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Original article

Gender differences in loneliness, anger, depression, self-management ability and biomarkers of chronic illness in chronically ill mid-life adults in Appalachia

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ABSTRACT

Aims: This study describes gender differences and relationships among loneliness, anger, depression, self-management ability and biomarkers of chronic illness in chronically ill mid-life adults in Appalachia.
Background: Loneliness predicts poor health, functional decline, and mortality in adults. Though self-management ability is linked to improved health outcomes, a gap existed when examining how loneliness impacts self-management ability (SMA).
Methods: This cross-sectional study recruited 90 patients from a primary care center. Instruments measured loneliness, anger, depression, and SMA. Measures were taken for BMI, blood pressure, and glucose. Descriptive and hierarchical multiple regression was used to test hypotheses.
Results: Participants were majority female (68%), white (89%), married (52%), employed (66%), and impoverished (70%). They were moderately lonely (M = 41.29, SD 12.13) and men were lonelier than women ($p < .01$). Men and women did not differ on anger, depressive symptoms, or SMA. Anger (5.64, SD 7.32) and depressive symptoms (M = 5.89, SD 5.54) were low. Loneliness positively correlated with anger ($r = 0.415$, $p < .01$) and depression ($r = 0.558$, $p < .01$), and inversely related to subscales of SMA ($p < .01$) [taking initiative (TI), investment behavior (IB), variety (V), multifunctionality (MF), self-efficacy (SE), and positive frame of mind (PM)]. After controlling for age, anger, and depression, loneliness was explanatory for poorer SMA (R squared change = 0.32, F change (1, 67) = 47.67, $p < .001$).
Conclusions: Loneliness impacts SMA and should be included in the care planning or study of chronically ill adults who struggle with self-management.

1. Introduction

Loneliness, a significant biopsychosocial stressor with a prevalence of 17% in U.S. adults (Mezuk et al., 2016; Theeke, 2009, 2010), is linked to poor outcomes for multiple chronic health conditions and poor health behaviors. Loneliness elicits a stress related inflammatory and neuroendocrine response (Hackett, Hamer, Endrighi, Brydon, & Steptoe, 2012) and has been identified as a major risk factor for hypertension (Hawkley, Thisted, Masi, & Cacioppo, 2010; Momtaz et al., 2012). In addition, loneliness is predictive of depression (Aylaz, Akturk, Erci, Ozturk, & Aslan, 2012; Bodner & Bergman, 2016; Cacioppo, Hawkley, & Thisted, 2010) and reported as a contributor to functional decline (Perissinotto, Stijacic Cenzer, & Covinsky, 2012; Theeke, 2012; Theeke et al., 2016), and mortality (Luo, Hawkley, Waite, & Cacioppo, 2012; Perissinotto et al., 2012; Tabue Teguo et al., 2016). Experiencing loneliness is traumatic as lonely people experience significant social stigma (Grov, Golub, Parsons, Brennan, & Karpiak, 2010; Switaj, Grygiel, Anczewska, & Wciorka, 2014), are more likely to be inactive (Theeke, 2010), and engage in substance use (Theeke, 2010). Loneliness is a costly health care problem with lonely persons visiting emergency services (Molloy, McGee, O'Neill, & Conroy, 2010), clinics (Friedman, Conwell, & Delavan, 2007; Gerst-Emerson & Jayawardhana, 2015), and long-term care facilities (Theeke, 2010) more frequently than those who are not experiencing loneliness.

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Understanding loneliness as a major predictor of depression is paramount because depression is estimated to become the number one cause of disability in the United States within the next 2 decades (Whooley, 2012a, 2012b). Shifting the focus from treatment to prevention of depression is important since overall depression rates for U.S. adults have been reported to be as high as 20.1% and, 36.9% of people with severe depressive symptoms receive either no treatment plan from a mental health professional or no treatment plan that reflects behavioral health therapies (Shim, Baltrus, Ye, & Rust, 2011). It is particularly important that providers understand depression and the antecedents of depression for adults in mid-life because it has been reported that prevalence of depression is highest among mid-life adults (Cacioppo et al., 2010) who have a 29.9% estimated lifetime risk for a major depressive episode (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012).

It is critical to understand loneliness and depression in the Appalachian region because this is an area where more adults may be suffering with untreated depression compared to other areas (Friedman et al., 2007). A disproportionate segment of the region's population is rural compared to the national population (Haaga, 2004), with increased poverty rates, increased physical illness, and lower educational attainment, all of which are social determinants of poorer behavioral health outcomes (Halverson, Ma, & Harner, 2004). In addition, common chronic illnesses such as diabetes and cardiovascular disease, both linked to loneliness and depression, are most prevalent in Appalachia, compared to other more urban parts of the country (Barker, Kirtland, Gregg, Geiss, & Thompson, 2011; Howard, Keleindorfer, & Judd, 2011).

In two recently completed qualitative studies, anger was identified as a significant emotion being experienced by chronically ill lonely older adults living in Appalachia (Theeke, Lucke-Wold, Mallow, & Horstman, 2017; Theeke, Mallow, Gianni, Legg, & Glass, 2015) but quantitative studies are lacking on loneliness and anger. Since loneliness, anger, and depression are reported as significant to cardiovascular disease (Nakamura et al., 2013) and depression (Asberg, 2013), anger an important related concept to consider when studying loneliness.

Understanding these gender differences for psychological constructs is key to culturally competent care as the information can be used to inform precise design of interventions. Men and women experience psychological distress differently and since the early 1980's, loneliness has been reported as differing by gender with incongruous results. It was recently reported that lower levels of family and social support can contribute more so to loneliness in women (Lee & Goldstein, 2016) yet social network characteristics are predictive of loneliness more so in men (Stokes & Levin, 1986). In one qualitative study of older adults, it was determined that women experience loneliness differently than man with higher scores on personal growth and discovery scales (Rokach, Matalon, Rokach, & Safarov, 2007).

This study was designed to fill gaps in knowledge related to loneliness, anger, and gender differences in both in Appalachia. Therefore, the had two specific aims: 1) to describe the gender differences for prevalence and characteristics of loneliness, anger, depression, self-management ability and biomarkers of chronic illness in a sample of chronically ill middle-aged adults living in Appalachia and 2) to describe the relationships among loneliness, anger, depression, self-management ability, biomarkers of chronic illness in chronically ill middle-aged adults living in Appalachia. Based on our extensive literature review on psychological constructs in persons living in Appalachia, the study team hypothesized that;

1) Women would have higher self-reports of loneliness and depression.
2) Men would have higher self-reports of anger.
3) Men would have higher mean scores for blood pressure when compared to women.
4) In both men and women, higher loneliness scores would be inversely related to self-management ability.
5) Loneliness would be predictive of poor self-management ability even while controlling for the possible effect of age, depression, and anger.
6) In both men and women, loneliness scores would be positively related to depressive symptoms, anger, and chronic control indicators.
7) Mean loneliness scores would differ based on diagnosis of depression.
8) Mean anger scores would differ based on diagnosis of hypertension.

1.1. Applying the PNI paradigm to loneliness

This study design and variable choice was framed using the Psychoneuroimmunology (PNI) paradigm (McCain, Gray, Walter, & Robins, 2005). This paradigm emphasizes that psychosocial stressors elicit both neurological and immunological stress responses that impact physical health, psychosocial functioning, and quality of life. For this study, the focus was on understanding relationships among the person factors (identified as socio demographic variables and chronic illness diagnoses), the psychosocial variables (loneliness, anger, and depression), and measures of physical health which included blood pressure, BMI, blood glucose, and self-management ability.

2. Methods

2.1. Design and setting

This descriptive, cross-sectional study took place in the Clark Sleeth Family Medicine Center, a community-based primary care center, located in North Central West Virginia. The Family Medicine Center sees over 5000 adult healthcare visits per year and is a unique environment with on-site physicians, nurse practitioners, physician's assistants, social workers, nurse care managers, physical therapists, nutritionists, and psychologists. The population construct for this study was adults who are mid-life and experiencing chronic illness. The target population included all adult patients between the ages of 45 and 64 who were experiencing chronic illness and who were being seen for a primary care visit at the clinical site. The clinical center cares for approximately 1600 adult patients in this age range annually.

2.2. Ethical considerations

A letter of approval for the ethical conduct of research was obtained from the West Virginia University Institutional Review Board. Informed consent was obtained from each participant and the consent form was reviewed with the potential participants prior to signing. Participants were interviewed in a secure and private interview room within the Family Medicine Clinic. All members of the research team were trained to meet confidentiality requirements.

2.3. Recruitment and sampling

Scheduled patients were made aware of the study using approved posters and flyers in the clinical site. Interested participants were screened using the inclusion and exclusion criteria prior to being invited to participate. Inclusion criteria were: diagnosis of least one chronic illness, living in Appalachia, and living in a community setting. Exclusion criteria were: current diagnosis of dementia, Folstein Mini-mental Status Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) less than or equal to 23, significant psychiatric illness requiring antipsychotic medicine, or inability to understand and respond to survey questions. Each interview took approximately 20 min. With a 5% margin of error and 95% confidence interval, an estimated minimum sample of 70 was needed. Oversampling of 90 participants was accomplished to allow for additional subgroup comparisons.

2.4. Measures

Data collection was conducted using three techniques. Face to face interviews to collect sociodemographic information and surveys of loneliness (UCLS), anger (CAS), depression (PHQ-9), functional ability (Katz ADL), perceived social support (MOS), and SMA (SMAS). The SMOG readability scores (Brangan, 2015) are reported for the each of the study instruments below. The study team then performed physical measure testing to establish BMI, blood pressure, waist-hip ratio, and blood glucose levels. Chronic illness diagnoses were obtained by self-report in the interviews and verified with the electronic health records.

2.4.1. Socio-demographic characteristics

Socio-demographic information included: gender, age in years at the time of enrollment, number of people in the home, health literacy, marital status, highest education completed, annual household income, employment status, and chronic illness diagnoses. Health literacy was operationalized using The Newest Vital Sign (NVS) (Weiss et al., 2005). The NVS consists of a nutrition label from an ice cream container, and six questions asked orally by a healthcare worker or researcher. Participants refer to the label when answering the questions. The number of correct responses corresponds to health literacy level: 0–1 suggests high likelihood (50% or more) of limited literacy; 2–3 indicates the possibility of limited literacy; 4–6 almost always indicates adequate literacy. Cronbach's $\alpha > 0.76$ has been reported in a reliability analysis, and validity has also been established (Weiss et al., 2005).

2.4.2. Psychosocial characteristics

Information about cognitive status, anger, loneliness, social support, functional ability, self-management ability, and depressive symptoms were collected.

Cognitive status was assessed using the Folstein Mini-mental Status Assessment (MMSE) (Folstein et al., 1975) which assesses orientation, registration, attention and calculation, short-term recall, and language. The scores are reported as a continuous variable and range from 0 to 30 with 30 being a perfect score for cognitive ability. Lower scores indicate diminished cognitive ability.

Anger was assessed using the Clinical Anger Scale (CAS). The CAS is a 21-item inventory that was chosen because it was developed to assess clinical anger which is conceptualized as a comprehensive assessment of anger and how it may be interfering with health and thinking (Snell, 1995). Each CAS score ranges from 0 to 63 with scores 0–13 indicating minimal anger, 14–19 indicating mild anger, 20–28 indicating moderate anger, and 29–63 indicating severe anger. Initial psychometrics support reliability (Cronbach's alpha = 0.94) and factor analysis supported a single factor analysis for men and women combined with an eigenvalue > 1. The SMOG score for readability is educational grade 3.4.

Loneliness was assessed using the 20-item scale Revised UCLA Loneliness Scale (Russell, 1996). This scale has been widely used in research for over 20 years with confirmed reliability and validity for assessing loneliness in multiple populations, including mid-life adults (Dussault, Fernet, Austin, & Leroux, 2009; Fernandez-Alonso, Trabalon-Pastor, Vara, Chedraui, & Perez-Lopez, 2012). Participants rank answers on a Likert scale that ranges from *Never* (1) to *Always* (4) and then 9 questions are reverse-coded for total scoring. Scores range from 20 to 80 with 40 considered to be moderate loneliness (Theeke, Goins, Moore, & Campbell, 2012) and 80 being very high loneliness. The SMOG score for readability is educational grade 3.

Perceived Social Support was measured using the Medical Outcomes Survey (MOS) Social Support Scale which includes four subscales; tangible support (the provision of material aid or behavioral assistance), affection support (involving expressions of love and affection), positive social support (the availability of other persons to do fun things with you), and emotional support (the expression of positive affect, empathetic understanding, and the encouragement of expressions of feelings) (Sherbourne & Stewart, 1991). The MOS Social Support Survey has high internal consistency ($\alpha = 0.97$) with alpha coefficients > 0.90 for each subscale (Sherbourne & Stewart, 1991). The SMOG score for the MOS Social Support is educational grade 5.

Functional Ability was measured using the Katz Index of Independence in Activities of Daily Living (Katz, Downs, & Cash, 1970). This scale assesses self-reported levels of independence for basic and more instrumental living tasks including: bathing, dressing, toileting, transferring, elimination, eating, use of telephone, travel beyond walking distance, grocery shopping, housework, cooking, handyman work, laundry, medicine management, stair climbing, and money management. The Katz Index has established construct validity (alpha's ranging from 0.74 to 0.88). In addition, external validity and convergent validity have also been established with alpha coefficients reported as 0.94 (Wallace & Shelkey, 2008). The SMOG score for the Katz Index is not widely reported but was calculated to be educational grade 12.

Self-Management Ability Scale was operationalized using the self-management ability scale (SMAS-S). This 18-item version (total scores ranging from 0 to 84) was designed to operationalize the six core abilities of self-management as subscales with varying score ranges. They are identified as Taking Initiatives (range 0–15), Investment Behavior (range 0–15), Variety (range 0–15), Multifunctionality (range 0–12), Self-Efficacy (range 0–12), and positive Frame of Mind (range 0–15) (Cramm, Strating, deVreede, Steverink, & Nieboer, 2012). Internal consistency measures of the six subscales are reported to range from Cronbach's alpha 0.69–0.77. The SMOG readability score for the SMA-S is educational grade 8.

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) (Arroll et al., 2010), which consists of nine items, each of which corresponds to a symptom of major depressive disorder. Patients report how often they experience these symptoms over two weeks on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day). The summed scores can range from 0 to 27, with scores of ≥ 5, ≥ 10, ≥ 15, and ≥ 20, representing mild, moderate, moderately severe, and severe levels of depressive symptoms, respectively. The reliability and validity of the PHQ-9 has been demonstrated extensively (Arroll et al., 2010). The SMOG score for readability is educational grade 6.

2.4.3. Measures of physical health

Biomarkers of chronic illness included blood pressure, body mass index, and fasting finger stick glucose. Blood pressure was measured by a registered nurse using a sphygmomanometer, BMI was calculated after obtaining and height and weight measures, and finger stick glucose was assessed using a calibrated plasma referenced glucometer and test strip. Chronic illness diagnoses were obtained by self-report in the interviews and verified with the electronic health records.

2.5. Data analysis

Data was entered into an SPSS data file and analyzed using SPSS Version 21. Prior to analysis, data was cleaned to look for outliers or impossible or missing values. Missing data patterns did identify < 5 cases of missing data on individual scale items and for these missing cells, mean substitutions based on gender were used. Analysis included repeating analyses with and without missing data to assess for any differences and none were present. To achieve the study aims, Analysis included exploration of variables for descriptive information and bivariate analysis as appropriate based on variable type to determine gender differences and significant relationships among study variables. Once significant relationships were determined, hierarchical multiple regressions were performed if it was logical to do so based on the bivariate analyses. Regression was seeking the explanatory value of loneliness, while controlling for age, anger and depression on self-management ability.

Table 1
Sociodemographic descriptors of sample compared by gender.

Variable	Female (N = 61) Mean (SD) N (%)	Men (N = 29) Mean (SD) N (%)	Test statistic	Sig (*p*)
Age	55.74 (5.27)	56.14 (6.08)	*t* = −0.320	.750
Number of people in home	2.38 (1.23)	2.10 (1.26)	*t* = 0.979	.330
Health literacy	4.21 (1.50)	4.31 (1.98)	*t* = −0.258	.797
Marital status			χ2 = 0.715	.699
Single	12 (19.7)	8 (27.6)		
Married/significant other	33 (54.1)	14 (48.3)		
Separated/divorced/widowed	16 (26.2)	7 (24.1)		
Highest education completed			χ2 = 2.119	.347
High school/GED or less	24 (39.3)	11 (37.9)		
Some college/2 year degree	20 (32.8)	6 (20.7)		
4 year college degree and up	17 (27.9)	12 (41.4)		
Household income ($/year)			χ2 = 4.971	.083
$29,999 or less	27 (44.3)	13 (44.8)		
$30,000–49,999	20 (32.8)	4 (13.8)		
$50,000–higher	14 (22.9)	12 (41.4)		
Employment status			χ2 = 0.025	.873
Employed for wages	41 (67.2)	19 (65.5)		
Not working	20 (32.8)	10 (34.5)		

Note. Equal variances assumed.

3. Results

The sample of 90 adults [mean age 55.86, SD 5.5, range 45–64 years] was majority female (68%), white (89%), married (50%) or divorced (20%), high school educated or higher (91%), and living at or near poverty level (mean number of people in the home > 2 and 65% with household incomes less than $40,000 per annum), working full-time (53%), and living in Appalachia > 10 years (79%). Eighty percent were born in Appalachia. Table 1 includes a more detailed report of sociodemographic descriptors compared by gender and reveals that there were no significant differences in sociodemographics by gender.

Table 2 includes descriptors of chronic illness diagnoses by gender. Overall, the study participants had a mean of 3.4 chronic illness diagnoses (SD 1.95). Men and women did not differ on diagnoses of hypertension, diabetes, anxiety, arthritis, obesity, hyperlipidemia, or heart disease. However, men and women did differ on depression ($p < .01$). Women had a higher incidence of depression (47.4%) compared to men (15.6%).

Table 2
Descriptors of chronic illness diagnoses compared by gender.

Variable		Female (N = 57) N (%)	Men (N = 32) N (%)	Difference statistic	Sig (*p*)
Hypertension	Yes	33 (57.9)	14 (43.8)	χ2 = 0.491	.483
	No	22 (38.6)	13 (40.6)		
Diabetes	Yes	18 (31.6)	11 (34.4)	χ2 = 0.509	.476
	No	37 (64.9)	16 (50.0)		
Anxiety/emotional problems	Yes	27 (47.4)	8 (25.0)	χ2 = 2.804	.094
	No	28 (49.1)	19 (59.4)		
Depression	Yes	27 (47.4)	5 (15.6)	χ2 = 7.113	.008**
	No	28 (49.1)	22 (68.8)		
Arthritis	Yes	23 (40.4)	7 (21.9)	χ2 = 1.971	.160
	No	32 (56.1)	20 (62.5)		
Obesity	Yes	15 (26.3)	8 (25.0)	χ2 = 0.077	.782
	No	39 (68.4)	18 (56.3)		
Hyperlipidemia	Yes	23 (40.4)	10 (31.3)	χ2 = 0.230	.613
	No	31 (54.4)	17 (53.1)		
Heart disease	Yes	9 (15.8)	6 (18.8)	χ2 = 0.416	.519
	No	46 (80.7)	21 (65.6)		

Total sample N = 79, mean total of chronic illness diagnosis 2.975 (SD 1.724, range 1.00–9.00).
Note. Equal variances assumed.
** *p* value was ≤.01.

In the overall sample, moderate loneliness was prevalent (mean UCLA score 41.29, SD 12.06, range 20–79) with only 1 participant having no loneliness. Depressive symptoms were low (mean PHQ-9 = 5.89, SD 5.54, range 0–22), and anger was low (mean 5.67, SD 7.12, range 0–37). Table 3 includes descriptive information compared by gender on key psychosocial variables including; mini-mental status, anger, loneliness, social support, basic and instrumental functional ability, self-management ability, and depressive symptoms. Men were lonelier than women ($p < .01$). Men and women did not differ on anger, depressive symptoms, or self-management ability. Men and women differed on overall social support ($p = .014$), affectionate support ($p = .001$), emotional support ($p = .01$), and positive social support ($p < .019$). *Hypothesis 1 was not supported* as women did not report higher loneliness and more depressive symptoms. *Hypothesis 2 was not supported* as there were no gender differences in self-reports of anger.

Table 4 presents prevalence of chronic illness control indicators for the whole sample. For the entire sample, all means for chronic illness control indicators were elevated above the clinically accepted values. Table 5 presents gender comparisons for chronic illness control indicators. Men had a higher mean waist-hip ratio when compared to women ($p = .001$). *Hypothesis 3* was not supported because men and women did not differ on blood pressure.

Table 6 presents correlations among loneliness, anger, self-management ability, social support, and depressive symptoms. High loneliness correlated with anger ($r = 0.415$, $p < .01$) and depressive symptoms ($r = 0.558$, $p < .01$), and anger was correlated with depressive symptom ($r = 0.621$, $p < .01$). Loneliness was inversely correlated with overall SMA ($r = -0.698$) and with all subscales of SMA ($p < .01$) which included taking initiative (TI), investment behavior (IB), variety (V), multifunctionality (MF), self-efficacy (SE), and positive frame of mind (PM). Anger inversely correlated to overall SMA ($r = -0.229$, $p < .01$) and inversely with TI and V subscales ($p < .05$), and depression inversely correlated with overall SMA ($r = -0.442$, $p < .01$) and with TI, IB, V, SE, and PM subscales ($p < .05$). *Hypothesis 4 was supported* since higher loneliness scores were inversely related to all subscales of self-management ability.

Hierarchical multiple regression was used to assess the ability of loneliness to predict levels of self-management ability after controlling for the influence of age, anger, and depression. Age, anger, and depression were entered at step 1, explaining 23% of the variance in self-management ability. After entering loneliness at step 2, the total

Table 3
Descriptors of key psychosocial variables compared by gender.

Variable	Female (N = 61) Mean (SD)	Men (N = 32) Mean (SD)	Difference statistic	Sig (*p*)	
Mini-mental (MMSE)	29.07 (0.93)	28.59 (1.74)	t = −1.705	.092	
Anger (CAS)	6.22 (7.86)	4.5 (6.13)	t = 0.972	.058	
Loneliness (UCLS)	38.6 (9.89)	46.83 (14.36)	t = −3.148	.002	**
Overall social support (MOS)	4.02 (0.97)	3.40 (1.30)	t = 2.555	.014	*
Tangible support	4.01 (1.10)	3.32 (1.32)	t = 2.577	.124	
Affectionate support	4.20 (1.11)	3.60 (1.57)	t = 2.104	.001	**
Emotional support	3.97 (0.95)	3.37 (1.29)	t = 2.466	.011	*
Positive social support	3.91 (1.21)	3.29 (1.53)	t = 2.096	.019	*
Basic function (KADL)	6.57 (1.89)	6.07 (0.37)	t = −1.419	.100	
Instrumental function (IADL)	12.08 (4.15)	11.31 (3.10)	t = −0.890	.193	
Self-management (SMA-S)	78.16 (12.25)	68.45 (12.10)	t = 3.527	.369	
Taking initiative	13.72 (2.86)	11.52 (2.94)	t = 3.385	.728	
Investment behavior	13.56 (11.59)	11.59 (3.55)	t = −2.603	.417	
Variety	11.98 (3.03)	11.00 (2.19)	t = 1.550	.212	
Multifunctionality	12.23 (1.76)	10.59 (2.13)	t = 3.870	.302	
Self-efficacy	13.59 (2.82)	12.48 (2.50)	t = 2.206	.700	
Positive frame of mind	13.08 (2.82)	11.28 (2.48)	t = 2.945	.225	
Depressive symptoms (PHQ9)	6.34 (6.05)	4.93 (4.22)	t = −1.133	.69	

Note. Equal variances assumed.
* *p* value was ≤.05.
** *p* value was ≤.01.

variance explained by the model was 54.8%, F (4, 67) = 20.34, $p < .001$. After controlling for age, anger, and depression, loneliness explained an additional 32% of the variance in SMA, R squared change = 0.32, F change (1, 67) = 47.67, $p < .01$. Therefore, loneliness was predictive for poor SMA and *Hypothesis 5* was supported.

Loneliness did correlate with depressive and anger symptoms but not with chronic illness control indicators, thus *Hypothesis 6 was partially supported*. Comparisons were conducted for differences in loneliness and anger based on chronic illness diagnoses. Tables 7 shows that mean loneliness scores did differ for chronic illness diagnoses of depression ($p = .05$) and emotional problems ($p < .01$) which means that *Hypothesis 7 was supported*. Mean scores for anger (see Table 8) did differ based on chronic illness diagnoses of depression ($p < .01$) and emotional problems ($p < .01$) but not on the diagnosis of hypertension and therefore, *Hypothesis 8* was not supported.

4. Discussion

This study is the first to explore loneliness, anger, depression, self-management ability, and chronic illness control in this population. Although loneliness had been reported in some studies of mid-life adults who face traumatic life events (Palgi, Shrira, Ben-Ezra, Shiovitz-Ezra, & Ayalon, 2012), empty nest (Wu et al., 2010) and retirement (Theeke, 2010), little was known about loneliness as it relates to other health variables. The sociodemographic and health-related descriptive findings were not surprising and are consistent with knowledge about determinants of health in Appalachia (Marshall et al., 2017). The overall prevalence of multiple chronic conditions is consistent with prevalence rates reported in WV (Pollard & Jacobsen, 2011). The finding that women were more often diagnosed with depression is congruent with findings from other studies in samples of adults in this region of Appalachia (Theeke et al., 2012). While the descriptive findings of this study are not surprising for this population, they do highlight the experience of social determinants of health in Appalachia as the findings differed from national statistics of mid-life adults on education and income. Nationally, over 30% of adults have a college degree or higher and the median household income is greater than $51,000 per year (Noss, 2013; Ryan & Bauman, 2016). It is known that social determinants of health, such as lower income and less educational attainment, have significant impact on physical and mental health.

The prevalence of loneliness reported by the mid-life adults in this study is similar to other studies that report loneliness as prevalent and moderately high in older Appalachian adults (Theeke et al., 2012). This is contrary to reports from other countries that adults in mid-life have generally less loneliness when compared to young or older adults (Victor & Yang, 2012). This finding makes it logical to consider that loneliness may be prevalent across the lifespan for Appalachian adults. This would be problematic as recent studies have reported that loneliness in mid-life adults is associated with systemic inflammation and contributes to poor physical health outcomes (Nersesian et al., 2018). Little is known about the link between elevated inflammatory markers at mid-life and the seemingly reciprocal relationships among functional decline, illness burden, and feelings of loneliness, anger, and depression.

Illness burden is linked to loneliness in other countries (Victor & Yang, 2012). Knowing that mid-life men may be lonelier than mid-life women in Appalachia is important. Gender differences in morbidity and life expectancy exist in relation to health disparities both nationally and in Appalachia. Life expectancy among women is higher than among men. However, research has consistently demonstrated higher morbidity among women (Olshansky et al., 2012). Because men and women

Table 4
Mean values of chronic illness control indicators in the sample.

Control measure	Mean (SD)	Sample range	Normal range	Conclusion
Fasting glucose, mg/dL	124.09 (51.94)	60–346	< 100	Elevated
SBP, mm Hg	133.10 (16.77)	95–190	≤120	Elevated
DBP, mm Hg	81.11 (10.43)	56–115	≤80	Elevated
BMI, kg/m^2	35.19 (7.80)	19.07–56.33	18.5–24.9	Elevated
Waist/hip ratio	0.95 (7.80)	0.55–1.30	0.80–0.90	Elevated

Table 5
Chronic illness control indicators compared by gender (total sample of N = 79).

Variable	Female (N = 57) Mean (SD)	Men (N = 32) Mean (SD)	*t* statistic	Sig (*p*)
BMI	35.59 (8.38)	34.37 (6.46)	t = 0.692	.491
Fasting glucose	120.15 (46.15)	132.38 (62.49)	t = −1.045	.299
Systolic blood pressure	133.71 (16.23)	134.60 (18.15)	t = −0.236	.814
Diastolic blood pressure	80.47 (11.19)	82.46 (8.66)	t = −0.847	.399
Hip/waist ratio	0.92 (0.11)	1.01 (0.10)	t = −3.600	.001**

Mean total number of chronic illness diagnosis 2.975 (SD 1.724, range 1.00–9.00).
Note. Equal variances assumed.
** *p* value was ≤.01.

did not differ on number of diagnoses in this study, it could be that the loneliness is related to the overall high chronic illness burden in the men. Chronic illnesses require support and the men also reported having less support.

The findings on anger were surprising and challenged existing qualitative findings that anger is very prevalent (El-Badri & Mellsop, 2008) in lonely people. Social relationships are needed for good mental and physical health. People who experience difficulties in establishing and maintaining mutual relationships with others are likely to experience loneliness, anger, depression, and anxiety (Heinrich & Gullone, 2006). However, it is difficult to establish the causal direction of the relationship between loneliness and anger because it is most likely that a reciprocal relationship exists (Cacioppo et al., 2000). We speculate, based on qualitative work, that anger in lonely persons is related to functional decline, frustration with healthcare system issues, disappointment in family or social relationships, and emotional dyscontrol from mental and physiological stress (Petitte et al., 2015; Theeke et al., 2015; Theeke et al., 2017). Hence, the fact that high loneliness was positively correlated with anger, even with anger being less prevalent, indicates that more work is needed to better measure anger in lonely persons.

The findings of this study are similar to national literature related to gender and depression with women having a higher incidence of depression compared to men (Girgus & Yang, 2015). In this mid-life population, 40% of women reported already having a diagnosis of depression, which is nearly double the incidence reported for national samples (Whooley, 2012a, 2012b), but similar to the incidence of depression in other samples of Appalachian adults (Friedman et al., 2007). It may be that men and women did not differ on mean depressive symptoms because women may have been receiving treatment for depression and thus, experiencing fewer symptoms. Finally, the findings on depression were similar to other research studies where loneliness positively correlated with depression symptoms (Cacioppo et al., 2010).

4.1. Limitations

The sample consisted of a convenience sample of mid-life adults from the north central region in Appalachia and potential participants were aware that the study included loneliness. Therefore, these findings represent loneliness in the mid-life Appalachian population, not the broader national population. It is also possible that sample bias exists and that men who were lonely volunteered to participate in the study since convenience sampling was used. Sociodemographic and survey responses were self-reported. Hence, these variables carry with them the limitations inherent in self-reported data. Given the characteristics of the anger described in this study, it is possible that the clinical anger scale did not capture the unique experience of anger specific to loneliness in this group. It is also possible that participants who value social desirability did not wish to disclose anger as an emotional response to loneliness. Lastly, it is possible that participants were experiencing other prevalent life circumstances that are not reflected in the survey questions.

Table 7
Comparison of mean loneliness scores by diagnoses.

Variable		N (%)	UCLA, mean	SD	*t*	*p*
Hypertension	Yes	47 (52.2)	40.39	12.17	1.21	.23
	No	35 (38.9)	43.71	13.11		
Diabetes	Yes	29 (32.2)	42.56	11.15	−0.24	.81
	No	53 (58.9)	41.57	13.09		
Depression	Yes	32 (35.6)	45.10	13.29	−1.96	.05*
	No	50 (55.6)	39.70	11.39		
Arthritis	Yes	30 (33.3)	40.07	11.23	0.97	.34
	No	52 (57.8)	42.81	12.98		
Obesity	Yes	23 (25.6)	43.61	10.91	0.69	.49
	No	57 (63.3)	41.47	12.99		
Hyperlipidemia	Yes	33 (36.7)	39.88	10.32	1.26	.21
	No	48 (53.3)	43.38	13.54		
Anxiety	Yes	16 (17.8)	46.06	13.24	−1.55	.13
	No	66 (73.3)	40.77	12.03		
Emotional problems	Yes	35 (38.9)	46.12	13.33	−2.84	.01**
	No	47 (52.2)	38.59	10.66		
Heart disease	Yes	15 (16.7)	47.13	13.05	−1.87	.07
	No	67 (74.4)	40.61	11.99		
Stroke	Yes	3 (3.3)	36.33	10.60	−0.80	.56
	No	79 (87.8)	42.29	12.66		
Lung disease	Yes	13 (14.4)	38.92	12.50	0.85	.40
	No	68 (75.6)	42.11	12.23		

Note. Equal variances assumed.
* *p* value was ≤.05.
** *p* value was ≤.01.

Table 6
Correlations of primary study variables.

	Loneliness	Anger	Self-management	Social support	Depression
1. Loneliness	1				
2. Anger	0.415**	1			
3. Self-management	−0.698**	−0.229**	1		
4. Social Support	−0.739**	−0.356**	0.651**	1	
5. Depression	0.558**	0.621**	−0.442**	−0.516**	1

Note. Loneliness measured with UCLA Loneliness scale, anger measured with the Clinical Anger Scale, self-management measured with the Self Management Assessment Scale, social support measured with the MOS Social Support survey, Depression measured with the PHQ9.
** *p* value was ≤.01.

Table 8
Comparison of mean anger scores by diagnoses.

Variable		N (%)	Anger, mean	SD	*t*	*p*
Hypertension	No	35 (38.9)	5.71	8.37	−0.28	.78
	Yes	47 (52.2)	6.20	6.47		
Diabetes	No	53 (58.9)	5.64	7.63	−0.61	.54
	Yes	29 (32.2)	6.67	6.70		
Depression	No	50 (55.6)	4.26	5.52	−2.82	.01**
	Yes	32 (35.6)	8.73	8.85		
Arthritis	No	52 (57.8)	5.71	6.84	−0.48	.63
	Yes	30 (33.3)	6.52	8.11		
Obesity	No	57 (63.3)	6.58	8.09	0.91	.37
	Yes	23 (25.6)	4.92	5.04		
Hyperlipidemia	No	48 (53.3)	6.45	8.28	0.63	.53
	Yes	33 (36.7)	5.41	5.75		
Anxiety	No	66 (73.3)	5.73	7.35	−0.68	.50
	Yes	16 (17.8)	7.12	7.17		
Emotional problems	No	47 (52.2)	3.83	4.26	−3.31	.001**
	Yes	35 (38.9)	8.92	9.32		
Heart disease	No	67 (74.4)	5.83	7.55	−0.45	.65
	Yes	15 (16.7)	6.78	6.19		
Stroke	No	79 (87.8)	5.78	7.15	−1.42	.16
	Yes	3 (3.3)	11.81	10.31		
Lung disease	No	68 (75.6)	6.28	7.57	0.71	.48
	Yes	13 (14.4)	4.70	6.06		

Note. Equal variances assumed.
** *p* value was ≤.01.

4.2. Implications for clinical practice

Advanced understanding of how loneliness relates to anger and depression could lead to assessment programs, improved behavioral health services, new interventions, or refinement of existing interventions. Knowing that depression is on the rise and a major contributor to national disability, makes understanding the antecedents to diagnosis important. Developing treatment plans for patients in mid-life who are at high risk for depression should include the assessment of loneliness. Intervening when people are moderately lonely, not severely lonely, may be the key to prevention of depression, improving self-management ability, and preventing poor chronic illness outcomes later in life, especially for those living in Appalachia and experiencing health disparities.

4.3. Implications for future research

Future studies are needed to fill gaps in understanding the links between the determinants of health and loneliness as a predictor of depression and poor health outcomes, especially in mid-life. The prevalence of loneliness across the life-span and the known disparity of diabetes, stroke, and cardiovascular disease in Appalachia, makes it imperative to understand the reciprocal relationships among loneliness, functional decline, illness burden, chronic illness, and self-management ability. Identifying moderating and mediating variables using the PNI paradigm as a framework is potential future research. Further exploration of gender differences in the experience of loneliness, chronic illness burden and illness could lead to more precise interventions that are precise to gender. Findings related to anger in this study and those voiced in previous qualitative research warrants future investigation aimed at understanding anger in relation to functional decline, frustration, social relationships, and emotional dyscontrol within the experience of loneliness. Future studies of mid-life women are also needed to understand the high depression scores that were concurrent with reports of adequate support and positive SMA.

5. Conclusions

Enhanced understanding of the relationships among loneliness, anger, depressive symptoms, and SMA in mid-life adults provides foundational information for future studies. This paper presents new information that loneliness is prevalent in mid-life adults in Appalachia and that loneliness is predictive of diminished self-management ability, even while controlling for the possible effects of age, anger, and depression. Including loneliness in behavioral health assessments in clinical practice and developing and studying the impact of interventions designed to target loneliness as a health problem will be imperative to continued understanding of loneliness and its impact on health.

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