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Authors

Salem, Benissa E
Nyamathi, Adeline
Brecht, Mary-Lynn
[et al.](#)

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

Benissa E. Salem, RN MSN PHN CNL PhD [Post-Doctoral Fellow],

University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Adeline Nyamathi, ANP PhD FAAN [Distinguished Professor, Associate Dean for International Research and Scholarly Activities],

University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Lynn Brecht, PhD [Adjunct Professor],

UCLA School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Linda R Phillips, RN PhD, FAAN, FGSA [Professor],

University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Janet Mentes, APRN-BC PhD FGSA [Associate Professor],

University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Catherine Sarkisian, MD MSPH [Associate Professor, UCLA Division of Geriatrics, VA Greater Los Angeles Healthcare System], and

Geriatric Research Education Clinical Center (GRECC), Address: 11301 Wilshire Blvd. Los Angeles, CA 90073

Judith A. Stein, PhD

University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue Los Angeles, CA 90095

Benissa E. Salem: bsalem@sonnet.ucla.edu; Adeline Nyamathi: anyamath@sonnet.ucla.edu; Lynn Brecht: lbrecht@mednet.ucla.edu; Linda R Phillips: lrphillips@sonnet.ucla.edu; Janet Mentes: jmentes@sonnet.ucla.edu; Catherine Sarkisian: csarkisian@mednet.ucla.edu; Judith A. Stein: jastein@ucla.edu

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Corresponding Author: Benissa E. Salem RN MSN PHN CNL PhD, University of California, Los Angeles School of Nursing, Address: 700 Tiverton Avenue, Los Angeles CA 90007, bsalem@sonnet.ucla.edu.

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Conflict of Interest

All authors have contributed to the design, analysis and interpretation of the paper, the writing and approval of the final version. All authors will take public responsibility for the content of the paper. The content of this paper has not been published nor is it being considered elsewhere. No possible conflicts of interest exist, there is no supplementary work to the results of the paper and the study was reviewed and approved by the respective institutional review board for human participants.

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 (U.S.). Defined as an accumulation of deficits (Rockwood & Mitnitski, 2007; 2011) across physical, psychological, and social domains (Gobbens, van Assen, Luijckx, & Schols., 2011), this phenomenon may be a major contributor to disability, morbidity, and premature mortality. For decades, frailty has been written about and characterized; a seminal paper identifies frailty as a clinical syndrome with specific hallmark characteristics (Fried et al., 2001) such as shrinking, weakness, exhaustion, slowness, and low activity. While other authors focus on signs, and disease classifications, often leading to adverse outcomes (Mitnitski, Mogilner, MacKnight, & Rockwood, 2002).

Los Angeles, a large metropolis denoted as the homeless capital of the U.S., 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, 2012; DiMassa, 2008; Kushel, 2012; Los Angeles Services Housing Administration [LAHSA], 2011; Sermons & Henry, 2010). Based on current trends of homelessness in Los Angeles, the population is aging; in particular, data reveal over one third are over 55 years of age (LAHSA, 2011) and frailty may be a significant issue.

Frailty among vulnerable populations has not been studied widely; however, homeless populations may have a lifetime of risk factors for frailty which may encompass poor nutrition (Baggett, et al., 2011; Sprake, Russell, & Barker, 2013), chronic diseases such as hypertension (Child, Bierer, & Eagle, 1998) and diabetes (Scott et al., 2013), along with the aging of the population (LAHSA, 2011), histories of incarceration (Tejani et al., 2013), gang-related activities and substance abuse which may lead to adverse outcomes.

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); models particularly focused on frailty among homeless populations have not been devised. Further, varied measurement instruments are used, along with definitions. One definition identifies frailty as an accumulation of deficits which includes signs, symptoms and disease classifications (Mitnitski, Mogilner, MacKnight, & Rockwood, 2002); while another indicates frailty is composed of shrinking, weakness, exhaustion, slowness, and low activity (Fried et al., 2001).

Frailty has been studied among community dwelling older adults (Bollwein et al., 2013) in Germany (Saum et al., 2012), Brazil (Vieira et al., 2013; de Andrade et al., 2013), Montreal (Au et al., 2011) and the United States (Fried et al., 2001) to name a few. Among older community dwelling adults, frailty prevalence has been found to be approximately 7%; predictors of frailty among community dwelling older adults included being African

American, having lower education and income, poorer health, and greater comorbid disease and disability (Fried et al., 2001). Using the same frailty measure, Brown et al., (2012) studied geriatric syndromes among homeless adults and found that the prevalence of frailty was 16%. Authors contend that homeless populations evidence unique risk factors for geriatric syndromes, one of which is frailty; in particular, those who have one geriatric syndrome should be screened for others, such as cognitive impairment, functional impairment, falls, sensory impairment and urinary continence (Brown et al., 2013a). Among older homeless adults, alcohol and drug use problems, having less than a high school education, diabetes and arthritis and difficulty with activities of daily living was associated with an increased number of geriatric syndromes, one of which was frailty (Brown, Kiely, Bharel, & Mitchell, 2013a). Authors acknowledge that evidence of frailty in homeless populations in general, and as demonstrated more recently among older homeless adults, has further strengthened the case for the need to conduct our study of frailty specifically among the older homeless adult group and to propose interventions which may include screening for geriatric syndromes and clinical case management (Brown et al., 2013a).

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.

Methods

Design, Sample and Site

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. 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.

Procedures

Community-based partnerships were established by the principal investigator (PI) upon obtaining UCLA Human Subjects Institutional Board approval. There were four community-based sites in the skid row expanse; one of which was a women’s center, another had a dedicated women’s day center, the third worked with women and the residential drug treatment site worked with women as well as men. Flyers were posted in common day center sites during the recruitment period, and numerous announcements were made in day centers by the PI. 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 session 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 commercial grocery store or food vendor.

Measures

The instrumentation was composed of a number of measures chosen based on the Frailty Framework among Vulnerable Populations (FFVP) and carefully selected in terms of not overlapping with the outcome. Antecedent indicator factors were included situational, behavioral, health related and resource factors.

The Structural Model

The variables in this study are guided by the hypothesized Frailty Framework among Vulnerable Populations (FFVP), 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). Variables within the framework are based on empirical research and they were explicitly developed for this study

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., 2012). Findings from another study using the same measure 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).

There is a bidirectional relationship between behavioral and health related factors. Specifically, behavioral factors such as illicit drug use may affect and lead to chronic health conditions. One study found that frequent cannabis use leads to both depression and anxiety (Hayatbakhsh et al., 2007) whereas methamphetamine use leads to all-cause mortality (Callahan et al., 2012). 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).

While there is minimal research which focuses on resilience among homeless populations, individuals who have **resource factors**, namely, resilience 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). That those who are exposed to high crime neighborhoods, may be less resilient and have increasing health conditions; these relationships have not been investigated, along with a lack of understanding with frailty.

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 to > \$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, Simpson, & Morey, 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 (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). 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, mid arm and calf circumference. A total score is derived which indicates if the participant is malnourished (< 17), at risk for malnutrition (17–23.5) or has a normal nutritional status (24–30). 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 are continuous level variables and include: physical (9 items, $\alpha=.917$), psychological (7 items, $\alpha=.733$) and social (8 items, $\alpha=.823$) domains. Each item was coded as either “0” which indicated the absence or “1” which indicated the presence. 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 $\chi^2_H = [1 + (2p+5)/6-N] \ln(1-|R|)$; 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 χ^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

Sociodemographics

The average age of the participants was 52.3 years (SD 6.8); the sample is African American (63.3%), followed by Anglo/White/Caucasian (12%), Hispanic/Latino (10.7%), and other groups (14%). 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%; table not shown).

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 ($\chi^2_H=0.50 > 0.00001$) (Field, 2009; Haitovsky,

1969). Bartlett's test of sphericity $\chi^2 (276) = 1680.0, p < .001$, 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, $\alpha = .917$), psychological (7 items, $\alpha = .733$), social (8 items, $\alpha = .823$) and overall (24 items, $\alpha = .867$).

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) $\chi^2 (N = 150) = 48.40, 20 df, CFI = .93, RMSEA = 0.098$; Satorra-Bentler (S-B) $\chi^2 = 44.63, 20 df, RCFI = .942, RMSEA = 0.091$. 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 ($p < .001$) and substantial in size. Factor loadings ($< .40$) were omitted.

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 $\chi^2 = 60.59, 44 df; CFI = .96, RMSEA = .05$; 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 Vulnerable Populations (FFVP), the purpose of our study was to test a latent variable known as frailty which encompasses physical, psychological and social domains and 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, education is an important variable in relation to frailty; in one secondary analysis among community dwelling older adult populations, low education was related with increasing frailty (Fried et al., 2001). 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. These findings highlight the need for interventions. In shelters and soup kitchens, it may be necessary to develop health promotion-related nutrition classes which focus on portion size, calorie counts and balanced meals based on availability. Further, it may be helpful to provide resources for healthy options based on soup kitchen and food availability with specific focus on neighboring stores. It may also be helpful to provide physical activity classes in shelters and work with nutritionists to help plan meals for homeless adults and develop workshops and training seminars to improve nutrition in an effort to promote wellness. For those who are frail, further screening and clinical case management may be necessary as well. 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., 2012; 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., 2012). 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., 2012). 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., 2012). 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., 2012).

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; however, we believe the individuals who are more resilience may be less frail. This necessitates further exploration.

Several variables were *not* predictive of frailty, the first being chronological age. While the CFA did indicate that increasing age was positively 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. It is plausible that homeless populations have difficult lives which have contributed to premature aging processes due to the ravages of life on the streets, substandard housing, and poor nutrition. It is important to bear in mind that the age range for this study was 40–73; thus, younger homeless people were not in the sample.

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.

Based upon the findings of this study, we need to take into account frequency of length of time homeless. Further, mediating variables need to be considered as they relate to health-related conditions and resilience. Equally important, other types of resources such as coping and positive social support need to be taken into account in relation with frailty. Further, cumulative lifespan issues which should be taken into account include childhood factors (foster care, emotional and physical abuse). In addition, outcomes of frailty need to be falls and health care utilization.

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. Exploring frailty among homeless populations is a pressing issue for several reasons. First, homeless populations may be considered frail at younger ages as compared to community dwelling older adults. Second, individuals who are pre – frail or frail may be more likely to become homeless. Next, understanding frailty among homeless populations may enable a greater fiscal response by federal agencies responsible for funding programs. Equally important, older adults are aging in place and on the streets which may increase emergency department use. 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). Further, small sample robust statistics were used in SEM (Bentler & Yuan, 1999). 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. In addition, we excluded individuals who had cognitive impairment which limits generalizability. 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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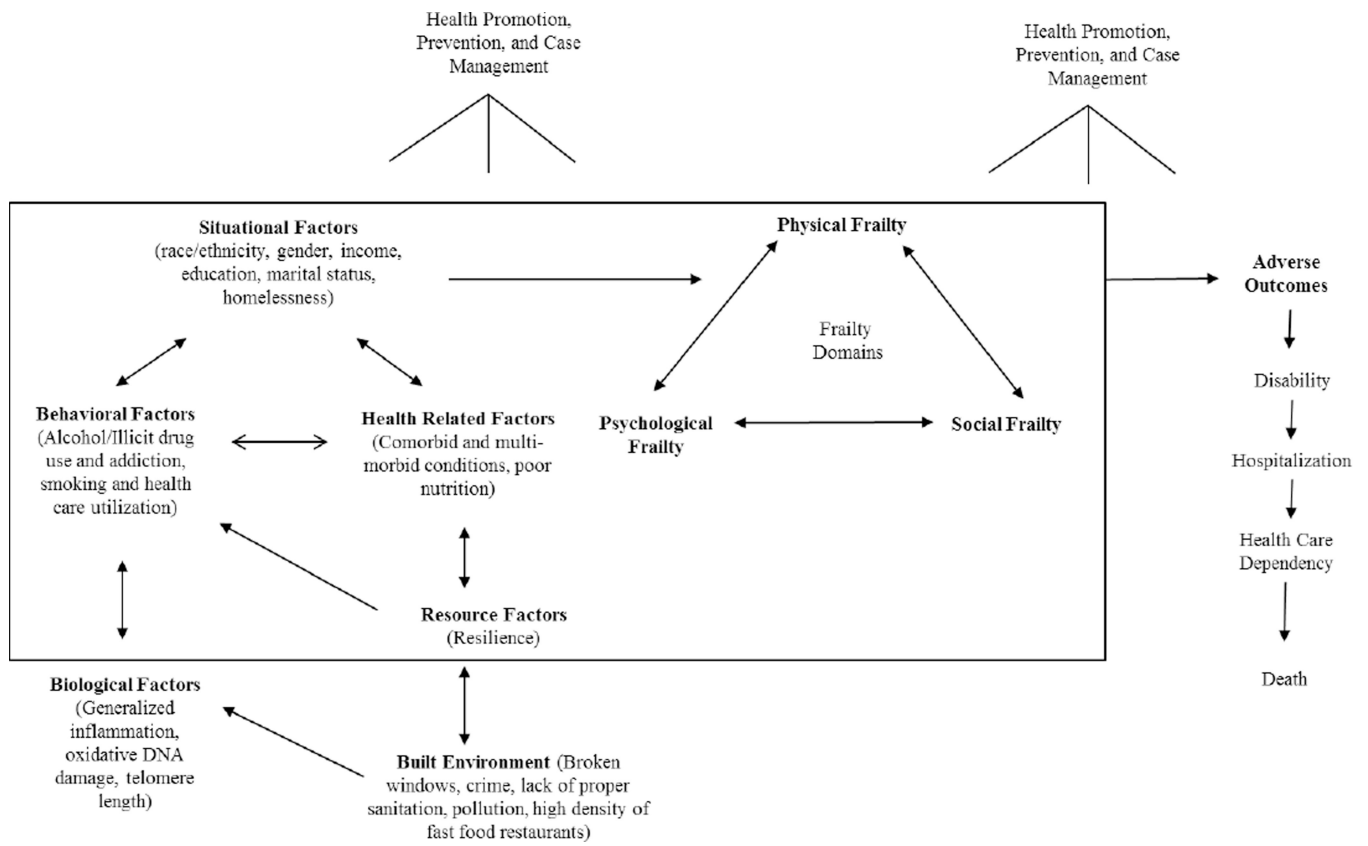


Figure 1.
Hypothesized Frailty Framework among Vulnerable Populations

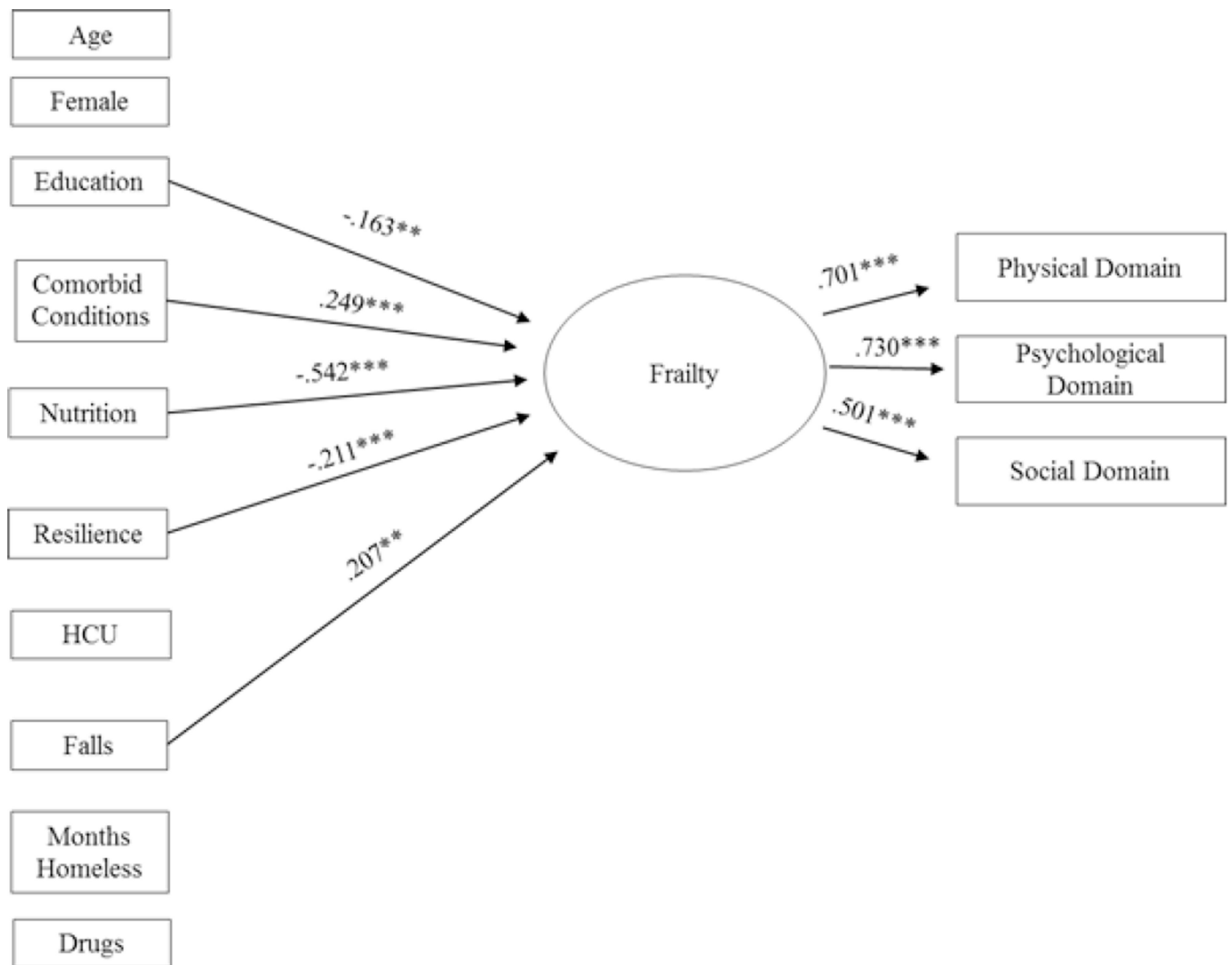


Figure 2.

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.

Table 1

Principal Components Rotated Factor Loadings among Homeless Adults (N=150)

Item	Factor Loading			Communality
	1	2	3	
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
Miss having people around you				.161
Receive enough support		.416		.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
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
Feeling sad, blue or depressed		.608		.405

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, and component 3 is the psychological domain which had strong loadings on seven 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 %
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)
Psychological Domain	3.34 (1.80)
Social Domain	15.17 (5.64)

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 to > \$2,000) and length of time homeless (in months); Texas Christian Drug Screen II responses included “yes/no” to each drug mentioned with a total score ranging from 0 to 9. Higher scores (3 or greater) indicate relatively severe drug-related problems and corresponds approximately to DSM drug dependence diagnosis. Self-reported drug use 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. Nutrition 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, mid arm and calf circumference. Falls included “yes/no” to the question. Resilience ranged from 25–175; a higher score meant greater resilience. Frailty was represented by three indicators physical (9 items, $\alpha=.917$), psychological (7 items, $\alpha=.733$) and social (8 items, $\alpha=.823$) domains. Each item was coded as either “0” which indicated the absence or “1” which indicated the presence.

Table 3

Correlations of Select Variables and Latent Construct of Frailty (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 ^a	.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

* $p < .05$.** $p < .01$.*** $p < .001$ ^aHealthcare Utilization