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Cardiovascular Health among U.S. Indigenous Peoples: A Holistic and Sex-Specific Systematic Review

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Abstract

Purpose: The purpose of this systematic review is to examine mental, sociocultural, behavioral, and physical risk and protective factors related to cardiovascular disease (CVD) and related outcomes among U.S. Indigenous peoples.

Methods: A total of 51 articles met the inclusion criteria of research focusing factors for CVD among U.S. Indigenous peoples (Mental $n=15$; Sociocultural, $n=17$; Behavioral/Physical, $n=19$).

Results: This review reveals clear risks for CVD, which tended to be elevated for females. Mental health problems (depression, anxiety, PTSD/trauma, alcohol and other drug (AOD) abuse) were clearly associated with CVD, along with enculturation, social support, and the social environment-including discrimination and trauma. Poor diet and obesity, diabetes, hypertension, cholesterol were behavioral or physical factors.

Discussion: Overall, identified research was limited and in beginning stages, lacking more information on etiology of the interconnections across sex and the mental, sociocultural, and behavioral determinants of CVD.

Keywords

Native American or American Indian or Alaska Native or Native Hawaiian; cardiovascular disease; mental health; cultural factors; social factors; diabetes

Introduction

A commonality across Indigenous peoples of the U.S. is the experience of historical oppression and trauma due to the cultural changes brought about through colonization

(including drastic changes in diet and lifestyle), as well as their distinct resilience and transcendence in the face of this adversity and culturally specific strengths (Burnette & Figley, 2017). These changes relate to healthy inequities that drive mortality and morbidity. Yet, social workers tend to focus on mental and behavioral aspects of living, with less attention to the pervasive and associated physical health problems. The glaring mortality rates for American Indian and Alaska Natives (AI/AN) are nearly 50% higher than for non-Hispanic whites and can be intricately connected to mental (i.e., mental health disorders), sociocultural (i.e. social support, the social environment, and engagement with cultural traditions), and behavioral (i.e., exercise and diet), and physical (co-occurring disorders with CVD, such as diabetes and obesity) outcomes. Cardiovascular disease (CVD) is the leading cause of death for both AI/AN individuals and non-AI/ANs (Indian Health Service, 2018). However, scarce research has examined the mental (i.e., psychological outcomes, such as depression and anxiety), sociocultural (i.e., social and cultural-related factors), and behavioral or physical risk and protective factors for CVD among AI/ANs using a culturally relevant theoretical framework (i.e., one that is developed with culture and the distinct historical context of Indigenous peoples in mind), with even less examining the sex-differences across these risk and protective factors (Harwell et al., 2001).

AI/ANs belong to 573 federally recognized and over 60 state recognized tribes, and with tribes that exist outside either jurisdiction (Bureau of Indian Affairs, 2018). Depending on their recognition, tribes have variable needs and resources, with federally recognized tribes receiving healthcare through Indian Health Service (IHS) as part of treaty agreements to provide for their health and well-being. This distinct trust relationship, based on treaty agreements with politically sovereign federally recognized tribes, warrants examining the disparities of Indigenous peoples of the U.S. (AI/AN and Native Hawaiians) separately. The scope of this review is Indigenous peoples of the U.S. who are thought to be the original inhabitants of the land and who are affected by colonization. For the purpose of this article, they include AI/ANs and Native Hawaiians. Scarce research exists for Native Hawaiians, but we have included them in this study to try and fill this gap. These Indigenous U.S. populations tend to experience similar health disparities related to colonization. When the respective research is delimited to American Indians only, this will be noted as AI.

The culturally-relevant Framework of Historical Oppression, Resilience and Transcendence (FHORT), which includes consideration of historical oppression (HO) informs this work (Burnette & Figley, 2017). Historical oppression expands on the prominent concept of historical trauma, a concept that includes the cumulative, massive, and chronic trauma imposed on a group across generations and over the course of life. HO is distinct in that it is localized to specific contexts and is inclusive of the proximal factors that continue to perpetuate oppression (for the purpose of this research, this could include poor access to healthcare and healthy foods as a result of poverty and discrimination). Resilience acknowledges the continuous efforts made by Indigenous peoples to respond to and transcend HO. The balance of risk factors (those that exacerbate or lead to negative outcomes—in this case CVD) and protective factors (those that buffer against or reduce CVD risk) predicts whether a person experiences wellness and health. For the purpose of this article, we focus on mental, sociocultural, behavioral, and physical risk and protective factors related to CVD.

Research has documented higher CVD (as well as associated risk factors, including obesity, smoking, cholesterol, and hypertension) amongst AI/ANs in comparison with non-AI/ANs (CDC, 2014; Denny et al., 2005; U.S Civil Rights Commission, 2004). Other research from the Behavioral Risk Factor Surveillance System (BRFSS) data has indicated that the primary risk factors for CVD, such as smoking, physical inactivity, obesity, diabetes, and poor general health, tend to be worse for AI/ANs than for Whites (Harwell et al., 2001). Moreover, unlike non-AI/AN populations, the prevalence of CVD has been shown to be increasing over time for AI/ANs and has been found to be more likely to be fatal, which may be related to the high prevalence of diabetes within these populations. The Strong Heart Study's (Welty et al., 2002) data trends for AI/ANs across the years 1989, 1995, and 2006 indicate that diabetes and hypertension rates have been increasing (with almost 80% having one or more CVD risk factors and almost 50% having two or more CVD risk factors); yet smoking, sedentary behavior, and intake of fruits and vegetables remained stable (Jernigan et al., 2010). This conundrum warrants examining risk and protective factors for AI/ANs more closely, to identify potential culturally specific factors.

Despite preliminary indication that mental, sociocultural, and behavioral determinants of health are salient, relatively little research has investigated these topics, with even less available for Indigenous peoples. Several systematic review have investigated cardiovascular health among Indigenous peoples of the U.S. (Deen et al., 2017; Ellis, 1994; Galloway, 2005; Hutchinson & Shin, 2014; Schumacher, Davidson, & Ehrt, 2003); however, none of these reviews have focused on mental and sociocultural factors, or those beyond physical determinants of health. Indeed, Hutchinson and Shin (2014) remark how, despite prevalence data are available, there is a dearth of research on the underlying causes of cardiovascular health disparities, namely social determinants of health. Without this information, social workers are left in the dark about associated factors, and how the physical, behavioral, social, and psychological aspects of living and quality of life may be interlinked. Thus, this review focuses on those mental, sociocultural, behavioral, and physical factors thought to be related to CVD and related health outcomes, including depression, anxiety, PTSD symptoms, historical trauma, AOD abuse, enculturation, violence, stress and resilience, social support the social environment, along with the conventional behavioral and physical factors known to be associated with CVD in the general population. Regarding mental determinants, extant research on depression indicates that depression is a risk factor for greater comorbidity for chronic conditions, such as hypertension and diabetes (Cooper et al., 2014; Goins and Pilkerton, 2010). Little research has examined anxiety as a risk factor for CVD and related outcomes, with some research indicating that the stress associated with anxiety can lead to overeating, which may be higher for women (Madan et al., 2012; Pine, 1985; Sawchuck et al., 2005). Indeed, stress from trauma, violence, discrimination, and health problems have been found to be risk factors for depression, CVD, diabetes, and other related chronic health conditions (Brave Heart & DeBruyn, 1998; Brave Heart, 1999; Burnette, 2015; Centers for Disease Control and Prevention, 2014; C. J. Clark et al., 2016; Daniels, Goldberg, Jacobsen, & Welty, 2006; Denny, Holtzman, Goins, & Croft, 2005; Jernigan, Duran, Ahn, & Winkleby, 2010; J. K. Kaholokula, Iwane, & Nacapoy, 2010; Pine, 1985; Thayer et al., 2017; Welty et al., 2002; Woods, Hall, Campbell, & Angott, 2008).

Alcohol abuse is a known risk factor for CVD, yet alcohol and other drug abuse (AOD) has been largely unexplored in relationship to CVD and diabetes among Indigenous peoples, despite it tending to be higher among these populations (Costello et al., 2013; Tann, Yabiku, Okamoto, and Yanow, 2007). Similarly, the limited research does indicate the benefits of enculturation and social support for overall health, including CVD, physical, and dietary health (Bersamin et al., 2014; Henderson & Ainsworth, 2000; Kading et al., 2015; J. K. Kaholokula et al., 2010; Thompson et al., 2001; Thompson et al., 2002; Thompson, Wolfe, Wilson, Pardilla, & Perez, 2003; Wolsko, Lardon, Mohatt, & Orr, 2007). All of these factors tend to vary by sex when it is included as a variable in analysis. Given their importance related to CVD and associated health outcomes for Indigenous men and women, the purpose of this systematic review is to examine mental, sociocultural, behavioral, and physical risk and protective factors to identify the state of research in this important yet understudied area. This article contributes to practitioners' and researchers holistic understanding of factors related to CVD, preventing the tendency to see these factors in isolation. Seeing factors holistically and comprehensively is necessary for social workers to address the primary factors related to health and mental/behavioral health, without missing key factors. This complete understanding is necessary to enable Indigenous peoples' attainment of full health and wellness

Methods

This systematic review includes peer-reviewed quantitative and qualitative research articles focusing on CVD and related mental, social, and cultural factors for Indigenous populations of all ages published between the years 1983–2017. These years were chosen due to the scarce research available on physical/behavioral factors, mental health factors, and social factors with regards to CVD experienced by Indigenous peoples. In other words, few articles were available, even with these broad years ($n = 51$), and we wanted to capture the full scope of available research. Only empirically-based research articles with samples including Indigenous youth or adults were included. The following search terms were used to identify peer-reviewed articles related to Indigenous CVD and their coinciding health factors: ("American Indian" OR "Alaska Native" OR "Native American" OR "First Nations" OR "Native Hawaiian" OR "indigenous") AND ("cardiovascular disease" OR "CVD" OR "obesity" OR "high blood pressure" OR "hypertension" OR "high cholesterol" OR "diabetes") AND ("mental health" OR "PTSD" OR "depression" OR "anxiety" OR "substance use" OR "suicide" OR "stress" OR "trauma" OR "resilience" OR "social support" OR "social ties" OR "adult attachment" OR "family support" OR "enculturation" OR "acculturation" OR "culture" OR "spirituality" OR "faith" OR "religion" OR "Post-traumatic growth" OR "posttraumatic growth" OR "transcendence" OR "intimate partner violence" OR "IPV" OR "domestic violence" OR "violence" OR "adverse childhood experiences" OR "historical oppression" OR "child abuse" OR "child maltreatment" OR "neglect") AND ("gender" OR "sex") OR ("gender difference" OR "sex difference"). Eight social science and health related databases were used to search for relevant articles (Google Scholar, EBSCO, PsycINFO, SocINDEX with Full Text, The Educational Resource Information Center (ERIC), Academic Search Complete, PubMed, and JSTOR) from October 2017 to December 2017, and articles were entered into Excel spreadsheets. We

initially searched titles of articles, then examined abstracts, and finally, full articles to identify articles included in this review. Manual searches of reference lists of relevant studies, based on eligibility criteria, were also conducted to locate additional published literature.

Inclusion criteria delimited the search to articles that: (a) were empirical; (b) were peer reviewed; (c) addressed various outcomes of CVD and mental, sociocultural, behavioral and/or physical factors; (d) included Indigenous peoples in their sample; and (e) occurred within the U.S. All aforementioned search strategies yielded a total of 40,796 articles. After applying the inclusion criteria of publication date and appearing in peer-reviewed academic journals, 332 articles were identified and screened for duplicates based on the titles and abstracts, resulting in 61 eligible articles. Of these, 10 were excluded after a full-text read for failing to meet the aforementioned criteria. The first author independently reviewed all articles and ensured the inclusion criteria were properly upheld. The resultant 51 articles met the inclusion criteria for this systematic review. Figure 1 depicts this process. The resulting articles, from which results were drawn, are now discussed.

Results

We organize results under the following overarching headings (a) Mental/Psychological Determinants of health (i.e., depression, anxiety, PTSD/historical trauma/stress, and AOD abuse); (b) Sociocultural Determinants of Health (i.e., enculturation, exposure to violence and trauma, discrimination and resilience, social support, and the social environment); and (c) Behavioral/Physical Determinants of health (i.e., diet and obesity, along with diabetes, hypertension, and cholesterol and other factors, including age). Table 1 displays the outcome, primary predictors, risk and protective factors, samples size, age, region of sample, sexes included in the study(s), whether the sample was urban or rural, and the study design of each article included in this review. Table 2 summarizes table of preliminary sex differences by outcome based on this review.

Mental/Psychological Determinants of Health

Fifteen articles with mental health outcomes were identified. These articles focused on depression, anxiety, PTSD/trauma, alcohol and other drug (AOD) abuse, and related physical health factors.

Depression.—Six studies examined the prevalence of depression and depressive symptoms in relation to CVD (Cooper et al., 2014; Goins & Pilkerton, 2010; Grandinetti et al., 2000; Kaholokula, Grandinetti, Crabbe, Chang, & Kenui, 1999; Sahota, Knowler, & Looker, 2008). A major risk factor for depression was having poor overall health or physical functioning (Cooper et al., 2014; Goins & Pilkerton, 2010; Grandinetti et al., 2000; Kaholokula, Haynes, Grandinetti, & Chang, 2006; Kaholokula et al., 1999; Sahota et al., 2008). Age (being older) was a risk factor for increased depression (Cooper et al., 2014; Goins & Pilkerton, 2010; Kaholokula et al., 2006; Kaholokula et al., 1999) as well as being female (Kaholokula et al., 1999; Sahota et al., 2008). Several studies found that metabolic changes in one's body due to diabetes could also increase depression (Grandinetti et al., 2000; Sahota et al., 2008). Two studies focused on depressive symptoms and its relation to

diabetes. Kaholokula et al., (2006), studied Native Hawaiians with Type 2 diabetes and found that physical functioning, role-emotional functioning (role limitations due to emotional problems), bodily pain, vitality, and general health were significantly associated with depression.

Through an investigation of medical records, Cooper et al., (2014) found that the odds of CVD increased in AI/ANs if they had depression and hypertension. Additional risk factors included being male, older, and having more than three comorbidities (Cooper et al., 2014). Two studies also identified comorbidities between depression and CVD and/or health issues related to CVD, including hypertension and diabetes (Goins & Pilkerton, 2010; Grandinetti et al., 2000). Older AI/ANs with more depressive symptomatology and lower personal mastery (generalized expectations about a person's sense of control) experienced higher rates of hypertension and diabetes (Goins & Pilkerton, 2010). In AI/ANs, depression was higher in participants with diabetes than those without diabetes and mean glycosylated hemoglobin levels were significantly higher among those that were depressed (Sahota et al., 2008). In addition, a significant association was identified between depressive symptoms and diabetes and hemoglobin A1c (Grandinetti et al., 2000). Finally, depressive symptoms were present in 15% of a sample of rural Native Hawaiians, and there was a strong correlation between depression, smoking, and the number of cigarettes smoked per day (Kaholokula et al., 1999). Despite some important preliminary information, most of the research did not address why depression may relate to CVD and related health outcomes. Moreover, despite males and females being included, explicit analysis of sex differences was largely absent.

Anxiety.—Two studies identified anxiety as a predictor of obesity (Madan et al., 2012; Pine, 1985) which is a known associate of CVD. In a sample of Native Hawaiians, Madan et al., (2012) identified positive associations between obesity, lack of sleep, and anxiety, whereas participants who engaged in regular exercise were at a decreased risk for obesity and anxiety (Madan et al., 2012). Pine (1985) analyzed anxiety and eating behavior and found that AIs overeat in response to stress and AIs with an anxiety disorder ate more than those without a disorder. Overall food consumption by AIs was greater than Whites, and females had higher levels of anxiety than males (Pine, 1985). Given the importance of anxiety to CVD and related outcome, the identification of only two studies, with the only one in the contiguous U.S. being conducted in 1985 is a clear gap in research.

PTSD/Historical Trauma/Stress.—PTSD, Historical Trauma, and stress, were implicated in cardiovascular health outcomes across three articles (Aronson, Palombi, & Walls, 2016; Clark & Winterowd, 2012; Daniels et al., 2006). Aronson et al., (2016) found PTSD to be positively correlated with past year hospitalization, hyperglycemia, low self-rated health status, and higher cholesterol in AIs with type 2-diabetes, with 21% of participants screening positive for PTSD. When PTSD was grouped with depression, the rates were even higher, at 31% (Aronson et al., 2016). Poor self-rated health status was reported by 10.6% of participants and those 65 and older had the lowest risk for PTSD. No significant differences were identified between sex, education, and income status and PTSD (Aronson et al., 2016). Clark and Winterowd (2012) discovered a significant relationship

between historical trauma/loss, racism, and emotional distress and binge-eating behavior and obesity. AI females were more likely to experience feelings of cultural loss, racism, and discrimination, increased rates of depression and PTSD (Clark & Winterowd, 2012). Daniels, Goldberg, Jacobsen, and Welty (2006) conducted a study to determine if psychological distress increased the risk of Type 2 diabetes; although those with the highest level of psychological distress were 1.2 times more likely to fall into the incident diabetes category, no significant difference was supported by the data. Like anxiety, three articles on PTSD is a clear lack of research, given the connection with CVD. Sex differences can scarcely be understood with so few studies. With the geographic diversity, much more research across geographical contexts is needed.

AOD abuse.—There was limited research, only two studies, which identified AOD abuse as a primary factor in cardiovascular health outcomes. Costello et al., (2013) examined the relationship between C-reactive protein (CRP), a marker for CVD, and the abuse of alcohol, nicotine, and cannabis in AI youth and young adults. CRP levels were higher when participants abused all three substances, and nicotine use predicted higher levels of CRP. Risk factors for AOD abuse and increased CRP levels were being female, older, and obese (Costello, Copeland, Shanahan, Worthman, & Angold, 2013). Tann, Yabiku, Okamoto, and Yanow (2007) identified a strong correlation between the prevalence of diabetes, having more poor mental health days, and heavy drinking, with AI/ANs having higher rates than Whites. Native Hawaiians had a higher prevalence of risk for heavy drinking, but low prevalence of both diabetes and poor mental health days compared to non-AI/ANs (Tann, Yabiku, Okamoto, & Yanow, 2007). Given the well-established link of AOD abuse and CVD in the general population, it is striking that only two studies were identified at all. This lack of attention to clearly linked factors contributes to the failure of this trust responsibility to provide to the health of U.S. Indigenous peoples.

Additional Factors.—Two studies were identified that were applicable to both mental health factors and CVD, but didn't fit into the other identified themes (Keen & Norton, 1987; Pine, 1983). Keen and Norton (1987) studied the relationship between attitudes, perceived beliefs, coping methods, and regimen adherence of diabetic AIs. Identified risk factors for diabetes included: stress, perception of others' beliefs (of having diabetes, going to the doctor, taking medication, etc.), smoking, and not adhering to diet. Protective factors included social support, religion, and hobbies (Keen & Norton, 1987). Pine (1983) measured the relationship between hypomania and obesity. There was a significant positive correlation between hypomania and obesity with AIs having higher scores than Whites and males having higher scores than females (Pine, 1983). More research on the promising area of protective factors is warranted.

Sociocultural Determinants of Health

Our search revealed several social and cultural factors implicated in the cardiovascular health of AI populations as risk or protective factors in these 17 articles. These included: enculturation/acculturation, exposure to violence and trauma, stress and resilience, social support, and characteristics of the social environment. Risk or protective factors for CVD

tended to be moderated by sex with mixed results (n=8 articles). Where this information is available, sex-differences are reported in their respective sections.

Enculturation.—In the literature regarding AI populations in the U.S., enculturation refers to one's level of identification with and involvement in Native culture, while acculturation refers to one's level of identification with and involvement in American mainstream culture. In general, enculturation has proven to be a protective factor for CVD and its health-related indicators, including physical activity, hypertension, AOD abuse, psychosocial stress, and mental health as indicated across six studies (Bersamin et al., 2014; Henderson & Ainsworth, 2000; Kading et al., 2015; Kaholokula et al., 2010; Thompson et al., 2002; Wolsko et al., 2007). Greater enculturation was associated with a more physically active, subsistence lifestyle that includes participation in cultural events and ceremonies (Bersamin et al., 2014; Henderson & Ainsworth, 2000; Thompson et al., 2002). Additionally, a higher level of enculturation was shown to be positively associated with positive mental health amongst AI adults with Type 2 diabetes, (Kading et al., 2015) and negatively associated with psychosocial stress in AN adults (Bersamin et al., 2014; Wolsko et al., 2007). Further, AN adults who reported higher levels of acculturation were more likely to turn to drugs and alcohol to cope with stress, while those with higher levels of enculturation turned to religion and spirituality as a means of coping (Wolsko et al., 2007). Women had higher levels of perceived stress than men; however, men were more likely to use drugs/alcohol to cope and women more likely to turn to religion/spirituality (Wolsko et al., 2007). Women were also more enculturated than men (Wolsko et al., 2007). The inclusion of acculturation in studies of Indigenous peoples, who are the original inhabitants of the land is a bit peculiar, as this term seems to be applied more to immigrants. However, it is striking that acculturation as it was defined was a risk for health among the sample.

Exposure to Violence and Trauma.—Six articles revealed a link between exposure to many forms of violence or trauma and CVD. Amongst ethnically diverse groups of research participants that included AI women, IPV was shown to negatively impact physical health (Woods et al., 2008) and increase risk of CVD (Clark et al., 2016). Women were more likely to report IPV exposure than men, although other factors contributed to men having higher incidences of CVD (Clark et al., 2016).

Woods and colleagues also found that IPV exposure was positively associated with post-traumatic stress symptoms (Woods et al., 2008). Additional studies have shown positive relationships between lifetime PTSD and Major Depression and CVD, (Sawchuk et al., 2005) and an association between high level trauma symptoms and lack of medication for diabetes management (Jacob et al., 2013). Similarly, individuals who experienced early life trauma and subsequently developed PTSD had a higher allostatic load (Thayer et al., 2017). Given the disproportionate rate of violence against Indigenous peoples, coupled with the established connection of violence and CVD, the lack of research, particularly exploring sex differences is glaring. Given women are disproportionately impacted by such violence, more research exploring their experiences is needed.

Discrimination and Resilience.—Discrimination and resilience were shown to be salient factor that increases CVD risk amongst AI populations across five articles. Jiang and

colleagues found a positive association between overall stress burden and diabetes prevalence across two tribes of AIs (Jiang et al., 2008). Factors contributing to stress burden included early life interpersonal trauma, location related hassles, childhood neglect, discrimination, family dysfunction, addiction problems, and economic distress. In alignment with these findings, Kaholokula and colleagues found that greater perceived racism is positively associated with hypertension status amongst Native Hawaiians, (Kaholokula et al., 2010) and Kading and colleagues found that discrimination was negatively associated with positive mental health amongst AI adults with Type 2 diabetes (Kading et al., 2015). Amongst older AI adults, low levels of resilience to life's stressors (measured using CD-RISC) were found to be associated with lower physical health scores (measured using SF-8), increased chronic pain, and the presence of depressive symptomatology (Schure, Odden, & Goins, 2013). Men were found to have substantially higher levels of resilience than women (Schure et al., 2013). A study of AI young adults revealed that perceived stress contributed to elevated risk for being overweight or obese, and Type 2 diabetes (Marley & Metzger, 2015). Examining discrimination and resilience is relatively novel, but promising in understanding CVD and connection with the social environment, along with pathways promoting health.

Social Support.—Within AI populations, support from family and friends was a protective factor that contributed substantially to physical activity, which can help improve cardiovascular health; four studies addressed these links (Bersamin et al., 2014; Henderson & Ainsworth, 2000; Moy, Sallis, Ice, & Thompson, 2010; Thompson et al., 2003). In a study of Pacific Islanders and Native Hawaiian adults, higher levels of social support were positively correlated with physical activity (Moy et al., 2010). Men were generally more likely than women to engage in physical activity as a protective factor for CVD, this was due to women's high level of family responsibility and other gendered work patterns (Bersamin et al., 2014; Henderson & Ainsworth, 2000; Thompson et al., 2002). However, Native Hawaiian and Pacific Islander women self-reported more than double the amount of physical activity than men (Moy et al., 2010). This finding is also true amongst AI women (Thompson et al., 2002; Thompson et al., 2003) and children (Thompson et al., 2001). Additionally, when adults were active with children, this was more common with boys than with girls, and girls reported safety concerns as a barrier to physical activity/play more than boys (Thompson et al., 2001). More research exploring sex differences is needed, as social support is a clear protective factor that can be built upon.

Social Environment.—In addition to social support, five studies discovered that additional characteristics of AI/ANs immediate physical and social surroundings acted as risk or protective factors for cardiovascular health. Several studies revealed that lack of neighborhood infrastructure and/or facilities that enable physical activity was a risk factor for cardiovascular health. AI women and children were more physically active when their neighborhood and school environments were perceived as more physically and socially supportive of physical activity, characterized by walking paths, exercise facilities, and other people exercising (Moy et al., 2010; Thompson et al., 2001; Thompson et al., 2002; Thompson et al., 2003). Women and girls were found to have greater barriers to physical activity than men and boys, putting them at greater risk for being overweight or obese

(Thompson et al. 2001; Thompson et al. 2002; Thompson et al. 2003; Moy et al. 2010). Neighborhood poverty, on the other hand, was identified as a risk factor for CVD, contributing to elevated risk for being overweight or obese, and Type 2 diabetes among AI young adults (Marley & Metzger, 2015). Providing social environments that promote health is a promising and understudied area; environmental attributes that promote health differentially for males and females are important to understand, given the potential safety concerns, particularly for females who are exposed to elevated levels of violence.

Behavioral and Physical Determinants of Health

Diet and Obesity.—Diet was associated with CVD in five articles ($n=5$ (Bersamin et al. 2008; Jernigan et al. 2010; Moy et al. 2010; Xu et al. 2007; Zephier et al. 1997)). Having a Western diet, compared to a traditional diet high in fruits and vegetables, was generally associated with increased risk for CVD (Bersamin et al. 2008; Jernigan et al. 2010; Moy et al. 2010). Having a higher intake of fat was also a risk factor for CVD, while having a well-balanced diet was protective (Xu et al. 2006; Zephier et al. 1997). Obesity was a common risk factor (Jernigan et al. 2010; Howard et al. 1998; Welty et al. 1995; Lee et al. 1995; Wang et al. 2006; Zhang et al. 2006) for CVD ($n=6$). Despite the important finding of the protective function of a more traditional Indigenous diet, deeper information on how to promote such a diet is needed.

Physical Behaviors.—Among the physical behaviors that can impact CVD prevalence and outcomes, physical activity and smoking were among the most frequently mentioned. The protective aspect of physical activity in reducing CVD was mentioned by eight articles (Jernigan et al. 2010; Welty et al. 1995; Zhang et al. 2006; Denny et al. 2005; Moy et al. 2010; Thompson et al. 2001; Thompson et al. 2002; Thompson et al. 2003) ($n=8$). For Welty et al., (1995) being female was a risk factor because of higher HDL and higher prevalence of diabetes, although being male was a risk factor because of its association with alcohol and other drug (AOD) abuse (Welty et al. 1995). Smoking and current tobacco use were also frequently noted as risk factors for CVD (Jernigan et al. 2010; Harwell et al. 2001; Lee et al. 2006; Welty et al. 1995; Wang et al. 2006; Denny et al. 2005; Levin et al. 2002; Rhoades et al. 2007) and were cited in eight articles ($n=8$). Extant research parallels that of the general population, yet less of a focus on sex differences was apparent.

Diabetes, Hypertension, and Cholesterol.—Consistent with extant research with the general U.S. populations, the association of diabetes with CVD was noted frequently by researchers, and was present in 12 articles (Jernigan et al. 2010; Xu et al. 2006; Harwell et al. 2001; Howard et al. 1998; Howard et al. 2000; Lee et al. 2006; Wang et al. 2006; Zhang et al. 2006; Denny et al. 2005; Levin et al. 2002; Rhoades et al. 2007) and included family history of diabetes as a risk factor (Lee et al. 1995) ($n=12$). Hypertension was also frequently mentioned as a risk factor for CVD (Jernigan et al. 2010; Harwell et al. 2001; Howard et al. 2000; Lee et al. 2006; Welty et al. 1995; Zhang et al. 2006; Levin et al. 2002; Rhoades and Buchwald 2003) and was cited in eight articles ($n=8$). High blood pressure (Wang et al. 2006) ($n=1$) was also a risk factor for CVD. Finally, the risks of having high low-density lipoprotein (LDL) and high high-density lipoprotein (HDL) cholesterol on CVD risk were mentioned in seven articles (Bersamin et al. 2008; Harwell et al. 2001; Howard et

al. 1998; Howard et al. 1999; Howard et al. 2000; Lee et al. 2006; Welty et al. 1995 ($n=7$)). Despite more research in these established areas of CVD, it pales in comparison to the general population; more in-depth understanding of sex and cultural differences are needed.

Age and Additional Factors.—Age was another risk factor that was brought up in 11 articles ($n=11$ (Xu et al. 2006; Zephier et al. 1997; Harwell et al. 2001; Howard et al. 2000; Lee et al. 2006; Lee et al. 1995; Wang et al. 2006; Zhang et al. 2006; Rhoades et al. 2007; Welty et al. 2002; Rhoades and Buchwald 2003)). The relationship between age and CVD was not always consistent. Younger age was a risk factor for CVD in some studies (Xu et al. 2006; Zephier et al. 1997; Lee et al. 1995), whereas older age was a risk factor in others (Wang et al. 2006; Zhang et al. 2006; Rhoades et al. 2007; Welty et al. 2002). Additional physical factors related to CVD were identified through this review. These factors included race (mentioned in two articles), with AI individuals being more at risk for CVD (Denny et al. 2005) (as compared with White), and the degree of AI ancestry, with having a greater proportion of AI ancestry being associated with more risk for CVD (Lee et al. 1995) ($n=2$). Having poor self-rated health was also associated with CVD (Denny et al. 2005; Levin et al. 2002; Saquib et al. 2013), with AI individuals having worse self-rated health than their White peers (Denny et al. 2005); this was mentioned in three articles ($n=3$). Alcohol abuse (Wang et al. 2006 ($n=1$)) and Albuminuria (presence of albumin in the urine, a symptom of kidney disease ((Howard et al. 2000; Lee et al. 2006) $n=2$)) were also factors that were identified as risk factors for CVD in these studies. Finally, differences based on geographic regions were also associated with CVD in four articles ((Howard et al. 1999; Lee et al. 1995; Levin et al. 2002; Rhoades et al. 2007) $n=4$). Regional differences were hard to determine because many studies were not nationally representative and did not include regional information.

Discussion

According to the FHORT, risk and protective factors across ecological levels predict whether one experiences cardiovascular health (Burnette & Figley, 2017). Overall, identified research was limited and in beginning stages, lacking more information on etiology of the interconnections across sex and the mental, sociocultural, and behavioral determinants of CVD. One would expect there to be more research where factors are known to be connected—such as AOD abuse and violence with CVD and related outcomes. Particularly given that AOD abuse and violence are also disproportionately high for Indigenous peoples, this lack of research is alarming. This contributes to a failure of the U.S. Trust Responsibility to provide for Indigenous peoples' health, contributing to the mortality and morbidity across these diverse populations. Related to geographic diversity, research generally focused on the Northern Plains, Southwest, or Midwest reservation communities, with less research on urban, Southeast, or Northeast communities. This gap in these signification populations is important to fill, particularly given geographic differences in prevalence and outcomes are the norm. Moreover, although males and females were included, the intentional examination of sex differences was generally missing. When sex was included, differences were identified. Thus, much more research with sex as a salient factor is needed.

This review revealed several sociocultural factors that are important to consider, namely historical trauma, a component of historical oppression, along with racism and discrimination. Enculturation was a culturally specific protective factor with resilience also relating to overall cardiovascular health. Finally, spirituality is a culturally relevant protective factor, relating to the transcendence aspect of the FHORT. Figure 2 displays the FHORT in relation to key risk and protective factors implicated in cardiovascular health. Despite the dearth of research, this review reveals clear associations between depression, PTSD, anxiety, AOD abuse and CVD and associated factors (i.e., diabetes, obesity, and smoking). Moreover, enculturation, social support, and social infrastructures for health were clear protective factors, with trauma at the individual and cultural levels posing as risk factors and differentially affecting women and men. Some results indicate cultural specificity and warrant further examination. Namely, having a Western diet compared to a traditional diet that is usually high in fruits and vegetables was generally associated with increased risk for CVD (Bersamin et al. 2008; Jernigan et al. 2010; Moy et al. 2010).

Though some authors found more CVD risk factors among men (e.g. Zephier et al. 1997; Harwell et al. 2001; Lee et al. 2006; Wang et al. 2006; Rhoades et al. 2007), many authors reported more risk for women (e.g., Howard et al. 1998; Howard et al. 2000; Lee et al. 1995; Welty et al. 2002). Overall women tended to experience greater vulnerability to risk factors for CVD, primarily through greater exposure to trauma, discrimination, and an overburden of responsibility with the lack of access to exercise and healthy activities. However, the coping of men and women tended to vary significantly, indicating the importance of analyzing sex-differences in research on CVD. More research on mental, cultural, and social factors is needed to extend the preliminary work that has been done.

Although fifteen articles focused on mental and psychological determinants of cardiovascular health, a striking finding was how few articles have critically focused on their interconnections, despite their significant links. First, depressive symptoms were salient mental health risk factors related to CVD and associated health concerns. Not only were depressive symptoms related to increased odds of CVD directly, they were a risk indirectly through their association with diabetes, smoking, and overall poor health outcomes. This risk varied by sex and age, with older age exacerbating the risk between depressive symptoms and CVD factors and being female posing a greater risk for CVD, though one study identified being male as posing greater risk. Personal mastery, a component of resilience was protective, indicating an interesting connection between mental and physical health (Goins & Pilkerton, 2010), consonant with indigenous beliefs about the mind-body connection. Second, two articles focused on the associations between anxiety and obesity, and exercise was found to offset this risk. AIs tended to consume more food than Whites, and this was in response to stress and anxiety; anxiety among females tended to be higher than among males.

Third, three articles focused on trauma, historical trauma and stress, indicating that PTSD was higher for participants with lower self-rated health status, diabetes, past-year hospitalization, diabetes and cholesterol, and this association was exacerbated when coupled with depression. Risk for PTSD was lower among older respondents, but no sex-differences were found. Historical trauma, racism, and emotional distress were positively associated

with obesity and binge-eating, which were more prominent among females, who also exhibited higher levels of PTSD and depression, indicating a particular vulnerability for females. The association of distress and diabetes is not yet clearly understood. Fourth, despite its known association with CVD, little research focused on the associations of CVD and AOD abuse. Being female, older age, and obesity posed as risk factors for AOD abuse and markers for CVD. Heavy drinking was associated with diabetes and poor mental health, particularly among AI/ANs in comparison with Whites. Native Hawaiians, however, had a higher prevalence for heavy drinking, yet lower prevalence for diabetes and poor mental health days, indicating a potential culturally specific protective factor(s) mediating this risk. Fifth, although not fitting into any one mental health category, some research drew connections between stress, perceived beliefs about others' health behaviors, smoking, and diet non-adherence as risks for CVD, whereas social support, religious involvement and having hobbies were protective against CVD. Hypomania was associated with obesity to a greater extent among AI men than Whites and AI women.

For cultural and social determinants of health, enculturation has some body of research supporting its link with greater physical activity and lower hypertension, AOD abuse, stress, and mental health problems. Identifying more with mainstream culture, however, posed a risk for AOD abuse, while enculturation tended to promote spiritual coping for health related concerns. IPV was associated with PTSD, which, in turn has been associated with a higher allostatic load, depression, and CVD, whereas, trauma tended to be a risk for diabetes management. Stress tends to be a risk for CVD, obesity and diabetes, with discrimination and racism being particularly prominent among these populations. Early trauma, hassles, childhood neglect, and economic distress can all pose as stressors. Lower resilience tended to contribute to poorer self-reported health, chronic pain, and depressive symptoms. Social support from family and friends tended to be protective, promoting physical activity, and this was especially true for women and children. Moreover, community infrastructure promoting physical activity tended to promote exercise, whereas neighborhood poverty tended to contribute to obesity, CVD, and Type 2 diabetes. Related to social factors, men reported higher levels of resilience, whereas women tended to report higher levels of stress. Men tended to engage in AOD abuse to cope, whereas women tended to rely on faith and spirituality. Men tended to be more physically active, which may be related to women's greater work and family obligations, which were barriers to physical exercise for women. Exposure to IPV and unsafe environments posed greater risks for women.

An important finding was that a Western diet seemed to be a risk factor for CVD. Indeed, the high rates of diet-related diseases are thought to be related to HO in the form of losses in knowledge about traditional foods (Ruelle and Kassam 2013). The traditional foods of many tribes tend to be much healthier and less costly than those available within the socioeconomic and geographic constraints where many Indigenous peoples reside. Subsistence living tends to include food that is carefully sourced and free of the chemical trappings found in grocery stores (Reo and Whyte 2012). Furthermore, traditional foods are seen as healthier alterNatives and more suitable to Indigenous physiological makeup than the Western diet (Ruelle and Kassam 2013), which now includes a great amount of processed foods high in fat, sugar, and carbohydrates (Bodirsky and Johnson 2008). In fact, prior to the 1950s, diabetes was said to be unheard of among Indigenous peoples and they

were thought to be immune (Satterfield et al. 2007). In a study which drew connections to the overall health of ANs (Bersamin et al. 2014), researchers found that not only do Indigenous communities have some of the lowest rates of physical activity of all other ethnic groups in the U.S., but that this is due in large part to a loss of culture. Living in what is thought to be a more traditional way often involves subsistence, which involves activities through which food is acquired, processed, prepared and consumed (Burnette, Clark, and Rodning 2018). Research indicates that subsistence can naturally promote a healthy diet, physical activity, and relationships, all protective factors against CVD (Burnette, Clark, and Rodning 2018).

Not surprisingly, diabetes, hypertension, and cholesterol were risks for CVD. Yet, given that the rate of diabetes for AIANs is over three times higher than that of non-AIANs and that women with diabetes have a higher risk for CVD than men, the implications of these associations are striking, such that AIAN women may be at heightened risk for CVD as compared to the general U.S. population. Other factors varied by sex, such as BMI, cholesterol, blood pressure, and AOD abuse. Age showed an inconsistent association with CVD, which warrants further inquiry. Other factors such as ethnic background, self-rated health, and region were shown to be significant in the preliminary research, indicating additional examination is needed.

Limitations

A key finding of this review is the glaring lack of research focusing on AI/ANs, despite the presence of epidemic health problems. The cultural or historical context of oppression was absent in research. A few studies were collected in the 1980s and would need to be replicated to verify whether they still hold true as culture and contexts are constantly shifting. Also, many articles did not specify region, despite this factor continually being a significant moderator of health outcomes and associated factors. As is overwhelmingly demonstrated in this review, rates vary by tribe, region, sex, and arguably data collection method and should not be generalized beyond their context. As such, there is no shortcut to identifying precise prevalence data and associated factors among Indigenous populations; culturally specific and culturally relevant research approaches are needed to establish an accurate portrayal of health and well-being. This precision is paramount if we are to eradicate the highly concerning CVD disparities. In addition, although the majority of AI/ANs reside in urban locations, it is significant to note that few studies sampled these areas or identified their sampling frame. To determine true geographic variability, more research is needed from regions with limited sampling. Moreover, only a handful of studies identified protective factors, indicating a need for a more nuanced and strengths-based approach to understand health equity.

Implications for Social Work Practice and Research

Our findings related to cultural and social determinants of health point to the need for greater investigation into the relationship between historical oppression (and its contemporary manifestations) and cardiovascular health. The scholarly literature suggests that experiences of discrimination and racism are significant factors related to stress, which can contribute to a variety of negative health outcomes, including CVD risk. Further, greater

assimilation, another component of historical oppression, posed a risk for AOD abuse, which can lead to increased risk for CVD. Conversely, greater enculturation was found to be a protective factor against CVD risk, consistent with a greater body of research supporting the link between enculturation, greater physical activity, and lower hypertension, AOD abuse, stress, and mental health problems. These findings point to the need for culturally-specific research related to cardiovascular health and its associated risk and protective factors.

Additionally, findings suggest that research is needed to investigate the relationship between resilience and cardiovascular health, as lower resilience seems to be a risk factor for CVD. Gendered analyses are also needed to examine differences between men and women in trauma exposure, resilience, and coping in relationship to CVD. These findings also demonstrate the importance of improving physical infrastructure and safety in AI/AN communities, as these factors may support cardiovascular health. Unsafe communities seem to pose particular threats for women's safety, as these studies revealed, making public safety in AI/AN communities a potentially gendered issue.

This review revealed important implications for programs, practice, and policy. First, funds to support social infrastructure, including programs for families and communities to support loved ones' health are warranted. A more holistic approach to health, which attends to mental, physical, social, and spiritual domains is recommended. Screening for these factors for patients seeking services for CVD and related disorders are also needed. Women may be most vulnerable due to increased rates of trauma and anxiety, which may lead to overeating and a higher allostatic load; thus, particular attention to the gendered patterns of health disparities require close scrutiny. Men may be more prone to AOD abuse, so parallel screening of physical and AOD use behaviors are warranted.

In closing, though Indigenous populations may share some underlying behavioral and physical factors related to CVD with the general U.S. population, broader cultural factors, such as historical oppression, may have set the stage to make health equity inaccessible for many. Programs and policies should incorporate cultural knowledge, which could promote health in culturally congruent ways. Disparities must be considered in the context of historical oppression, as such oppression may give rise to, exacerbate, and perpetuate social and health disadvantage. Despite experiencing oppression, Indigenous peoples have continually demonstrated resilience and even transcendence. Resilience refers to positive adaptation despite experiencing adversity, which may include developing well despite being at high risk for negative outcomes, exhibiting consistent competence while experiencing stress, and recovering well after experiences of trauma (Fleming & Ledogar, 2008). Given the glaring absence of attention to strengths or protective factors and the cultural context of historical oppression, a more culturally nuanced approach to research and clinical practice is needed. Moreover, a focus on regional and sex-differences is essential.

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Figure 1. Flow chart of the search process.

Note. The chart indicates the various levels of search results for the systematic review, leading to the final 51 articles that met the inclusion criteria.

Figure 2. The Framework of Historical Oppression, Resilience, and Transcendence

Note. The FHORT examines risk and protective factors across ecological levels as they relate to cardiovascular health and related outcomes. The primary mental and sociocultural factors related to cardiovascular health identified in the systematic review are listed next to each respective cluster of factors.

Empirical Articles by Outcomes, Predictors, Risk and Protective Factors, Sample Size, Age, Region, Gender, Rurality, and Study Design

Table 1

	Citation	Outcomes	Predictors	Risk & Protective Factors	Sample Size	Age	Region	Sex	Urban or Rural	Study Design
Mental Health Factors	Aronson, Palombi, & Walls (2016)	Diabetes	PTSD, self-rated health status (SRHS), depression, hyperglycemia, cholesterol, PY hospitalization	RF: PTSD-SRHS, PY hospitalization; PTSD & depression =hyperglycemia, PY hospitalization, SRHS, being younger. PF: Being older (less PTSD/depressive symptoms)	n=218	18+	MW	M/F	R	CS
	Clark & Winterowd (2012)	Binge eating	Historical loss, acculturation, racism, distress, obesity (BMI)	RF: Historical loss, distress, racism	n=269	19–70	Natl.	F	U & R	CS
	Cooper et al. (2014)	CVD	Depression, PTSD, race	RF: Hypertension, depression	n=24,719	60–96	Natl.	M/F	UK	CS
	Costello, Copeland, Shanahan, Worthman, & Angold (2013)	C-Reactive Protein	AOD abuse	RF: Being female, being older, poor, obese, in sub-optimal health, on psychotropic medicine, having any psychiatric disorder, increased CRP, AOD abuse. PF: Being male, being younger	n=1,420	youth 9–16, 19, 21	SE	M/F	U & R	L
	Daniels, Goldberg, Jacobsen, & Welty (2006)	Diabetes	Distress	No relationship identified	n=919	45–74	MW & SW	M/F	UK	L
	Goins & Pilkerton (2010)	Diabetes	Depressive symptoms	RF: Being older, poor physical functioning, depressive symptomology, lower personal mastery	n=505	55+	SE	M/F	UK	CS
	Grandinetti et al. (2000)	Diabetes	Depression	RF: Depression	n=581	30+	HI	M/F	R	CS
	Kaholokula, Grandinetti, Crabbe, Chang, & Kenui (1999)	Smoking	Depressive symptoms	RF: Being female, being younger, living in rural area, lower educational attainment. PF: Being male, being married	n=524	30+	HI	M/F	R	CS
	Kaholokula, Haynes, Grandinetti, & Chang (2006)	Health Related Quality of Life (HRQOL) and diabetes	Depressive symptoms	RF: Being older, lower educational attainment, being married or disrupted marital status, perceived racism, acculturation	n=190	18+	HI	M/F	R	CS
	Keen & Norton (1987)	Diabetes adherence	Perceived beliefs of others, attitudes, coping methods also added to the prediction of adherence for stress reduction	RF: Perceived beliefs, smoking. PF: Social support, religion (praying), hobbies	n=60	25–70	MW	M/F	R	CS
	Madan et al. (2012)	Obesity	BMI, health status, health behaviors, frequency of exercise, symptoms of psychiatric disorders	RF: Being male, being Hawaiian, low physical activity, difficulty sleeping, anxiety	n=402	18–53	HI	M/F	R	CS
	Pine (1983)	Obesity	Mental health	RF: Being male	n=160	18+	UK	M/F	UK	CS
	Pine (1985)	Obesity	Anxiety	RF: Being female	n=160	18+	Natl.	M/F	U	CS
	Sahota, Knowler, & Looker (2008)	Diabetes	Depression	RF: Being female, depression was higher in those with diabetes and associated with bad glycemic control	n=541	18+	SW	M/F	UK	CS
	Tann, Yabiku, Okamoto, & Yanow (2007)	Diabetes	AOD abuse, depression, ethnicity	RF: Being AIAN, AOD abuse, depression	n=26,4684	18+	Natl.	M/F	UK	CS

	Citation	Outcomes	Predictors	Risk & Protective Factors	Sample Size	Age	Region	Sex	Urban or Rural	Study Design
Social/Cultural Factors	Bersamin et al. (2014)	Physical activity	Enculturation, stress, metabolic RF	RF: Being female, acculturation, higher perceived stress, being older. PF: Being male; enculturation; low levels of psychosocial stress, being younger	n=488	14+	AK	M/F	R	CS
	Clark et al. (2016)	CVD	IPV	RF: IPV exposure, being male, older, financial stress, neighborhood poverty, child maltreatment	n=9976	Nov-34	Natl.	M/F	U & R	L
	Henderson & Ainsworth (2000)	Physical activity	Physical activity	RF: Being female, historical oppression, access to physical activities, higher family responsibility. PF: social support, ethnic pride, being male, less family responsibility	n=56	40+	SE & SW	F	U & R	CS
	Jacob et al. (2013)	Diabetes	Trauma	RF: Geographic region, smoker, depression, trauma	n=3776	15+	MW & SW	M/F	UK	CS
	Jiang et al. (2008)	Diabetes	Stress	RF: Trauma, geographic region, child maltreatment, community stresses, family dysfunction, addiction problems, economic distress	n=3,084	15–54	MW & SW	M/F	UK	CS
	Kading et al. (2015)	Diabetes and HRQOL	Enculturation, discrimination	RF: Diabetes, perceived discrimination. PF: Enculturation, living on reservation	n=218	18+	MW	M/F	UK	CS
	Kaholokula, Iwane, & Nacapoy (2010)	Obesity	Racism and acculturation	RF: Acculturation, greater perceived racism	n=94	18+	HI	M/F	UK	CS
	Marley & Metzger (2015)	Obesity and diabetes	Neighborhood poverty, housing mobility, and stress	RF: Neighborhood poverty, perceived stress	n=11,100 (393 AI)	12–32	Natl.	M/F	U & R	L
	Moy, Sallis, Ice, & Thompson (2010)	Physical activity	Health behaviors, neighborhood environment, and knowledge of physical activity recommendations	RF: Being male, barriers (lack of time), diet. PF: Being female, higher social support, higher education, higher level of readiness to change, neighborhood environment	n=100	40–59	NW, HI	M/F	UK	CS
	Sawchuk et al. (2005)	CVD	PTSD, Depression	RF: PTSD, depression	n=1,414	18–57	MW	M/F	R	CS
	Schure, Odden, & Goins (2013)	Physical and mental health	Resilience	RF: Low levels of resilience. PF: Moderate or high levels of resilience	n=185	55+	SE	M/F	R	CS
	Thayer et al. (2017)	Allostatic load	Early-life trauma, PTSD, biomarker measurements	RF: Direct exposure to early-life trauma, PTSD, substance abuse	n=197	15–54	MW	M/F	R	CS
	Thompson et al. (2001)	Physical activity	Physical activity & Social environment	RF: Excessive homework, TV/video games, safety concerns. PF: School environment supportive of physical activity, family support, peer support, access to health activities	n=616	8–11	MW & SW	M/F	UK	CS
	Thompson et al. (2002)	Physical activity	Physical activity & Family and Social Environment	RF: High level of family responsibility, cultural norms around health, community environments not supportive of physical activity. PF: Social support, community support, enculturation	n=30	20–50	SW	F	R	CS
	Thompson, Wolfe, Wilson, Pardilla, & Perez (2003)	Physical activity	Personal, social, and environmental factors	RF: Having a marital partner, low self-motivation, lack of resources and time. PF: High perceived health, high confidence, healthy support network, attending religious services	n=350	20–50	SW	F	U & R	CS
	Wolsko, Lardon, Mohatt, & Orr (2007)	Stress burden	Stress burden	RF: Greater acculturation, AOD abuse. PF: Being female, being older, traditional lifestyle, use of religion/spirituality	n=488	14–94	AK	M/F	R	CS

	Citation	Outcomes	Predictors	Risk & Protective Factors	Sample Size	Age	Region	Sex	Urban or Rural	Study Design
	Woods, Hall, Campbell, & Angott (2008)	Physical health	IPV, homicide risk	RF: IPV, PTSD, physical health	<i>n</i> =157, AI=<11	8–64	MW		UK	CS
Behavioral/Physical Factors	Bersamin, Luick, King, Stern, & Zidenberg-Cherr (2008)	CVD, obesity, and metabolic risk	Western or Tradition diet	RF: Being female (for BMI & % Body Fat) PF: Being female (HDL & LDL cholesterol, systolic BP)	<i>n</i> =530	14–94	AK	M/F	UK	CS
	Denny, Holtzman, Goins, & Croft (2005)	Chronic disease risk	Ethnicity, obesity, leisure physical activity, smoker, self-rated health	RF: Smoker, physical inactivity, obesity, diabetes, poor general health status, ethnicity	<i>n</i> =127475	55+	Natl.	M/F	U & R	CS
	Harwell et al. (2001)	CVD	Diabetes, gender, smoker, cholesterol	RF: Being older, being male hypertension, smoker, high cholesterol, diabetes	<i>n</i> =1905	18+	NP	M/F	R	CS
	Howard et al. (1998)	CVD	Gender, diabetes	RF: being female, obesity, diabetes	<i>n</i> =4549	45–74	MW & SW	M/F	R	CS
	Howard et al. (1999)	CVD	Gender, diabetes	RF: Being female (fatal CVD, higher triglycerides, hypertension), being male (nonfatal CVD), LDL cholesterol, being older, diabetes, geographic region	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Howard et al. (2000)	CVD	Diabetes, cholesterol	RF: Diabetes, LDL cholesterol, being older, hypertension, albumiuna, being female (obesity, triglyceride levels)	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Jernigan, Duran, Alm, & Winkleby (2010)	CVD	Diabetes, obesity, hypertension, cigarette smoker, sedentary behavior, low vegetable or fruit intake	RF: Hypertension, diabetes, obesity	<i>n</i> =2548	18+	Natl.	M/F	U & R	CS/L
	Lee et al. (1995)	Diabetes	Gender, age, level of obesity, amount of AI ancestry, parental diabetes status	RF: Being female, level of obesity, family history of diabetes, geographic location (SW), being younger, amount of AI ancestry (more=higher risk); PF: Being male, having less AI blood, no family history of diabetes, being older	<i>n</i> =4304	45–74	MW & SW	M/F	Uk	CS
	Lee et al. (2006)	CVD	Diabetes, age, gender, total cholesterol, LDL cholesterol, HDL cholesterol, smoker, diabetes, hypertension, albuminuria	RF: Being older, being male, total cholesterol, LDL cholesterol, HDL cholesterol, smoker, diabetes, hypertension, albuminuria	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Levin, Welch, Bell, & Casper (2002)	CVD	Diabetes, fair/poor perceived health status, current tobacco use, hypertension	RF: Geographic region, smoker, diabetes	<i>n</i> =3095	25+	MW & SE	M/F	Uk	CS
	Rhoades & Buchwald (2003)	Hypertension	Obesity, diabetes, CVD, depression, renal disease, number health problems	RF: Being older (increases hypertension), obesity, diabetes, depression, heart disease, or renal disease	<i>n</i> =524	50+	NW	M/F	U	R
	Rhoades et al. (2007)	CVD	Diabetes, smoker, gender	RF: Being male, being older, geographic region; PF: Being female, being younger	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Saquib et al. (2013)	CVD	Perceived physical health	RF: Low physical health	<i>n</i> =20308	50–79	Natl.	F	UK	CS
	Wang et al. (2006)	Hypertension and CVD	AOD abuse, diabetes, blood pressure, gender, age, obesity, smoker	RF: Being older, being male, AOD abuse, obesity, diabetes	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L

	Citation	Outcomes	Predictors	Risk & Protective Factors	Sample Size	Age	Region	Sex	Urban or Rural	Study Design
	Welty et al. (1995)	CVD	Smoker	RF: Being female (higher HDL and prevalence of diabetes), being male AOD abuse, obesity, sedentary lifestyle	<i>n</i> =4549	45–74	MW & SW	M/F	UK	CS
	Welty et al. (2002)	CVD		RF: Being female, being older PF: Being male, being younger	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Xu et al. (2006)	CVD	Dietary fat intake	RF: Being younger, higher intake of fat, diabetic PF: Being older, well-balanced diet	<i>n</i> =4549	45–74	MW & SW	M/F	UK	L
	Zephier et al. (1997)	CVD	Nutrient intake	RF: Diet/nutrient intake PF: Being female, being older, well-balanced diet	<i>n</i> =4549	45–74	MW & SW	M/F	UK	CS
	Zhang et al. (2006)	CVD	Diabetes, physical activity	RF: Being older, higher BMI, higher waist circumference, hypertension	<i>n</i> =4549	45–74	MW & SW	M/F	R	L

Note. RF=Risk Factors; PR=Protective Factors; BMI=body mass index; M/F=Male/Female; CS=Cross-sectional; L=Longitudinal; R=Retrospective; DNS=does not specify; MW-MW/Northern Plains; SW=SW; NW-Northwest; SE=Southeast; Natl.=Natl.; HI=Hawaii; AK=AK; UK=Unknown; R=Rural; U=Urban.

Table 2.

Table of Sex differences for Risk and Protective Factors. F=Female; M=Male

Factor	Risk Factors	Protective Factors
Diet	Western Diet F>M	
Exercise	More Barriers for F	
BMI	F>M	
Anxiety	Obesity, Overeating F>M	
Depression	F>M (Diabetes, CVD, hypertension, smoking, health)	
AOD	F>M	
Enculturation		F>M(CVD, stress, mental health, AOD, physical activity)
Violence and Trauma	IPV F>M (Diabetes, mental health, obesity)	
Discrimination/Stress	F>M (hypertension, obesity, diabetes)	
Resilience	M>F	
Social Support		F>M