freedom, controlling for sample size, and values less than .06 indicate a relatively good fit between the hypothesized model and the observed data (Hu & Bentler, 1999). Robust statistics were used in addition to the maximum likelihood statistics because they are more appropriate and robust if the data are not distributed normally.

Results

Principal component analysis (PCA). A principal component analysis (PCA) was conducted to assess the underlying structure for the items hypothesized to compose frailty utilizing orthogonal rotation (Varimax) (Table 1). Three factors were requested based on domains of frailty. After rotation, the first factor accounted for 33.8% of the variance, the second factor accounted for 11.8% variance and the third factor accounted for 6.6%. The Kaiser-Meyer-Olkin (KMO), verified sampling adequacy (KMO=0.895) (Hutcheson & Sofroniou, 1999). Further, Haitovsky's test was used to detect multicollinearity of the data (χ^2_H=0.50 > 0.00001) (Field, 2009; Haitovsky, 1969). Bartlett's test of sphericity χ^2 (276) =1680.0, p<.001), indicated that correlations between items were sufficiently large for PCA. The items that clustered on the same components suggested that component 1 was the physical domain, component 2 was the social domain, and component 3 was the psychological domain. Items were deleted to remove conceptual overlap and reliability analysis was conducted to determine scale reliability (Field, 2009), frailty subscales and high Cronbach's for physical (9 items, α =.917), psychological (7 items, α =..733), social (8 items, .823) and overall (24 items, α = .867).

Confirmatory factor analysis (CFA). Table 2 presents the rotated means, standard deviations, and factor loadings of the measured variables in the Confirmatory Factor Analysis (CFA). The initial fit statistics for the CFA model were acceptable given that some of the items in the CFA were only minimally correlated with each other: maximum- likelihood (ML) χ 2 (N = 150) = 48.40, 20 *df,* CFI =.93, RMSEA = 0.098.; Satorra–Bentler (S-B) χ 2 =44.63, 20 *df,* RCFI =.942, RMSEA=0.091). Although fit indexes were not ideal with the inclusion of several possible predictors of frailty and their associations among themselves, the principle interest in the CFA was the viability of the hypothesized latent variable representing frailty and its associations with the hypothesized predictors. The three factor loadings: physical (.701), psychological (.730) and social (.501) domains were all significant ($p \leq .001$) and substantial in size.

Table 3 reports the correlations among the model variables. Of most interest were the bivariate associations with the frailty latent construct. Except for age and drugs, all of the independent variables were significant associated with frailty in the CFA. These included months homeless ($p< .01$), female gender ($p< .05$), education ($p< .05$), comorbid conditions ($p< .001$), nutrition ($p < .001$), resilience ($p< .001$), healthcare utilization ($p< .01$), and falls ($p< .001$).

Path model. Initially, all independent variables were used to predict frailty. In addition, all correlations among the predictors were included. Non-significant correlations among the predictors and non-significant regression paths from the predictors to the latent variable of frailty were dropped gradually until only significant paths and correlations remained. The final predictive structural equation model is depicted in Figure 2. This trimmed path model explains 84.3% of the variance in frailty. Fit indexes for the final path model were very good: ML χ2 =

60.59, 44 *df*; CFI = .96, RMSEA = .05; S-B $\chi 2$ = 61.14, 44 *df*; RCFI = .96; RMSEA = .05. While many variables were significantly associated with frailty in the bivariate analysis, some were not significant predictors in the path model once associations with other variables in the model were accounted for. Significant predictors of frailty included education ($p<.01$), comorbid conditions ($p<.001$), nutrition ($p<.001$), resilience ($p<.001$), and falls ($p<.01$). However, age, gender, length of time homeless, health care utilization and drug use did not emerge as significant in the path model.

Discussion

Guided by the modified Frailty Framework among Homeless and Vulnerable Populations (FFHVP), the purpose of our study was to test a latent variable known as frailty which encompasses physical, psychological and social domains and then utilize SEM to assess the relative impact of predictors among a sample of 150 homeless adults in Los Angeles, California. We developed the latent construct, frailty, based upon physical, psychological and social domains which had no conceptual overlap and had high factor loadings. Our findings revealed that education, nutrition, comorbid conditions, resilience and falls predicted frailty. Educational attainment was inversely related to frailty. Although our latent construct of frailty has not been replicated in other studies, this finding has been mirrored in another secondary analysis among community dwelling older adult populations (Fried et al., 2001) indicating that education is an important predictive variable. We also found that lower nutrition scores predicted higher frailty scores. Data suggest that obtaining adequate nutrition may be a critical issue for homeless populations (Kinder, 2004) as many scavenge for food (Richards & Smith, 2006) or obtain food in private and public shelters (Luder, Ceysens-Okada, Koren-Roth, & Martinez-Weber, 1990).

A study analyzing a national dataset of homeless adults (N=966) in 79 health care for homeless clinics (HCH) found that nearly 25% of homeless adults did not have adequate nutrition (Baggett et al., 2011). Individuals who were food insufficient were more likely to use emergency rooms (68.5% vs 59.7%) and be hospitalized for a psychiatric condition (30.3% vs 13.0%) as compared to those who did not (Baggett et al., 2011). These findings point to the need for targeted interventions improving receipt of essential nutrients to sustain health and well-being among homeless populations. Poor nutrition was the most powerful predictor of frailty.

Further, our findings revealed there was a positive predictive relationship between comorbid conditions and frailty; in this analysis, we removed comorbid conditions from items comprising the dependent variable so this relationship is not tautological. Data suggest that regardless of geographic location, whether in Boston or Los Angeles, homeless populations are burdened by poor health conditions (Brown et al., 2011; Nyamathi et al., 2012b). One Boston based study of homeless persons found that depression, hypertension and arthritis were the top three self-reported conditions (Brown et al., 2011). Future research should examine the predictive power of specific health conditions on frailty and assess health management challenges.

Our findings further suggest that falling was associated with frailty. Although we did not control for being under the influence of drugs when falling, it is important to note that drugs and falls were negatively associated with each other. Limited studies have explored falls among homeless populations. One study found that among homeless adults in Boston (N=247) impaired mobility was a significant issue; specifically 41.3% had self-reported difficulty walking when compared to population based cohorts (MBS: 28.9%, p=0.002; NHIS: 9.9%, p<0.001; NHANES: 8.1%, p<0.001) (Brown et al., 2011). Further, results revealed that over one third of older

homeless adults reported difficulty with balance when compared to other population cohorts population-based cohort (Brown et al., 2011). Interestingly, over half of the homeless population reported that they had fallen in the previous year (53.2%) when compared to the population based cohorts (MBS: 37.5%, p=0.50; NHIS: 13.6%, p<0.001) (Brown et al., 2011).

In the CFA, resilience was negatively related to comorbid conditions, and positively related to nutrition. In addition, in the final path model, resilience was inversely related to frailty, meaning that as resilience decreased, frailty levels increased. This connection has not been explored in the literature to date and may point to the need to explore the influence that resilience has on other variables.

Several variables were *not* predictive of frailty, the first being chronological age. While the CFA did indicate that increasing age was positively significantly related to length of time homeless, comorbid conditions, and negatively related to drugs, meaning that younger participants were more likely than older to use illicit substances, age was not related to frailty. Although frailty measures differ, indeed this finding is discordant with other literature which showcases that increasing age increases the risk for frailty (Crews & Zavotka, 2006; Garre Olmo et al., 2013; Goggins, Woo, Sham, & Ho, 2005; Yu et al., 2012). One plausible explanation is the fact that this population is heavily burdened by physical, psychological health and poor social support, despite chronological age. The literature is rife with studies which detail that homeless populations have difficult lives which have probably aged them prematurely due to the ravages of life on the streets, substandard housing, and poor nutrition. It remains to be seen if frailty will be a significant issue among older, homeless adults as opposed to all homeless populations since it was not significant in this analysis keeping in mind that the age range for this study was 40-73; thus, younger homeless people were not in the sample.

The CFA found that longer time spent homeless was significantly associated with frailty, in the final path model, however, length of time homeless was not predictive of frailty. This is probably due to other associations in the data between time homeless and comorbid conditions and falls. It seems sound that homeless persons should have higher degrees of frailty; however, it could be that longer times spent on the street may not contribute independently to frailty scores.

The CFA model also found that there was a significant association between female gender and frailty; however, in the final path model, this association was not significantly predictive of frailty. This is contrary to what other investigators have found; despite different frailty indices used, women were more likely to be frail when compared to men (Garre-Olmo et al., 2013; Goggins et al., 2005; Syddall et al., 2010). It is important to consider that these findings are based on a relatively small sample size for SEM, thus, it is highly probable that significant paths between gender and frailty would emerge based on a larger sample size.

Health care utilization was also not significant in the path model; however, is a significant issue among homeless populations. One study among a Boston-based sample of homeless adults found that close to one third of homeless adults had no usual source of care or used the emergency department (Brown et al., 2011). Further, more than two-thirds of the population visited the emergency department over the previous year and 43.3% of the population had at least one inpatient hospital admission (Brown et al., 2011). In the CFA, healthcare utilization was found to be inversely related to nutrition and positively related to frailty, months homeless, and comorbid conditions. In the future, it may be best to place healthcare utilization as an outcome of frailty, rather than an antecedent. In particular, increasing health care utilization may be a significant issue among frail, homeless populations.

In the CFA, drug use was significantly inversely associated with age, being female, education, nutrition, and resilience; individuals who were younger were more likely to use illicit substances, and participants who spent longer times on the street were more likely to use drugs. Individuals with less education were likewise more likely to use drugs, along with men. Despite the fact that substance use is a significant issue among homeless and impoverished populations (NCH, 2009; Slesnick & Erdem, 2012), it was not a significant path in the model; however, indirect associations may be equally important and future research should utilize mediators in the model.

Conclusions

For decades, researchers have been independently and collaboratively investigating social, psychological and physical parameters as they relate to homeless populations; this paper reframes these interrelated concepts, connecting, constructing, and identifying frailty, an elusive phenomenon. These findings point to possible nodes of intervention. One plausible nurse-led model which may be considered is to enlist frontline nurse navigators, with specialized training, to work with service agencies to address nutrition, falls and education related to comorbid conditions. In fact, it may be that a collaborative case management approach can be taken among both nursing and partner sites in an effort to address gaps in care. These collaborative health promotion efforts can be accomplished in day centers by multidisciplinary teams which focus on improving of nutrition and fall prevention guidelines, which may necessitate environmental modifications.

In essence, these findings serve as a catalyst for the unification of a collaborative approach among clinicians and service providers in order to utilize frailty screening tools.

Future research should also focus on testing the latent variable frailty and its component measures among homeless populations in order to develop nurse-led larger intervention studies.

Limitations

There are some limitations in this study; first, SEM is generally utilized with larger sample sizes, and when using this method with smaller sample sizes, multiple models should be tested (Bentler, 2006). Several variables were excluded from the hypothesized model. First, race and ethnicity as represented by dummy variables (White, African-American, and Hispanic) was tested in the model; however, these variables were removed due to the lack of significance as was marital status. In addition, income was removed because the entire sample was below the federal poverty line and there was a lack of variance in the measure. Further, a cross-sectional study does not allow researchers to completely understand the nature of all of the complex relationships. Further, self-report data may cause bias; in particular, drug use, may be sensitive information and may not have been assessed accurately. Thus, future research should focus on a larger sample with a longitudinal design even though challenging to obtain among a transient population.

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Table 1

Principal Components Rotated Factor Loadings

	Factor Loading			
Item	1	2	3	Communality
Physical tiredness.	.595			.525
Difficulty with vigorous activities.	.794			.690
Difficulty with moderate activities.	.740			.585
Difficulties with lifting or carrying groceries.	.779			.618
Difficulty with bending, kneeling or stooping.	.822			.720
Difficulty walking more than one mile.	.766			.631
Difficulty walking several blocks.	.830			.734
Difficulty walking one block	.744			.581
Satisfaction doing things want to do.	.614			.538
Problems with memory.			.497	.263
Feeling down in last month.			.497	.313
Feeling nervous or anxious in the last month.			.514	.294
Not able to cope well.			.707	.520
Difficulty solving problems.			.616	.525
Feelings of hopelessness.			.654	.405

Table 1

Principal Components Rotated Factor Loadings Continued

Item	Factor Loading			Communality
	1	2	3	
Feeling sad, blue or depressed			.608	.405
Live alone				.114
Miss having people around you				.161
Receive enough support		.416	.486	.441
Someone to turn to for personal problem		.785		.738
Having someone who shows love and affection.		.827		.694
Having someone to do something enjoyable with.		.738		.597
Having someone to take to medical appointment.		.812		.678
Someone to give you advice about a problem		.703		.577

Note: Loadings <.40 are omitted

The first factor, which seems to index physical frailty, had strong loadings on the first nine items. The second factor, which seems to index the social domain, had strong loadings on the first five items, and component 3 is the psychological domain which had strong loadings on eight items.

Table 2

Means, Standard Deviations (SD), Percentages, and Factor Loadings in the Confirmatory Factor Analysis Model (N=150 Homeless People).

Variables	Mean (SD) or %	Factor Loading
Age (40-73)	52.36 (6.80)	---
Female	50%	
Education (years)	11.74 (0.5)	---
Length of Time Homeless (months)	80.44 (96.54)	---
Falls	0.47 (0.50)	---
Drugs	3.67 (3.56)	---
Comorbid Conditions	3.48 (2.20)	---
Nutrition	22.10 (4.41)	---
Resilience	134.53 (23.63)	---
Subscales		
Physical Domain	4.23 (2.80)	.701
Psychological Domain	3.34 (1.80)	.730
Social Domain	15.17 (5.64)	.501

Table 3

Confirmatory Factor Analysis (N=150)

	1	2	3	4	5	6	7	8	9	10
1. Frailty										
2. Age	.027									
3. Months Homeless	.241**	.108*								
4. Female	.184 *	.014	-.199**							
5. Education	-.222*	-.018	-.069	.053						
6. Comorbidity	.657***	.229**	.200**	.224**	-.055					
7. Nutrition	-.831***	.039	-.128	-.113	.110*	-.522***				
8. Resilience	-.477***	.047	.009	.067	.035	-.153*	.379***			
9. HCU	.284**	.063	.269***	.059	.034	.369***	-.191**	-.016		
10. Falls	.492***	.158*	.240***	.147*	.099	.424***	-.330***	-.103	.310***	
11. Drugs	.113	-.258***	.244***	-.377***	-.254***	.016	-.135	-.060	.001	-.119

*$p < .05$. **$p < .01$. *** $p < .001$

Figure 1

Hypothesized Frailty Framework among Homeless and Vulnerable Populations

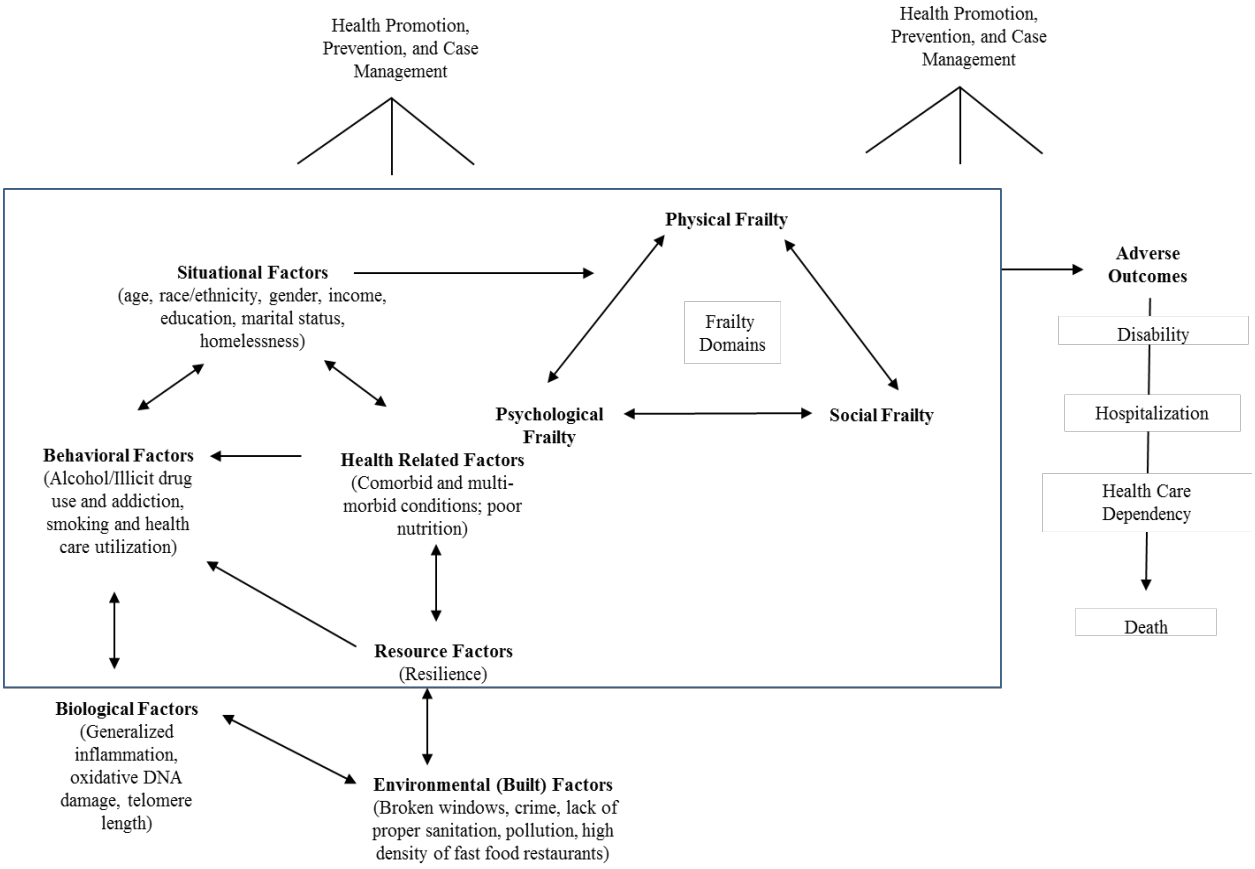
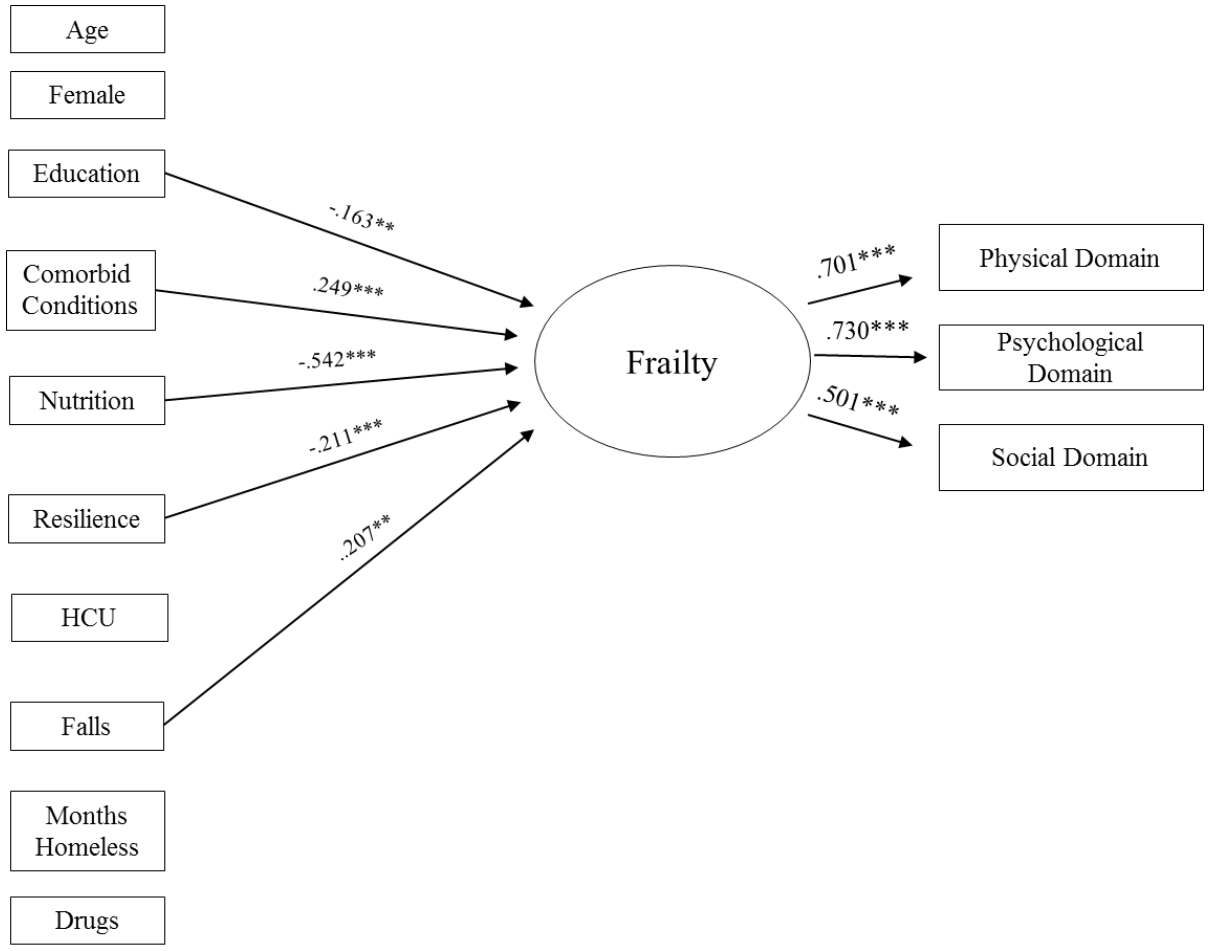


Figure 2

Final Path Model Depicting Significant Predictors of Frailty among 150 Homeless Men and Women. The Ovals Designate Latent Variables; The Rectangles Represent Measured Variables. One-Headed Arrows Represent Regression Paths.



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Conclusion to Dissertation

As a heterogeneous population, homeless urbanites have unique social and health service needs. The findings of chapter one illustrate the Frailty Framework among Homeless and Vulnerable Populations (FFHVP) model which was developed by this investigator, modifies previous models, and is guided by empirical literature proposing unique antecedents which contribute to frailty and may affect disability, hospitalization, health care dependency and death among vulnerable populations.

In chapter two, correlates of frailty are explored and a Pearson (r) bivariate correlation revealed a weak relationship between frailty and being female (r =.230, p<.01). Significant moderate negative correlations were found between frailty and resilience (r =-.395, p<.01), social support (r =-.377, p<.01), and nutrition (r =-.652, p<.01). Further, Spearman *rho* (r_s) bivariate correlations revealed a moderate positive relationship between frailty and health care utilization (r_s =.444, p<.01). A stepwise backward linear regression analysis was conducted and in the final model, age, gender, health care utilization, nutrition and resilience were significantly related to frailty. The multiple correlation squared was .542, indicating that 54.2% of the variance in frailty could be explained by the variables in the model.

In the last chapter, SEM was used to test a modified FFHVP model. In bivariate analysis with the latent construct frailty, months homeless (p<.01), female gender (p<.05), education (p<.05), comorbid conditions (p<.001), nutrition (p<.001), resilience (p<.001), healthcare utilization (p<.01), and falls (p<.001) were significantly associated with frailty. In the final path model, significant predictors of frailty included educational attainment (p<.01), comorbid conditions (p<.001), nutrition (p<.001), resilience (p<.001), and falls (p<.01). However, age,

gender, healthcare utilization, drugs, and months homeless did not emerge as significant predictors.

The findings from this dissertation provide a context for a better understanding of frailty and may inform care for homeless populations utilizing community-based participatory models. Perhaps by identifying frailty among an already vulnerable population, namely the homeless, nurse-led initiatives can be developed in order to help meet health and social delivery needs. This dissertation is the first step towards exploration within this field, which may ultimately lead to utilizing qualitative, as well as, mixed methods research in order to create cost-effective interventions for this hard to reach population.