

# A Systematic Review of Loneliness and Common Chronic Physical Conditions in Adults

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**Abstract:** Loneliness is a prevalent and global problem for adult populations and has been linked to multiple chronic conditions in quantitative studies. This paper presents a systematic review of quantitative studies that examined the links between loneliness and common chronic conditions including: heart disease, hypertension, stroke, lung disease, and metabolic disorders. A comprehensive literature search process guided by the PRISMA statement led to the inclusion of 33 articles that measure loneliness in chronic illness populations. Loneliness is a significant biopsychosocial stressor that is prevalent in adults with heart disease, hypertension, stroke, and lung disease. The relationships among loneliness, obesity, and metabolic disorders are understudied but current research indicates that loneliness is associated with obesity and with psychological stress in obese persons. Limited interventions have demonstrated long-term effectiveness for reducing loneliness in adults with these same chronic conditions. Future longitudinal randomized trials that enhance knowledge of how diminishing loneliness can lead to improved health outcomes in persons with common chronic conditions would continue to build evidence to support the translation of findings to recommendations for clinical care.

**Keywords:** Chronic Condition, Loneliness, Systematic Review.

## INTRODUCTION AND BACKGROUND

Prevalence rates of loneliness in adult populations ranges from 17% in U.S. Adults [1] to over 30% in older adults in Australia [2]. Loneliness has been defined as a unique psychological construct consisting of distressing emotions that are derived from the absence or perceived absence of expected meaningful interpersonal relationships [3]. In addition to being a major predictor of psychological problems like depression [4] and anxiety [5], loneliness is linked to overall morbidity and mortality in adult populations [6, 7]. More recent literature suggests that loneliness is linked to multiple chronic physical health conditions like cardiovascular diseases [8] such as atherosclerosis [9] and hypertension [8], through inflammatory and neuroendocrine pathways. The purpose of this paper is to present a systematic review of quantitative studies that demonstrate the links between loneliness and common chronic conditions including heart disease, hypertension, stroke, lung disease, obesity, metabolic syndrome, and adult onset diabetes.

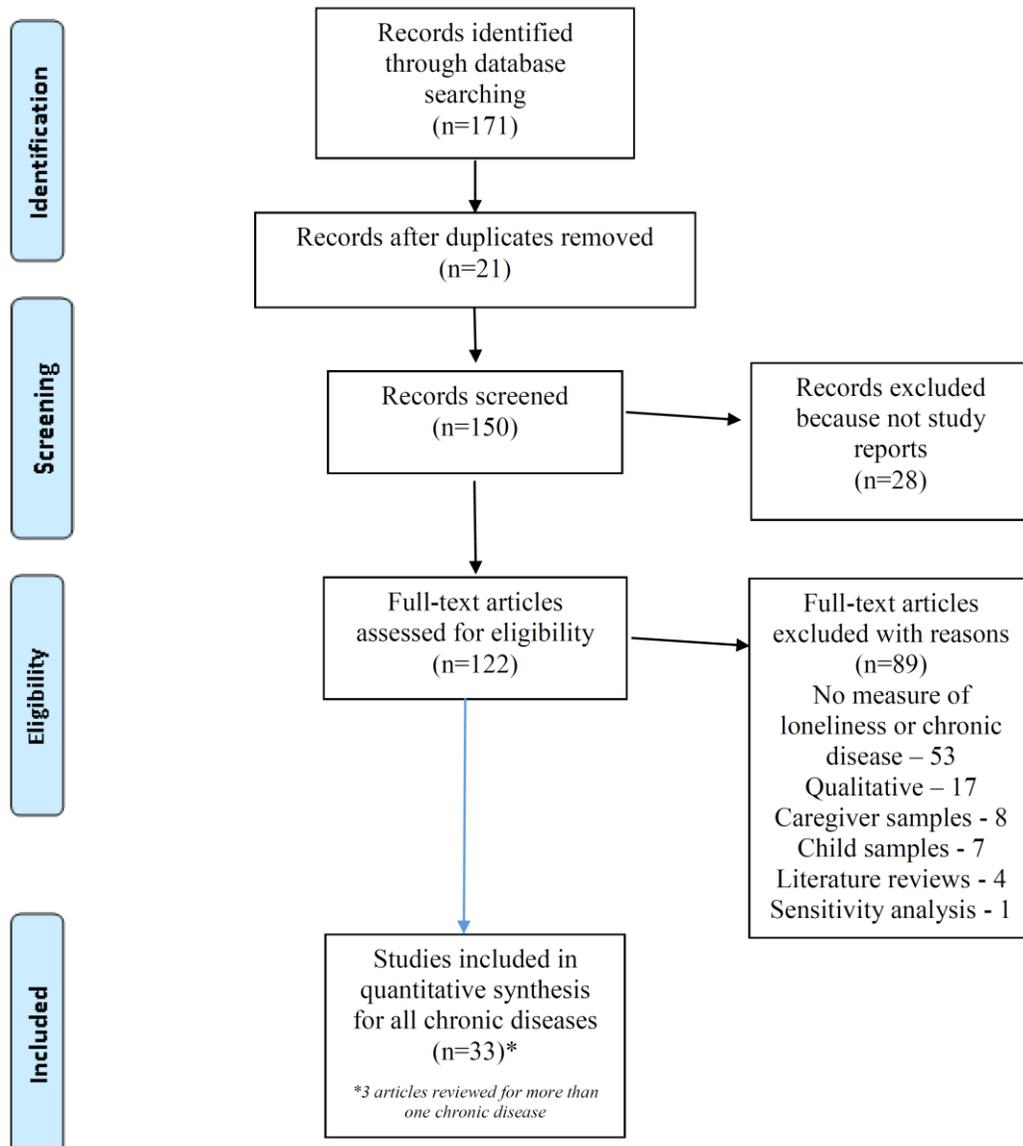
## METHODS

The PRISMA method [10] guided the development of this systematic review of loneliness and common chronic

conditions. A comprehensive literature search was conducted using EBSCOHost with the following databases selected: Academic Search complete, CINAHL with Full Text, ERIC, MEDLINE, PsycARTICLES, and PsycINFO. Loneliness and the name of each common chronic illness were used as keywords for each chronic illness. For hypertension, the search terms of hypertension and high blood pressure were used. The terms of heart disease, stroke, and obesity were used exclusively for these three chronic conditions. For pulmonary conditions the search terms used were 'pulmonary disease' and 'chronic obstructive pulmonary disease'. Diabetes was searched using 'type 2 diabetes' and 'metabolic syndrome'. Limits were set to include only peer-reviewed quantitative studies of adults written in the English language. In addition, the Cochrane Library was searched for a review on loneliness and chronic conditions but none were retrieved.

The search netted 171 articles, 21 duplicates were eliminated within the individual chronic conditions (Fig. 1). A total of 150 articles were abstracted and 28 articles were excluded because they were not quantitative study reports but rather posters, narratives, or opinion pieces. Of the 122 articles abstracted for eligibility, 89 were excluded for the following reasons: no measure of loneliness or chronic disease, qualitative research design, caregiver or child samples, literature reviews or sensitivity analysis. Thirty-

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**Fig. (1).** Literature search result: identification, exclusion, eligibility and included.

three articles were included for all chronic conditions and 3 of the articles were reviewed in the context of more than one chronic conditions. Table 1 presents a summary of each article including the authors, year of publication, location of study, purpose of the study, study design, sample size and target population, data collection methods including study instruments, chronic disease focus, strengths, and weaknesses.

## LONELINESS AND HEART DISEASE

There were a total of 112 articles published between the years of 2000 and 2014 that were considered for inclusion from the literature search for studies of loneliness and heart-related problems. After removing 16 duplicates and excluding 79 articles for not meeting the inclusion criteria, 16 articles remained. Articles were excluded as follows: 46 did not either measure or report data on loneliness and heart problems, 11 were narratives or stories, 10 were qualitative

in design, 6 included child samples, 5 were opinion pieces or columns, 1 was a case study, and 1 was of adults with congenital heart anomalies.

The relationship between the stress of loneliness and heart problems has been described since the 1970's. The sentinel piece of literature, a book entitled "The Broken Heart: The medical consequences of loneliness" [11] described relationships between loneliness, social desirability, importance of love and relationships, health behaviors, morbidity, and mortality in adults in the United States. Since that time, quantitative studies of loneliness and heart disease have focused on varied populations with cardiovascular illness including those with hypertension, coronary heart disease, and heart failure. It is thought that the mechanism of this connection is in the human response to stress which results in a cascade of hormones that influence cardiovascular tone [12], blood pressure [13], and inflammatory responses [9].

Table 1. Literature review matrix: purpose, design, data collection characteristics, results and strengths and weaknesses

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
(Brouwers <i>et al.</i> , 2014) Netherlands	To examine the relative importance of inflammation, disease severity, and personality as predictors of depression in HF patients	L	N= 268 adults	Data collected at baseline and at one-year follow-up.	HD	At baseline, loneliness was significantly related to depression. Loneliness was independently associated with higher depression levels at one-year follow-up (p < .005)	Longitudinal design included biomarkers of disease severity and personality measures	Sample - 60% males with NYHA class I HF diagnosis. Directionality of relationship between inflammation, disease severity & personality could not be assessed.
(Cacioppo <i>et al.</i> , 2000) USA	To investigate the autonomic and neuroendocrine responses to acute stress in 27 women who are presently caring for a spouse and 37 noncaregivers matched for age and family income	X, DC	64 carers and non-carers, Convenience sample	Face to face and physical measures	HD	Caregivers were lonelier. (p< .05) and caregivers had greater activation of the sympathetic branch of the autonomic nervous system, given the controls, this is likely the chronic stress.	NYUL scale Reliable measures Rigorous measure of BP, HR, PEP, RSA, Resp	Small sample size may have limited analysis on some of the variables.
(Cacioppo <i>et al.</i> , 2002) USA	Explore four possible mechanisms by which loneliness may have deleterious effects on health: health behaviors, cardiovascular activation, cortisol levels, and sleep.	X	22 older adults	Revised UCLA Loneliness Scale. Beck Depression Inventory. Pittsburgh Sleep Quality Index Salivary cortisol assays Blood pressure and heart rate	HD	Total peripheral resistance was higher in lonely persons. Cardiac contractility, heart rate, and cardiac output were higher in non-lonely persons.	Reliable instruments used to assess loneliness and sleep	Sample size may be too small to determine the effect of health behaviors and cortisol levels on loneliness and health.
(Chen, Fettich, & McClosky, 2012) USA (Chicago)	Examine whether weight-related stigma increases (1) the likelihood of suicidal ideation and/or behavior or (2) the degree of loneliness; and	X	396 severely obese adults seeking bariatric surgery	Weight-related stigma - Stigmatizing Situations Inventory (SSI) Loneliness – UCLA Loneliness Scale Suicidality – Suicidal Behaviors Questionnaire (SBQ)	O	Women: Greater weight-related stigma was significantly associated with greater loneliness (SE = 1.03, t = 2.01). Greater loneliness was significantly associated with	Separate analysis of men and women due to gender influence on suicidality.  Use of valid and reliable surveys.	Other mediators for suicidality may exist. Cross-sectional design limited attempt to assess mediation.

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
	whether hypotheses (1) and (2) are supported (3) if loneliness mediates the effect of weight-related stigma on suicidal ideation and/or behavior.					greater suicidality ( $SE = 0.01, t = 2.01$ ), controlling for weight-related stigma. Men: Greater weight-related stigma was significantly associated with greater loneliness ( $SE = 2.29, t = 2.23$ ). Greater loneliness was not associated with suicidality ( $SE = 0.01, t = 0.57$ ), when controlled for weight-related stigma.		Convenience sample. Self-report prior to bariatric surgery which may have influenced responses.
(Hilari <i>et al.</i> , 2010) United Kingdom	To determine the factors that predict psychological distress during the six months after stroke including those with aphasia	L	N=87 at baseline N=71 at 6-months Ages 19 to 91	General Health Questionnaire-12, NIH Stroke Scale, Barthel Index, Frenchay Aphasia Screening Test, Frenchay Activities Index, MOS Social Support Scale	S	Variables associated with distress 6-months post stroke were: loneliness ( $r = -0.50, p < 0.001$ ), psychological distress ( $r = 0.45, p < 0.001$ ), and low satisfaction with social network ( $r = -0.29, p < 0.001$ )	Longitudinal design, inclusion of people with aphasia & a wide range of variables such as social factors in an effort to determine prevalent predictors of distress post stroke.	Cognitive impairment may be a predictor of distress post stroke, but was not measured or considered. Exclusion of people with severe receptive aphasia.
(Jacobs, J. M., Cohen, A., Hammerman-Rozenberg, R., & Stessman, J., 2006) Israel	To describe the nature of global sleep satisfaction (GSS) of older people and the factors associated with it.	L	N = 290 Subjects recruited from the Jerusalem Cohort Study (age 70 at baseline and 77 at follow up)	Interview and exam in hospital (phase 1) and at home (phase 2). GSS – “Are you satisfied with your sleep in the last month?”  ADLs: 6 items taken from the Katz scale  IADLs: 5 IADLs analyzed  Depression – Brief Symptoms	O	Risk factors at age 70 for subsequent poor GSS were loneliness (OR 3.8, 95% CI: 1.8-8.2), depression, poor self-rated health, economic difficulties, back pain, obesity (OR 2.3, 95% CI: 1.0-5.2), and prior poor GSS.  Loneliness was significantly associated with poor GSS ( $p = .002$ )	Sample representative of population.	Did not use standard measures (BMI) to define obesity.  Data collected 7 years apart.

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
				Inventory  Obesity – defined as the upper quartile of body mass index within the cohort.		Poor GSS was significantly associated in 70- and 77-year-olds with general fatigue, poor self-rated health, depression, difficulty with one or more ADLs, low physical activity, obesity ( $p = .02$ ), and joint pain.		
(Jacobs, Hammerman-Rozenberg, Cohen, & Stessman, 2006) Israel	To achieve a primary description of the nature, prevalence, and time course of chronic back pain among the elderly; identify significant associations with health-related variables over time; and identify predictive factors for the development of chronic back pain in this age group.	L	N = 277 (age 70 at baseline and 77 at follow up)	Loneliness - Asked: “Do you ever feel lonely?” with possible responses <i>never, very rarely, occasionally, and very often.</i> Loneliness was defined as any positive response.  Obesity – defined as the upper decile of body mass index within the cohort.	O	At both ages (70 and 77), chronic back pain was more frequent among those reporting loneliness ( $P < 0.001$ ).  Chronic back pain was associated with obesity at both ages ( $P = 0.06$ and $P = 0.59$ , respectively).  Loneliness is an independent risk factor at age 70 for Chronic back pain (Regression coefficient = 1.54, OR = 4.60, 95% CI 1.19-17.71).	Representative sample.  Longitudinal design.	Measure of obesity is not the commonly accepted definition of BMI > 30 (they used top decile of sample).  Single question to evaluate loneliness.
(Jongenelis <i>et al.</i> , 2004) Amsterdam, Netherlands	To classify the contributions of different socioeconomic and dietary factors that contribute to obesity	M	N=350 Ages 55 and older	Geriatric Depression Scale (GDS), Schedule of Clinical Assessment in Neuropsychiatry, 11-item Loneliness Scale, Social Support - SSL12-I	S	Loneliness was associated with sub-clinical depression (OR= 3.44, 95% CI 1.90-6.21); minor depression (OR = 4.52, 2.06-9.90); and major depression (OR = 13.37, 3.08-58.15)	Depression assess by both symptom rating scale (GDS) and a diagnostic tool (DSM IV)  Rigorous sampling of nursing home residents	High drop-out rate Cannot determine depression rates prior to nursing home admission therefore causal relations could not be assessed in depression & risk indicators

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
(Kara & Mirici, 2004) Turkey	To explore the differences in perceptions of loneliness, depression, and social support among people with COPD and their spouses	X	N=30 People with COPD and their spouses	Loneliness – UCLA loneliness scale  Depression – Beck Depression Inventory  Social support – Perceived social support from Friends and Family scale	P	Social support may help to alleviate feelings of loneliness in patients with COPD and their spouses	Three reliable instruments used to measure loneliness and contributing factors	Small sample size, replication of previous research
(Keele-Card, Foxall, & Barron, 1993) USA (Midwest)	To explore the differences in perceptions of loneliness, depression, and social support among people with COPD and their spouses	X	N=30 People with COPD and their spouses	UCLA loneliness scale  Center for Epidemiological Studies Depression scale  Social support questionnaire (SSQ <sub>6</sub> )	P	Loneliness exists among patients with COPD and their spouses. Community home health nurses need to be sensitive to the needs of their clients and family members.	Based on deJong-Gierveld's model of loneliness, rigorous inclusion criteria	Small sample size, restricted to small geographic area and recruited by single pulmonologist
(Kramer, Kapteyn, Kuik, & Deed, 2002) Amsterdam, Netherlands	To determine the association between hearing impairment and chronic diseases, including stroke, and psychosocial status, including depression & loneliness	X L	N=3,107 in Longitudinal Aging Study Amsterdam (LASA)	Depression – Center for Epidemiologic Studies Depression Scale (CES-D)  Self-efficacy – General Self-Efficacy Scale  Mastery – Pearlin Mastery Scale  Loneliness – De Jong-Gierveld loneliness scale	S	Those with stroke impairment didn't have statistically significant rates of loneliness while those with hearing impairment had statistically significant rates of loneliness.	One of only a few studies that measure the effects of psychosocial outcomes in relation to hearing problems among persons with chronic conditions including stroke.	Self-reported variables - no objective measure of hearing impairment or the presence of chronic disease was utilized
(Lofvenmark, Mattiasson, Billing, & Edner, 2009) Sweden	To investigate perceived loneliness and social support in patients with HF	X	N=149	Face to face questionnaires	HD	Loneliness reported in 29% of participants, more often in women. Those with loneliness had more days hospitalized (p = .044) and more hospital readmissions (p = .027) despite not having more severe heart failure.	Homogeneous sample of heart failure patients	Self-reported variables

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(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
(Momtaz, <i>et al.</i> , 2012) Malaysia	To examine the impact of loneliness on hypertension later in life	X	N=1,880	Philadelphia Geriatric Center Morale Scale (PGCMS) item, "How much do you feel lonely?" Self-reported chronic conditions	HD	Older persons with a lot of loneliness had significantly higher prevalence of hypertension as compared with older persons with low levels of loneliness after controlling for sociodemographic and health factors [OR=1.31,(95% CI 1.04-1.66)]	Large representative sample of elderly Malaysian population	Self-reported chronic medical conditions  Weight and BMI not measured  Single-item subjective self-report of loneliness
(Morse, Ciechanowski, Katon, & Hirsch, 2006) USA (Washington)	The purpose of the study was to examine night-eating symptoms and diabetes care management strategies of patients with type 1 or type 2 diabetes.	X O	N= 714 patients with type 1 and 2 diabetes	EHR record review. Questionnaires: NES=1 question from O'Reardon <i>et al.</i> Depression PHQ-9 Diabetes Self-care – Summary of Diabetes Self-Care Activities. Diabetes Symptoms – Self-completion Patient Outcome instrument Diabetes complications – self report via list.	DM , O	Participants eating more than 25% of their food after the evening meal, nocturnal eating syndrome (NES), were significantly more likely to have major depression and to eat in response to emotions such as loneliness ( $X^2$ 17.66, $p < 0.001$ ). Compared with patients without NES, those with NES were significantly more likely to have A1C values > 7% (OR 2.2 [95%CI 1.1-4.1]), to be obese (2.6 [1.5-4.5]), and to have two or more diabetes complications (2.6 [1.5-4.5]).	The study question is relevant. The study adds a potential link between loneliness and poor control of diabetes & obesity. The design was appropriate for the research question. While the study did examine psychosocial variables, the stated hypothesis of the article did not address psychosocial variables. The available data does support the conclusions of the study.	The stated hypothesis of the article did not address psychosocial variables or hypothesize a direction of the relationship. Used self-report (1 question) to establish the presence of NES. Self-reported BMI. No report of how the presence of loneliness was measured.  Cross-sectional design limitations.  Tertiary care setting, may not be generalizable
(Nausheen, Gidron, Gregg, Tissarchondou, & Peveler, 2007) UK	To adapt an implicit measure of loneliness, and use it alongside the measures of explicit loneliness and social support,	PPT	N=25 women, 18-39 years of age	Self-reported and physical measures	HD	Loneliness was significantly correlated with diastolic blood pressure reactivity after one of the stressors.	Accurate physical measures	Self-reported measures

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
	investigating their correlations with cardiovascular reactivity to lab stress							
(Nefs, Pouwer, Pop, & Denollet, 2012) Netherlands	There were 3 aims of this study: to examine the validity of type D personality and its assessment in patients with diabetes; clinical outcomes correlated with Type D personality in patients with diabetes; Type D personality model across men & women with diabetes.	PCD	N=1553 primary care patients with type 2 diabetes	A single item was used to measure feelings of loneliness in the past 12 months (ranging from 1 "I never felt lonely" to 10 "I always felt lonely").	DM	Patients with a Type D personality did not differ from non-Type D personality with respect to diabetes duration, cardiovascular disease history, current microvascular complications or physiological cardiovascular risk factors, including glycemic control, cholesterol and blood pressure. However, participants with Type D personality reported more loneliness, emotional distress, including symptoms of depressed mood, anhedonia and anxiety. Also, type D women had a more sedentary lifestyle.	The study questions are relevant and the study adds new information related to the validity of using a Type D personality inventory in Diabetes Patients. The design is appropriate for the research questions. The statistical analyses are performed correctly.	Loneliness is measured by a single item Likert scale self-report question.
(Norman <i>et al.</i> , 2011) USA	Examine the role of perceived social isolation in moderating the effects of oxytocin on cardiac autonomic control in humans.	E	N=40 20 men and 20 women	UCLA Loneliness Scale Beck Depression Inventory Perceived Social Stress Scale (PSS-10) Electrocardiogram and impedance cardiogram Blood samples Blood pressures	HD	The effects of oxytocin on cardiac autonomic control were significantly associated with loneliness ratings. Higher loneliness was associated with diminished parasympathetic cardiac reactivity to intranasal oxytocin. Thus, lonely people may be less responsive to the effects of	Randomized to either the oxytocin group or placebo group in a double blind manner	Unable to determine if the effects of oxytocin on the autonomic nervous system activity are isolated to cardiac output

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(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
						oxytocin on cardiovascular reponsivity		
(O'Donovan & Hughes, 2007) Ireland	Examine the relation of social support at university and loneliness with pulse pressure reactivity to acute psychological stress in sample of young adults	X	N=65 college females, 17 to 21 years of age	Revised UCLA Loneliness Scale. Blood pressure measurements taken multiple times at rest and during stressor task. The Social Support at University Scale (SSUS).	HD	Students with medium or high loneliness had significantly less PP reactivity compared to low lonely students (P < .05) for medium and .004 for high lonely	UCLA scale and took physical measures, used calculations of obtained blood pressures to get pulse pressure	Small sample size. No male students in sample and thus gender difference for loneliness and pulse pressure could not be assessed
(Österberg, Baigi, Bering, & Fridlund, 2010) Sweden	To explore perceived importance and knowledge of known risk factors for coronary artery disease among non-attendees in cardiac rehab programs	DC	106 patients Treated for myocardial infarction (MI) and/or coronary artery bypass graft (CABG) or cardiac cath. and who declined to participate in cardiac rehabilitation 69% men	Self-report questionnaires	HD	Participants who were declining cardiac rehab were aware that psychosocial factors contributed to heart disease.	No comparison group – those who attend cardiac rehabilitation	Newly developed questionnaire has not been tested for reliability
(Patterson & Veenstra, 2010) USA	To investigate the impact of loneliness on all-cause mortality, mortality from ischemic disease, and mortality from other cardiovascular diseases.	L	N=6,768 in 1965; N=4,522 in 1999  3,168 of those in the original sample died by the end of the study	Alameda County Health and Ways of Living Study  Self-reported measure in response to question about how often they feel “very lonely or remote from other people” with response categories of never, sometimes and often  Death certificate data	HD	Frequent loneliness was not significantly associated with mortality from ischemic heart disease but it more than doubled the odds of mortality from other ailments of the circulatory system in models controlling for age and gender. Chronic or recent loneliness may increase risk for mortality	One of only a few longitudinal studies on a representative sample of the health effects on loneliness	Self-reported data  Imprecise measure of loneliness  Irregular intervals of data collection  Small sample size for some causes of death (i.e. suicide) other than cardiovascular deaths

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
(Penninx <i>et al.</i> , 1999) Amsterdam, Netherlands	To explore social network size, functional social support and loneliness among elderly with different chronic diseases	X, L	N=3,107 in Longitudinal Aging Study Amsterdam (LASA) N=2,788 included in sample for this study	De Jong Gierveld loneliness scale	S	Among all the chronic diseases studied including stroke, only peripheral vascular disease, lung disease and arthritis were found to have risks for feelings of loneliness.	Comparisons of people with and without different chronic diseases in their social networks, social support and loneliness patterns	High nonresponse rate among oldest age groups which are associated with ill physical health and this may cause a weakening of the associations explored
(Seo, Yates, Dizona, Laframboise, & Norman, 2014) USA	To enhance understanding of the effects of depression on patients with heart failure	X, DC	N=150 Adults		HD	In patients with heart failure, those who were lonely had more dyspnea.	Cross-sectional, used reliable and valid instruments. Used SEM to demonstrate relationships	No causality established
(Smith, Theeke, Culp, Clark, & Pinto, 2014) USA (West Virginia)	To describe relationships among self-rated health, stress, sleep quality, loneliness, and self-esteem, in obese young adult women	X	N = 68 (BMI 30 or higher; age 18-34 years)	Demographics – Age & BMI Self-rated health – 5 point Likert scale, then dichotomized for 2 groups: poor/fair and good/very good. Perceived stress scale, 10-item tool Revised UCLA loneliness scale. Rosenberg Self-esteem Scale. Pittsburgh Sleep Quality Index, 19 self-rated items.	O	Higher perceived stress had a stronger positive correlation with both increased loneliness ( $r = 0.560, p < .001$ ) and poorer sleep quality ( $r = 0.414, p < .001$ ). Loneliness was negatively related to self-esteem ( $r = -0.688, p < .001$ ). Participants who rated health as poor/fair reported higher mean scores for stress ( $M = 23.25$ ) and loneliness ( $M = 47.20$ ) and, lower mean scores for self-esteem ( $M = 15.65$ ) when compared to those who rated health as good/very good ( $M = 17.42, M = 37.10$ , and $M = 22.73$ ).	Enhances understanding of the relationship between stress, sleep, loneliness, self-esteem and self-rated health status among college students	Convenience sample.

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
(Taylor, 2009) Canada	To evaluation the effectiveness of videoconferencing for an educational and exercise self-management program for people who have had a stroke and their caregivers	L, E	N=12 people with stroke N=4 caregiver	Focus groups, attendance rates, Geriatric Depression Scale (GDS), Activity-Specific Balance Confidence Scale, Berg Balance Scale, 6-Minute Walk Test, Goal Attainment Scaling	S	Mean depression scores on GDS ranged from pre-test (M=5.3, SD=3.2), post-test (M=4.9, SD=2.1) to 3-month follow-up (M=3.2, SD=2.3)	Intervention – experimental design	No specific measure of loneliness
(Theeke & Mallow, 2013) USA	To learn more about the prevalence of loneliness in rural older adults with chronic illness.	X	60 adults age 65 and older	Face to face interviews and EHR record review	HD	Participants with heart disease had significantly higher loneliness scores than those without	Cross-sectional descriptive design using valid and reliable instruments	Only descriptive, self-reported variables
(Theeke <i>et al.</i> , 2014) USA					S			
(Thurston & Kubzansky, 2009) USA	To examine associations between loneliness and risks for CAD	DC, R		Existing NHANES data	HD	High loneliness was associated with increased risk of incident CHD ( hazard ration = 1.76, 95% confidence interval (1.17-2.63)	Rigorous longitudinal data	Loneliness assessed by single item from CES-D
(Tigani, Artemiadis, Alexopoulos, Chrousos, & Darviri, 2012) Greece	To study associations of various sociodemographic, disease-related, lifestyle & psychosocial factors, ability to perform activities of daily living with self-rated health (SRH) in centenarians. Lifestyle factors – smoking, BMI, sleep satisfaction.	X	N = 400 (adults 100-109 years)	Self-rated health-single item with Likert scale answer Classified into healthy, one disease, or co-morbidity. Loneliness – “Do you feel lonely or abandoned?” International Personality Item Pool (IPIP) Health Locus of Control (HLC)	O	Nearly half were normal weight (48.5%) and more than a third were overweight or obese (35.1%).  Significant relationship between worse Self-Rated health and feelings of loneliness (p<0.01) Obese subjects reported very good SRH more often than individuals with normal BMI (OR, 95% CI: 5.35, 1.67-17.18),	Large sample size  Identification of multiple non-disease factors that influence SRH.	Disease status – one item “Do you currently suffer from a condition requiring regular medical treatment?”  Mis-match in data from tables and text, so unsure which is correct.  Results may not be generalizable

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
	6 questions of food consumption					but this was not the case for good vs. poor comparisons of loneliness and pessimism, which were significantly related with worse SRH for both comparison groups (OR, 95% CI: 2.23 (1.24-4.01) and (OR, 95% CI: 2.15 (1.22-3.8).		to other age groups.  Measurements mainly based on self-reporting  Non-random sampling
(Tilvis et al, 2004) Finland	To determine preventable risk conditions for cognitive decline in persons 75 years of age and older	L, PCD	N=650 baseline N=248 10-year follow-up	Mini-Mental State Examination (MMSE), Clinical Dementia Rating	S	Loneliness and apolipoprotein E allele $\epsilon 4$ were strong predictors of cognitive decline. After controlling for age a decline in MMSE was found among those with feelings of loneliness (RR=3.0, 95% CI 1.4-6.8)	Large randomized sample size Comprehensive examinations Long follow-up period	High attrition rate decreased the statistical power of the results
(Tobo-Medina & Canaval-Eraza, 2010) Columbia, South America	To describe the feelings and emotional states most often and predominantly associated with stress experienced by persons with coronary artery disease (CAD)	X, DC	65 women and men with CAD	Questionnaire on 38 feelings and emotional states which were used to identify characteristic emotions and their frequency, predominance and force of appearance	HD	Loneliness was identified as one of 10 predominant characteristics in adults with CAD	Homogeneous sample of persons with CAD so likely relevant to the CAD population	Relatively small sample with a Questionnaire used to collect data
(Tomaka, Thompson, & Palacios, 2006) USA New Mexico	To examine relationships among social isolation, loneliness, and social support to health outcomes	X	N=755 60 years of age and older	UCLA Loneliness scale	HD, S	Belongingness support is needed and related most consistently to health outcomes	Survey face to face	Cross-sectional and self-reported data  Uncertain cultural appropriateness of the support and loneliness measures
(Wågert et al., 2005) Sweden	To explore social, functional, and medical factors associated with	X, O	N=319 85 years and older	Philadelphia Geriatric Center Morale Scale (PGCMS), Barthel Activities of Daily	S	Participants who did not feel lonely, living in ordinary housing, not having depression	Large randomized sample	No direct measure of loneliness in stroke patients

Table 1. Contd....

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
	morale among elderly			Living Index, Geriatric Depression Scale, Mini-Mental State Examination, Mini Nutritional Assessment and symptom questionnaire		and with self-rated good to excellent health had significantly higher PGCMS scores (p<0.001)		Cross-sectional limitations Oldest age groups had some cognitive impairment and couldn't answer the PGCMS
(Wharton, 2010) USA (Michigan)	Comparison of 2 models of care: home-based primary care model (HBPC) used by the Veterans Affairs Medical Center & the Michigan Waiver Program's (MWP) home-based care	X, R	HBPC (N=89)  MWP (N=9324)  Weighted sample  Ages 50-96	InterRAI-HC scale to measure cognitive function, Cognitive Performance Scale, Changes in Health, End-stage disease, Signs & Symptoms (CHESS) score to predict mortality, physical function, activities of daily living hierarchy scale	P	Veterans with COPD, CAD and/or cancer receiving home-based care had higher degrees of loneliness than their counterparts receiving home-based care through the Michigan Waiver Program.	Cross-sectional retrospective analysis of data collected with a standardized, validated assessment instrument with good inter-rater reliability	Self-reported variables, instrument doesn't capture post-traumatic stress disorder.
(Whisman, 2010) UK	To evaluate the association between loneliness and metabolic syndrome.  To evaluate potential moderators of the association between loneliness and the metabolic syndrome.	X, L	N=3,211 Adults 50 – 79 years of age living in private households	The study sample was obtained from the English Longitudinal Study of Ageing (ELSA), an ongoing longitudinal population based survey, Blood pressure & blood samples. Loneliness – measured with Three-Item UCLA Loneliness Scale	DM O	Loneliness was significantly associated with increasing likelihood of meeting criteria for metabolic syndrome and central obesity.  Holding demographic variables and smoking status constant, loneliness was significantly associated with the metabolic syndrome (p <.05, OR = 1.1, 95% CI = 1.0, 1.2)  Controlling for demographics and smoking status, loneliness was significantly associated with elevated waist	Loneliness was measured with the Three-Item UCLA Loneliness scale Metabolic Syndrome – meeting 3+ of the following: elevated waist circumference; elevated triglycerides (150 mg/dL or drug therapy); reduced HDL or drug treatment; elevated blood pressure (130/85 mm Hg or drug therapy); and elevated fasting glucose (100 mg/d or drug therapy)	Excluded those with diabetes.  Due to cross sectional design, unable to determine direction of association between metabolic syndrome and loneliness.  Loneliness measured once, which limits separation of chronic vs. situational loneliness and effect on metabolic

**Table 1. Contd....**

(Authors, Year) Location	Aim	Design	Sample Size	Data Collection	CI	Results	Strengths	Weaknesses
						circumference ( $p < .001$ , OR = 1.1, 95% CI = 1.0, 1.2).	Large sample size	syndrome over time.
Wyller, Holmen, Laake, & Laake, (1998) Norway	To explore the subjective perspective of well-being among people who have had a stroke	X  two sample factor analysis model	N=1417 stroke patients N=1439 comparison group of stroke-free people Sample from cross-sectional study N=74,977	Nord-Trondelag Health Survey – Height, weight, blood pressure, blood glucose.  Questionnaires on perceived health, functional abilities, contact with health care system, work conditions, chronic disease, lifestyle, housing, education level, medical symptoms, social support, subjective well-being (SWB)	S	A fitted linear regression model with 12 explanatory variables including loneliness explained 50.3% of the variance in the SWB score.	Large randomized sample size	Concurrent validity of a measure of the SWB could not be established because a gold standard does not exist.  Cross-sectional design doesn't allow for the effect of age on SWB to be measured

Authors: APA format

Year: Year of Publication

Aim: Purpose of the Study

Study Design: Cross-sectional (X), Descriptive Correlational (DC), Experimental (E), Mixed methods (M), Quasi-experimental (QE), Retrospective (R), Longitudinal (L), Observational (O), Pre-Post Test (PPT), Prospective cohort design (PCD)

Sample Size: n and target population

Data Collection: Self-report questionnaires, observations, physiological, medical records

Chronic Disease: Diabetes (DM); Heart Disease (HD); Obesity (O); Pulmonary Disease (P); Stroke (S);

**LONELINESS AND CARDIOVASCULAR HEALTH PROBLEMS**

Three studies examined relationships among loneliness and overall diagnosis of heart conditions. [14-16]. Tomaka (2006) studied 755 older adults and concluded that loneliness is prevalent and that belongingness support could result in improved health outcomes. Theeke and Mallow (2013) reported that loneliness is prevalent in a sample of 60 older adults with multiple chronic conditions including heart disease and that those with heart disease had some of the highest loneliness scores. Finally, Patterson and Veenstra (2010) investigated the impact of loneliness on all-cause mortality and concluded that loneliness significantly increased the odds of death from cardiovascular related problems.

**LONELINESS, CARDIOVASCULAR REACTIVITY, AND HYPERTENSION**

Six different studies focused on the relationships among loneliness, cardiovascular reactivity, and blood pressure [12, 17-21]. These studies provide evidence, in samples that ranged from young adults to older adults, that loneliness is related to cardiovascular reactivity [17] and demonstrate that lonely adult caregivers have greater activation of the sympathetic branch of the autonomic nervous system when

compared to those less lonely, and that lonely people have higher total peripheral resistance [18]. Nausheen *et al.* (2007) studied women between ages of 18 and 29 years and reported that loneliness correlated with diastolic blood pressure reactivity. O’Donovan and Hughes (2007) studied young adult females and concluded that those with medium or high loneliness scores had significantly less pulse pressure reactivity when compared to those with low loneliness. Norman *et al.* (2011) studied the effects of oxytocin on cardiac autonomic control and evaluated the influence of loneliness on this response to oxytocin in a sample of 40 adults (20 women and 20 men). In this study, it was demonstrated that loneliness predicted changes in respiratory and cardiovascular function when compared to a placebo group. This finding is significant because this change existed even while controlling for independent influence of depression, anxiety, and other serum lab values, leading to the conclusion that loneliness may actually create a change in normal autonomic response to a health diminishing response. Finally, Momtaz *et al.* (2012) studied 1,880 older Maylasians and concluded that loneliness significantly increased the likelihood of hypertension in later life (OR 1.31,  $p < .05$ , 95%, CI 1.04-1.66).

**LONELINESS AND CORONARY HEART DISEASE**

Three studies focused on relationships among loneliness and the development or treatment of those with coronary

heart disease (CHD). [22-24]. In 2009, Thurston and Kubzansky reported findings from a data analyses of existing National Health and Nutrition Study (NHANES). Loneliness is assessed in this data using the single self-report item from the Center for Epidemiological Studies Depression Scale (CES-D). Based on these analyses, adults with high loneliness had higher risk of having coronary heart disease. Tobo-Medina and Canaval-Erazo (2010) identified loneliness as one of 10 predominant characteristics in a sample of 65 men and women with CHD. Finally, in 106 patients who had already been treated for myocardial infarction and were expected to enroll in cardiac rehabilitation services, it was recognized that the participants were unaware that loneliness could have significantly contributed to their CHD, indicating a need for education in this specific group.

### LONELINESS AND HEART FAILURE

Three studies of heart failure patients indicated that loneliness is also problematic in this population. In one sample of 149 heart failure patients, loneliness was identified as a prevalent problem (29%) [25]. In addition, in this same heart failure population, loneliness was associated with increased healthcare utilization including more days hospitalized and more re-hospitalizations. [25]. In a more recent cross-sectional study of 150 adults with heart failure, participants with loneliness expressed significantly more dyspnea [26]. Finally, in a recent longitudinal study of loneliness and biomarkers of heart failure disease severity (sample included 268 adults experiencing heart failure), loneliness was independently associated with higher depression levels at 1-year follow-up ( $p < .05$ ) [27].

### LONELINESS AND ISCHEMIC STROKE

Twenty-nine articles were initially retrieved in the literature search on loneliness and stroke. Nineteen of the articles were eliminated as follows: 8 were studies of caregivers; 5 were qualitative; 3 were poster abstracts; 1 didn't include a stroke measurement; 1 was a commentary; and 1 was a duplicate of an article reviewed for the diabetes section of this paper. Therefore, 10 studies were included that measured loneliness in a sample of people who had suffered stroke.

Loneliness has been associated with increased prevalence of stroke and increased mortality, disability, and poor recovery following stroke [28-30]. Stroke patients reported higher perceived social isolation when compared to age-matched healthy individuals [31]; and loneliness was linked to an increased risk of post-stroke depression (PSD). PSD encompasses a broad class of emotional stressors, including depression, depressive-like symptoms, mood disorders, anxiety, and loneliness and is associated with increased mortality, stroke recurrence, disability, and decreased quality of life. Duration and time of onset of PSD are variable, lasting as few as several weeks in some, or persisting longer than 20 months in others [32]. Regardless of the time of onset or the duration of PSD, the effect on stroke recovery is striking. Consensus from these studies is that the loneliness and depression have an increased prevalence in stroke

survivors, and that both are associated with decreased overall quality of life.

Several factors were identified that influence and predict the degree of loneliness and depression among stroke survivors, the most significant being presence of loneliness or depression prior to the stroke, stroke severity, and whether or not the patient went to a nursing or rehabilitation facility. Nine of the 10 studies reported an increase in depression and loneliness and decreased quality of life, well-being, and morale among stroke survivors compared to controls [14, 33-42]. Two studies reported that depression and loneliness were higher among stroke patients discharged to a nursing home or other care facility in comparison to those discharged home [33] (Jongenelis, 2004). Similarly, Wagert (2005) reported that stroke survivors living at home alone reported increased feelings of loneliness compared to age-matched controls living at home alone. In addition, Wagert (2005) reported that stroke survivors who lived at home, but were not alone, had higher morale compared to age-matched older adults who had not suffered a stroke. These findings suggest that social support in a familiar home environment is associated with a greater quality of life and morale, even in the absence of stroke.

Penninx (1999) reported contradictory findings concerning discharge location and loneliness. Penninx *et al.* interviewed 2,788 elderly citizens in the Netherlands, both stroke survivors and non-stroke controls, to assess feelings of loneliness, as part of the larger Longitudinal Aging Study Amsterdam (LASA) [43]. This group reported that stroke survivors received more social and instrumental support compared to other chronic diseases, and consequently, stroke survivors were not at a higher risk of loneliness than non-stroke controls. These contradictory findings may be the result of differing study design, or cultural differences in the populations under study. Penninx (1999) excluded participants living in nursing homes because social support in the long-term care facilities was incomparable to older adults who are living independently. This exclusion criterion makes the findings of Penninx (1999) incomparable to that of Theeke and Barr (2014) and Jongenelis (2004). Further, Penninx (1999) used the de Jong Gierveld loneliness scale instead of the more widely used UCLA Loneliness Scale (as used in both Theeke and Barr (2014) and Jongenelis (2004)), which may also account for the discrepant findings.

There are several other factors that have been shown to mediate loneliness in stroke, including socioeconomic status [33], sensory deficits following stroke [38, 39, 41], and race [14]. Specifically, Theeke and Barr (2014) reported higher feelings of loneliness and decreased quality of life in stroke survivors in the Appalachian region of the United States compared to more urban areas of the US. This region is associated with a lower median household income than the national average that is consistently associated with negative health outcomes in a variety of disease states. It is also important to consider that many inhabitants of the Appalachian region populate rural areas that are geographically isolated from health care facilities. Both of these factors may contribute to the increased loneliness, depression, and incidence of stroke in this region, and these findings may extend to other rural underserved populations.

The correlation between socioeconomic status and loneliness after stroke may be related to race or ethnicity. Tomaka (2006) found that while loneliness is a predictor of stroke outcome in Hispanics, loneliness does not predict stroke outcome in a Caucasian population. As national data suggests that the US Hispanic population has a lower socioeconomic status than Caucasians, these findings may reflect confounding differences in known determinants of health experienced by diverse populations

The goal of all of these studies was to describe loneliness, depression, and quality of life following stroke and identify the factors that mediate these conditions, with the ultimate goal of developing clinical care standards that will improve stroke prognosis by reducing loneliness and depression. Of the ten studies described, only one focused on progressing clinical care. Taylor (2009) described the implementation of a videoconference, telehealth program for stroke survivors and their caregivers in a rural population. This community program titled, Moving On After Stroke (MOST), was delivered to 12 stroke survivors in a rural population. MOST is a 9-week program with two, two-hour sessions per week for subjects. These weekly sessions consisted of one hour of discussion, followed by one hour of physical exercise. After the 9-week MOST program, Taylor (2009) reported that both stroke survivors and caregivers reported lower loneliness scores when compared to subjects who had not undergone MOST. Given the findings of Theeke and Barr (2014), the MOST program may provide a means to provide social support to rural populations and reduce loneliness and improve stroke prognosis.

### LONELINESS AND OBESITY

Of the 17 articles identified on loneliness and obesity, only 7 were included in this review. Three were excluded because they didn't include a measure of loneliness, 2 were excluded because they were reviews, 1 was excluded because it didn't include a measure of obesity, 1 was excluded because it focused on child subjects, 1 was a commentary, 1 was a duplicate and another was excluded because it was a sensitivity analysis. Obesity and loneliness are conditions that both negatively impact health. An association between obesity and loneliness exists [44-48]. However, the exact nature and extent of the relationship between obesity and loneliness is unclear and warrants further study.

Obesity and loneliness appear to have a synergistic negative impact on both physical and emotional health. For example, Jacobs *et al.* (2006) found loneliness was associated with poor sleep ratings, and that poor sleep ratings were associated with obesity, low physical activity, depression and other negative health outcomes. Additionally, increased loneliness was seen in those with increased weight-related stigma which includes lower rates of hire and promotion, higher rates of wrongful dismissal and social isolation [44]. Morse, *et al.* (2006) studied night time eating symptoms and found a relationship between eating in response to emotions including anger, sadness, loneliness, worry or being upset. Of the 714 patients studied, 40.2% reported being lonely and of those 63.8% had night-eating symptoms ( $\chi^2=17.66$ ,  $p < 0.001$ ). When compared to patients

without night-eating symptoms, those with night-time eating symptoms were significantly more likely to be obese [OR=2.6 (95% CI 1.5-4.5)] [49].

Another study looked at centenarians and found that those who were obese reported very good self-rated health (SRH) more often than those with normal body mass index (BMI) [OR=5.35 (95% CI 1.67-17.18)] [47]. However, when comparing groups who rated their health as very good or good to those rating their health as poor, loneliness was significantly related to worse SRH [OR=2.89 (95% CI 1.63-5.13)] & [OR=2.23 (95% CI 1.24-4.010)] respectively. A longitudinal study followed patients from age 70 to age 77 and found that at both ages, chronic back pain was more frequent among those reporting loneliness ( $p < 0.001$ ) and chronic back pain was associated with obesity at both ages ( $p=0.06$  and  $p=0.59$ , respectively) [45]. This study also reported loneliness to be an independent risk factor at age 70 for chronic back pain [OR=4.60, (95% CI 1.19-17.71)].

Finally, one recent study of obese female college students reported that loneliness is a significant negative emotional experience. Loneliness was reported as being inversely related to, to self-esteem ( $r = -0.688$ ,  $p < .001$ ) and a positively related to higher perceived stress levels ( $r = 0.560$ ,  $p < .001$ ) [50]. The results of this study make it logical to contemplate that the experience of loneliness may be eliciting a physiological stress response that contributes to obesity.

### LONELINESS AND DIABETES

Few studies could be found that examined the significance of loneliness to diabetes. Of six potential articles identified, 2 were literature reviews, one was qualitative, and 3 involved the use of questionnaires [49, 51-55]. Only one study was retrieved that used a valid and reliable measurement of loneliness [55]. While limited findings are present in the literature, some common themes emerged. Loneliness and outcomes of diabetes seem to have a reciprocal relationship. Complications of diabetes lead to decreased physical mobility which decreases an individual's ability to seek social interaction and causes strain on marital, family, and friend relationships, thus leading to loneliness [49, 51, 53-55]. Conversely, the stress induced systemic inflammation observed in persons with loneliness is a known risk factor for poor health outcomes associated with diabetes [51, 52, 55].

### LONELINESS AND PULMONARY PROBLEMS

Seven articles were retrieved from the results of the EBSCOHost search of Loneliness and Pulmonary Disease and an additional 2 were reviewed from a search of Loneliness and Chronic Obstructive Pulmonary Disease. Of these articles, 2 duplicates were eliminated, one was eliminated because it was not in English even though English language was one of the selection criterion. Two articles were eliminated because they were opinion/commentary pieces and one article was eliminated because it was qualitative study.

A study of 30 people with COPD and their spouses described the prevalence of loneliness, depression, social support, and satisfaction with social support [56]. This study

used a convenience sample and measured loneliness using the UCLA loneliness [56]. Sixty-three percent of those with COPD and, similarly, 67% of spouses reported moderate to moderately high levels of loneliness. A larger percentage of those with COPD reported high levels of depression than did their spouses. Social support and satisfaction with the social support was found to have an association with loneliness among those with COPD. Those with higher levels of social support satisfaction had lesser feelings of loneliness and depression. Among spouses it was unexpected that social support was not found to have a statistically significant correlation with loneliness.

A similar study was conducted on 30 patients with COPD and their spouses in an outpatient clinic of a university hospital in Turkey [57]. They were asked to complete the UCLA Loneliness Scale, the Beck Depression Inventory and the Perceived Social Support Scales. Both patients and their spouses reported similar levels of loneliness ranging from moderately high to low levels. Nearly 97% of patients and 93% of spouses reported levels of loneliness as moderate to moderately high. A greater number of patients (n=18) with COPD rated their level of loneliness as moderately high than did the spouses (n=11) and conversely less patients rated their loneliness as moderate or low (n=12) than did spouses (n=19). Similar to the findings reported by Keele-Card *et al.*, (1993), a significant positive association was reported between loneliness and depression in both groups. In the patients with COPD, a small inverse association existed between loneliness and perceived social support from family, and a strong negative association existed between perceived social supports from friends. In the spouses, a moderate inverse association was reported between loneliness and social support from both family and friends. The mean loneliness scores for both groups in this study were higher than those reported by Keele-Card *et al.*

A third study comparing the differences between clients of a Veterans Affairs Home-Based Primary Care and State Medicaid Waiver Program in Michigan found higher degrees of loneliness among the Veterans than the Medicaid clients [58]. Eighty-nine participants from the Veterans program and a weighted sample of 9,324 Medicaid participants with coronary artery disease, chronic obstructive pulmonary disease and cancer were compared using the interRAI home care (interRAI HC) assessment instrument. The interRAI HC measures disease presence and symptoms, physical and cognitive function, social support and services used. Although this study sample was not exclusive for COPD, it is worth noting that while both groups reported loneliness, Veterans reported a statistically significant higher incidence of loneliness than did Medicaid recipients. Differences in the two groups was a limitation due to the Veterans having higher functioning than the Medicaid recipients which may in part be due to the higher rates of dementia among those in the Medicaid program.

## DISCUSSION

Though the majority (15 studies) of the research on loneliness and the chronic conditions included in this synthesis was conducted in the United States, the remaining studies were conducted in various locations, emphasizing

that loneliness is being studied worldwide. Four studies were conducted in the Netherlands, four in Sweden, three studies in the United Kingdom, two in Israel, and one each in Turkey, Malaysia, Ireland, Canada, Greece, Finland, and South America. The widespread study locations is a true indicator that loneliness is currently viewed as a global health phenomenon that negatively impacts the outcomes of multiple chronic conditions.

The included studies varied in quantitative design and methodologies with twenty-one studies using cross-sectional methods and nine employing longitudinal study designs. Four studies reported results based on descriptive correlational design, two were experimental, two were observational, two were retrospective, one used mixed methods, one included a pre- and post-test design and one was a prospective cohort design. Sample sizes ranged from a low of 22 to 3,107 and the age range of the subjects was 17 to 109 years old. Several studies reported analyses of data from larger national studies. The UCLA Loneliness Scale and Beck Depression Inventory were the most common instruments used to assess loneliness. In addition, the de Jong-Gierveld loneliness scale, Philadelphia Geriatric Morale Scale, and single item questions were the basis for assessing loneliness in the remaining studies.

Loneliness had some reported association with all of the chronic conditions. Among older adults, loneliness was related to poorer clinical outcomes in those with heart disease and Tomaka (2006) suggested that improved belongingness support could result in improved health outcomes. Similarly, high levels of loneliness were reported among both persons with COPD and their spouses and among this population, higher levels of social support were also related to lower levels of loneliness [56, 57]. This is similar to the findings by Bergdahl *et al.* (2005) who found that persons living at home after a stroke, but were not alone had higher morale and thus were less lonely than those in similar home environments who have not had a stroke [37].

Additionally, physiologic measures deviating from normal for hypertension and cardiovascular reactivity were more commonly found among those who reported higher rates of loneliness [17-21, 59]. Lab value differences among persons who reported being lonely indicate that the autonomic response to chronic conditions may have a negative effect on health outcomes [20]. It is important to note that studies of adults and older adults who are healthy without chronic conditions have highlighted the presence of a physiological stress response in relation to cardiovascular disease [60-62]. These studies were not included in this review because the samples used were described as healthy individuals without heart disease. Likewise, stress induced inflammation that occurs in persons who are lonely is a risk factor for poor diabetes outcomes [52, 55, 63]. Some studies suggested that loneliness might actually be a predecessor to chronic conditions. Loneliness as a predominant characteristic in many studies showed an increase in exacerbation of symptoms and disease progression [24, 26].

Loneliness was also found to be associated with hospital readmissions, longer lengths of stay and the over utilization of healthcare resources for cardiovascular disease [25]. Heart failure and stroke were both found to be linked to higher

depression levels after disease onset [27, 31]. Placement in a nursing home or rehabilitation facility after a stroke increases the prevalence of loneliness and depression [33, 41]. Lower socioeconomic status and living in a rural area were associated with a higher incidence of loneliness. Socioeconomic status and loneliness after stroke were found to be related to race [14].

Studies of obesity and loneliness revealed a number of factors associated with the simultaneous presence of these conditions including; poor sleep, depression, low physical activity, higher rates of night time eating and increased chronic back pain [45, 46, 49]. Weight-related stigma resulting in less success in the workplace, including not being hired or promoted and being wrongfully dismissed, and was associated with increased loneliness [44]. Loneliness was significantly associated with increasing likelihood of meeting metabolic syndrome criteria and central obesity [55]. This study was one of the few that included a measure of loneliness in people with diabetes and did find that higher rates of loneliness had a detrimental effect on diabetes outcomes.

Effective interventions for loneliness are limited and thus, are needed. One meta-analysis of interventions, that included studies across populations and age groups, reported that the most effective interventions may be those that address the ineffective or maladaptive thinking processes that occur when one is experiencing loneliness [64]. Currently, there are three interventions that have true potential for diminishing loneliness in older adults. One feasibility study focused on reducing loneliness in a sample of stroke survivors and evaluated the efficacy of an intervention that was based on videoconferencing and telehealth programs [42]. After completing the intervention, study participants reported less loneliness. More recently, investigators reported that a mindfulness-based stress reduction program resulted in lower loneliness scores and less pro-inflammatory gene expression when tested in a sample of older adults who were healthy without common chronic conditions [65]. This type of intervention has the potential to also demonstrate effectiveness in populations who suffer common chronic conditions. Most recently, the results of the first randomized trial of LISTEN (Loneliness Intervention based on Story Theory to Enhance Nursing-sensitive outcomes) were reported to diminish loneliness and improve blood pressure [66, 67]. LISTEN was developed by integrating the core concepts of story theory [68] with the basic principles of cognitive restructuring and was effective for diminishing loneliness and systolic blood pressure when delivered in small groups of rural, underserved, chronically ill older adults [69]. Designing effective interventions for loneliness requires in-depth understanding of loneliness as a psychological construct that may be experienced in ways unique to an individual based on life experiences, life expectations, and cultural experience. Both LISTEN and the mindfulness intervention developed and studied by Creswell (2012) have real potential for success at diminishing loneliness in older adults and other populations and age groups.

## CONCLUSION

Loneliness is known to be associated with or influence the outcomes of multiple chronic conditions including heart disease, hypertension, stroke, obesity, diabetes and pulmonary disease. Although some studies have explored the physiological mechanisms that may be triggered by loneliness, better defining these physiological links to the progression of chronic conditions would contribute to the refinement of knowledge about loneliness and health. Intervention trials aimed to diminish loneliness in persons with multiple chronic conditions have been limited, and thus, are needed. In addition, there may be opportunities for public health awareness campaigns regarding the significance of loneliness as a negative health state that may influence chronic conditions, functional ability [70, 71], and even mortality [6, 7]. Several recent with successful programs has the potential to decrease morbidity and mortality and improve quality of life among those affected by these chronic conditions. The health care system would benefit from developing successful programs to eliminate or reduce loneliness that could potentially delay or prevent the onset of chronic disease and lessen complications and improve outcomes of those already afflicted by these chronic conditions.

## CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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