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Awareness, Knowledge, and Perceptions of Cardiovascular Disease
among Adult Women Ages 25-55

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Nursing

by

Lauren Rountree

2023

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ABSTRACT OF THE DISSERTATION

Awareness, Knowledge, and Perceptions of Cardiovascular Disease
among Adult Women Ages 25-55

by

Lauren Rountree

Doctor of Philosophy in Nursing

University of California, Los Angeles, 2023

Professor Holli A. DeVon, Chair

Abstract

Background. Cardiovascular disease (CVD) risk factors have increased in young and middle-aged women. Assessing awareness, knowledge, and perceptions of CVD among younger women, and how these factors relate to stage of behavior change, are critical to primary prevention.

Aims. (1) Conduct a systematic review of the awareness, knowledge, and perceptions of risk factors for CVD among young to middle-aged women. (2) Examine whether race/ethnicity and age were significantly associated with awareness, knowledge, and perceptions of CVD after adjusting for potential confounding factors. (3) Describe the relationship between stage of behavior change and awareness, knowledge, and perceptions of CVD.

Methods. PubMed, Cumulated Index to Allied Health and Nursing Literature (CINAHL), Embase, and Web of Science were searched for relevant studies. Women ages 25-55 living in the

United States without a self-reported CVD history were recruited for a cross sectional, descriptive study. Awareness was measured with the question, “What is the leading cause of death for women in the United States?” Knowledge, perceptions, and stage of behavior change were measured with the Heart Disease Fact Questionnaire, Health Beliefs Related to CVD, and the Precaution Adoption Process Model questionnaires, respectively.

Results. A review of articles yielded six eligible articles. Younger age was linked to lower awareness and women perceived their knowledge of and susceptibility to CVD as low. 149 women were recruited for the study (mean=37.15±7.86 years). Women had a high level of awareness and knowledge of CVD. Non-Hispanic white women had higher knowledge (HDFQ= 23.27±1.72 vs. 22.35±2.50, p=0.011) and lower susceptibility (9.86±2.75 vs 11.48±3.53, p=0.003) compared to racial/ethnic minority women. A binary logistic regression of stage of behavior change on awareness, knowledge, and perceptions of CVD showed that the perception subscales of susceptibility and severity were significantly associated with stage of behavior change (OR 1.247, p<0.001 and OR .809, p=.004 respectively), and remained significant when controlling for covariates (OR 1.242, p=.002 and OR=.801, p=.004, respectively)

Conclusions. In this sample of well educated, younger and predominately minority women, awareness and knowledge were high. The racial/ethnic minority women believed they more susceptible to CVD. Susceptibility and severity were associated with intent to change behavior.

The dissertation of Lauren Rountree is approved.

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2023

Dedication

To my husband, Josh, for being my biggest supporter and encourager, and my son, James, for always keeping things in perspective.

To my parents, Laura Talbot Metter and Bill Talbot, for their sacrifices, enduring love, free babysitting, and believing in me for over 30 years.

And finally, to all women everywhere; especially the next generation.

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List of Acronyms

CVD: Cardiovascular Disease

CINAHL: Cumulated Index to Allied Health and Nursing Literature

HDFQ: Heart Disease Fact Questionnaire

HBCVD: Health Beliefs Related to Cardiovascular Disease

PAPM: Precaution Adoption Process Model

DM: Diabetes Mellitus

HTN: Hypertension

HLD: Hyperlipidemia

APO: Adverse pregnancy outcomes

CI: Confidence Interval

OR: Odds Ratio

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- Integrative Medicine and Health. Feasibility and Preliminary Efficacy of Acupuncture for Angina in Underrepresented Diverse Urban Individuals: Advancing Health Equity. May 26, 2022. Podium presentation.
- Rountree, L. Sigma Theta Tau International Nursing Research Congress. Cardiovascular Disease and Knowledge among Young Adult Latina Women: A Literature Review. July 2021. Poster Presentation.
- Rountree, L. UCLA School of Nursing Research Day. Cardiovascular Disease Awareness Among Adolescent Females: An Integrative Literature Review. May 2020. Poster Presentation.
- Rountree, L. Western Institute of Nursing: Communicating Nursing Research. Empathy Levels of New Graduate Nurses in a Nurse Residency Program. April 2019. Podium Presentation.
- Rountree, L. Sigma Theta Tau: Creating Healthy Work Environments. Empathy Levels of New Graduate Nurses in a Nurse Residency Program. February 2019. Poster Presentation.

Chapter One: Introduction

Cardiovascular Disease in Young Women

Cardiovascular disease (CVD) is largely preventable.¹ Although some risk factors like age and family history can be modified, other major risk factors like smoking status, diet, and physical activity can be modified.^{2,3} Despite this, CVD is the number one cause of death for women in the United States, accounting for about 500,000 deaths annually.⁴ Although older women are more at risk for heart disease, younger women are experiencing concerning trends. Rates of modifiable risk factors such as diet and physical activity are worsening and rates of hypertension, hyperlipidemia, and diabetes are increasing among young women CVD risk factors are rising among young women and mortality rates are stagnating or even increasing.⁵ Mortality rates among young women are already reflecting these trends. Mortality rates related to coronary artery disease have been dropping for men and women over the past 30 years, but for young women, but some studies have found an increase (1.3%) in mortality among young women 35-44 years old.⁶

Cardiovascular Disease Awareness, Knowledge, and Perceptions

Women tend to develop heart disease 8-10 years later compared to men, leading to the misconception that women are not vulnerable to heart disease.¹ While only about half of women are aware that CVD is the leading cause of death among women⁷, one study showed that less than 20% of physicians understood that CVD is the leading cause of death among women⁸, leading to fewer physician-initiated discussions⁹ and possibly delays in medical care.¹⁰ Younger women and women from racial/ethnic minority groups tend to have lower levels of CVD awareness compared to older women and their awareness levels have been declining, despite increases in modifiable risk factors for CVD.^{7,11} Younger women also have less

knowledge about heart disease and tend to view themselves as less vulnerable to heart disease.^{12,13} These awareness, knowledge, and perception deficits have far reaching implications. For example, young women who presented to the emergency room with myocardial infarction were more likely to misperceive myocardial infarction symptoms as stress or anxiety, delay seeking care, or have their symptoms misinterpreted by a provider.¹⁴

Cardiovascular Disease and Behavior Change

Primary and primordial prevention are most effective in heart disease prevention, making younger women a key population to target for prevention efforts.^{15,16} Promoting CVD awareness and knowledge may be an effective tool to promote and influence CVD prevention behaviors^{2,17,18}, but research has been split in its efficacy and association with prevention behaviors.¹⁹ Additionally, the research on CVD awareness, knowledge, and perceptions and their relationship to behavior change among young women is sparse.

Statement of Study Purpose

Young women are an increasingly important population to study in the realm of CVD. Although mortality rates and rates of CVD risk factors are increasing²⁰, rates of CVD awareness and knowledge are decreasing, making this a critical area of research.¹¹ This dissertation adds to the state of the science by contributing a review of the literature and examining awareness, knowledge, perceptions, and stage of behavior change among young women.

Specific Aims

1. To conduct a systematic review of the awareness, knowledge, and perceptions of personal risk factors for CVD among young to middle-aged women.

2. Determine if there were differences in the awareness, knowledge, and perceptions of personal risk factors for CVD between non-Hispanic white racial/ethnic minority groups in women 25-55 years old.
3. Examine whether race/ethnicity and age are significantly associated with awareness, knowledge, and perceptions of personal risk factors for CVD after adjusting for potential confounding factors.
4. Describe the relationship between stage of behavior change and awareness, knowledge, and perceptions of CVD among women 25-55 years.
5. Identify the predictors of stage of behavior change.

Content of the Dissertation: Three Manuscripts

The content of the dissertation features three manuscripts, which are as follows:

1. Chapter Two: Cardiovascular Disease Awareness, Knowledge, and Perceptions among Young to Middle Aged Women: A Systematic Review (Aim 1). This chapter features a systematic review of the literature from the past five years. Main results were that younger women were more likely to have lower levels of awareness, especially women under 18. Also, younger women were also less likely to perceive themselves as susceptible to CVD.
2. Chapter Three: Race/ethnicity is not a Significant Predictor of Awareness, Knowledge, or Perceptions of CVD among Women 25-55 Years Old (Aims 2 and 3). This chapter describes a quantitative, cross sectional, online study. For this study, 149 mostly young (mean=37.15±7.86 years) and racial/ethnic minority women (70.5%) were included. For

main study findings, awareness (71.8%) and knowledge (mean HDFQ=22.62±2.33 of 25) were high. Non-Hispanic white women had higher knowledge scores (HDFQ=23.27±1.72 vs. 22.35±2.50, p=0.011) and lower susceptibility scores (9.86±2.75 vs 11.48±3.53, p=0.003) compared to racial/ethnic minority women. Race/ethnicity was not a significant predictor of awareness, knowledge, or perceptions of CVD after adjusting for covariates.

3. Chapter Four: Perceived Susceptibility to and Severity of Cardiovascular Disease are Associated with Intent to Change Behavior Among Women 24-55 Years Old (Aims 4 and 5). This chapter also describes a quantitative, cross sectional, descriptive study. For this study, 149 women were included (mean=37.15±7.86 years). Over half (53.7%) of the sample were not in a stage of behavior change to reduce their chances of getting CVD. A binary logistic regression of awareness, knowledge, and perceptions of CVD on stage of behavior change demonstrated that the perception subscales of susceptibility and severity were significantly associated with intent to change behavior (OR 1.247, p<0.001 and OR .809, p=.004 respectively). Furthermore, susceptibility and severity remained significant when controlling for sociodemographic and health condition covariates (OR 1.242, p=.002 and OR=.801, p=.004, respectively). Finally, awareness and knowledge of CVD were not associated with stage of behavior change.

4. Chapter Five: Dissertation Summary. The dissertation summary will provide a summary of study significance as well as recommendations for future research.

References

1. Abbasi SH, Kassaian SE. Women and coronary artery disease. Part I: basic considerations. *J Tehran Heart Cent.* Summer 2011;6(3):109-16.
2. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women—2011 Update. *Circulation.* 2011/03/22 2011;123(11):1243-1262. doi:10.1161/CIR.0b013e31820faaf8
3. McSweeney JC, Rosenfeld AG, Abel WM, et al. Preventing and Experiencing Ischemic Heart Disease as a Woman: State of the Science. *Circulation.* 2016/03/29 2016;133(13):1302-1331. doi:10.1161/CIR.0000000000000381
4. Bybee KA, Stevens TL. Matters of the heart: cardiovascular disease in U.S. women. *Mo Med.* Jan-Feb 2013;110(1):65-70.
5. Garcia M, Mulvagh SL, Bairey Merz CN, Buring JE, Manson JE. Cardiovascular Disease in Women. *Circulation Research.* 2016/04/15 2016;118(8):1273-1293. doi:10.1161/CIRCRESAHA.116.307547
6. Ford ES, Capewell S. Coronary heart disease mortality among young adults in the U.S. from 1980 through 2002: concealed leveling of mortality rates. *J Am Coll Cardiol.* Nov 27 2007;50(22):2128-32. doi:10.1016/j.jacc.2007.05.056
7. Cushman M, Shay CM, Howard VJ, et al. Ten-Year Differences in Women's Awareness Related to Coronary Heart Disease: Results of the 2019 American Heart Association National Survey: A Special Report From the American Heart Association. *Circulation.* 2021/02/16 2021;143(7):e239-e248. doi:10.1161/CIR.0000000000000907
8. Barnhart J, Lewis V, Houghton JL, Charney P. Physician knowledge levels and barriers to coronary risk prevention in women: survey results from the Women and Heart Disease

Physician Education Initiative. *Womens Health Issues*. Mar-Apr 2007;17(2):93-100.

doi:10.1016/j.whi.2006.11.003

9. Mosca L, Mochari H, Christian A, et al. National Study of Women's Awareness, Preventive Action, and Barriers to Cardiovascular Health. *Circulation*. 2006/01/31 2006;113(4):525-534. doi:10.1161/CIRCULATIONAHA.105.588103
10. Miracle VA. Coronary Artery Disease in Women: The Myth Still Exists. *Dimensions of Critical Care Nursing*. 2006;25(5)
11. Gooding HC, Brown CA, Liu J, Revette AC, Stamoulis C, de Ferranti SD. Will Teens Go Red? Low Cardiovascular Disease Awareness Among Young Women. *Journal of the American Heart Association*. 2019/03/19 2019;8(6):e011195. doi:10.1161/JAHA.118.011195
12. Gooding HC, Brown CA, Revette AC, et al. Young Women's Perceptions of Heart Disease Risk. *Journal of Adolescent Health*. 2020;67(5):708-713.
doi:10.1016/j.jadohealth.2020.05.010
13. Liu J, Patterson S, Goel S, Brown CA, De Ferranti SD, Gooding HC. Helping young women go red: Harnessing the power of personal and digital information to prevent heart disease. *Patient Education and Counseling*. 2021/10/01/ 2021;104(10):2571-2576.
doi:<https://doi.org/10.1016/j.pec.2021.03.008>
14. Lichtman JH, Leifheit EC, Safdar B, et al. Sex Differences in the Presentation and Perception of Symptoms Among Young Patients With Myocardial Infarction: Evidence from the VIRGO Study (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients). *Circulation*. Feb 20 2018;137(8):781-790. doi:10.1161/circulationaha.117.031650
15. Gillman MW. Primordial prevention of cardiovascular disease. *Circulation*. 2015/02/17 2015;131(7):599-601. doi:10.1161/CIRCULATIONAHA.115.014849

16. McGill HC, McMahan CA, Gidding SS. Preventing heart disease in the 21st century. *Circulation*. 2008/03/04 2008;117(9):1216-1227. doi:10.1161/CIRCULATIONAHA.107.717033
17. Cubbin C, Winkleby MA. Protective and Harmful Effects of Neighborhood-Level Deprivation on Individual-Level Health Knowledge, Behavior Changes, and Risk of Coronary Heart Disease. *American journal of epidemiology*. 2005;162(6):559-568. doi:10.1093/aje/kwi250
18. Alm-Roijer C, Stagmo M, Udén G, Erhardt L. Better knowledge improves adherence to lifestyle changes and medication in patients with coronary heart disease. *Eur J Cardiovasc Nurs*. Dec 2004;3(4):321-30. doi:10.1016/j.ejcnurse.2004.05.002
19. Ramachandran HJ, Wu VX, Kowitlawakul Y, Wang W. Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: An integrative review. *Heart & Lung*. 2016/05/01/ 2016;45(3):173-185.
doi:<https://doi.org/10.1016/j.hrtlng.2016.02.004>
20. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association. *Circulation*. 2019/03/05 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659

Chapter Two: Literature Review (First Manuscript)

Cardiovascular Disease Awareness, Knowledge, and Perceptions among

Young to Middle Aged Women: A Systematic Review

Abstract

Background. Heart disease is the number one cause of death among women. Despite advances, declining mortality rates have stagnated and risk factors for cardiovascular disease (CVD) have increased in young and middle-aged women. Awareness of CVD risk is low among young women. This underscores the importance of CVD risk education and promoting positive cardiovascular health behaviors from a young age when prevention is feasible.

Aims. To conduct a systematic review of the awareness, knowledge, and perceptions of personal risk factors for CVD among young to middle-aged women.

Methods. PubMed, Cumulated Index to Allied Health and Nursing Literature (CINAHL), Embase, and Web of Science were searched for studies published between 2019-2023. Six articles met inclusion criteria of: 1) adult women, 2) examined CVD awareness, knowledge, or perceptions, and 3) conducted in the United States.

Results. A total of 1247 articles were identified. After screening by title and abstract, 85 articles were accessed for eligibility. Further review of the full text identified six eligible articles.

Younger age was linked to lower levels of awareness in a majority of articles; however, there was a wide range of levels of awareness, with 10-62% of participants identifying CVD as the leading cause of death for women. Across studies, women perceived their knowledge of CVD as low. Finally, there was a low perception of susceptibility to CVD among younger women. Lack of standardized measures made it difficult to generalize findings.

Conclusions. Young women had low knowledge of CVD risk and did not believe they were susceptible to CVD. Future studies in this area are necessary to address study limitations including homogeneous cohorts, lack of standardized measures, and few studies on women under 55 years.

Background

Heart disease is the leading cause of mortality for women in the United States (US) and has been for the past 30 years.^{1,2} Although heart disease rates are higher among older women, heart disease impacts younger women, as well. Women less than 55 years old with acute myocardial infarction (AMI) tend to have more comorbidities, longer length of stays, and higher in hospital mortality rates compared to men.^{3,4} From 1995 to 2014, while the annual incidence of hospitalizations for AMI decreased for young men, they increased for young women. Additionally, the proportion of young patients admitted for AMI during this time period increased from 27% to 32% ($P=0.002$), with the largest increase in young women.⁵ Finally, over the past 30 years, there has been an overall 68% decline in CVD mortality.⁶ However, young and middle aged women have not seen these benefits. Women less than 55 years old have had the lowest decline in estimated annual percentage change for CVD mortality from 1979-2011, bordering on stagnation.⁶

Heart disease risk factors such as diabetes, hypertension, obesity, and hyperlipidemia are rising among younger women.⁷ One study found that among pregnant women from 2011 to 2019, the optimal pre-pregnancy cardiovascular score declined from 42.1 to 37.7, with an average annual percentage change of -1.4% per year (CI -1.3,-1.5).⁸

Despite these negative trends, CVD can be mitigated or prevented if evidence-based interventions for young women can be developed. Although cardiovascular risk factors in young

adulthood can lead to CVD later in life, young adults who reach middle age with fewer CVD risk factors have a significantly reduced probability of developing CVD.^{9,10} However, awareness of CVD risk is low among young women.¹¹⁻¹³ This underscores the importance of emphasizing CVD risk education and promoting positive cardiovascular health behaviors from a young age to increase primordial and primary prevention of heart disease. In order to increase education and elicit behavior change, it is critical to first assess awareness, knowledge, and perceptions of heart disease among young and middle-aged women. No review on cardiovascular disease awareness, knowledge, and perceptions of CVD has specifically addressed young and middle-aged women.^{14,15} Therefore, the aim of this literature review was to determine levels of awareness, knowledge, and perceptions of heart disease in young to middle-aged women.

Methods

Search Strategy and Study Selection

Articles were obtained by searching Pubmed, Cumulated Index to Allied Health and Nursing Literature (CINAHL), Embase, and Web of Science. Search terms included female* OR woman OR women OR girl* OR gender; “early adult” OR “young adult” OR young; “cardiovascular disease” OR “heart disease” OR “coronary artery disease” OR “myocardial infarction” OR “heart attack”; and knowledge OR awareness OR understanding OR perception OR perceive*.

Article inclusion criteria were: adult women; examined CVD awareness, knowledge, or perceptions; and were conducted in the US. We excluded studies that were not in English, were only focused on healthcare provider awareness, were focused on congenital heart disease, or were more than five years old. Studies outside of the US were excluded because of differences in healthcare systems, healthcare accessibility, and health disparities in other countries, which may

impact awareness, knowledge, and perceptions of CVD. Additionally, studies on healthcare providers were excluded because many providers have knowledge of heart disease. Studies published more than five years ago were excluded because two reviews were recently published on similar topics. A systematic review and meta-analysis on knowledge and attitudes of CVD and risk factors for young adults, including both men and women,¹⁵ was published in 2018 by Trejo et al. Additionally, Ramachandran et al (2016) published an integrative review on awareness, knowledge, and healthy lifestyle behaviors related to coronary heart disease among women; however this review was not focused on young women.¹⁴ Three studies were included in this review which enrolled women younger than 18 and older than 55. One article included men, but stratified results by sex.

Data Extraction and Synthesis

The first author independently examined the titles and abstracts to determine if articles met inclusion criteria. Duplicate articles were removed. Titles and abstract that appeared to meet inclusion criteria were marked for full-text review. If eligibility was not clear it was also marked for full-text review. A systematic analysis of all articles was completed by two reviewers (L.R. and H.D.) using a data extraction form developed by the authors. The reviewers conducted the data extraction process independently. Data were summarized using descriptive statistics from each article.

Quality Appraisal

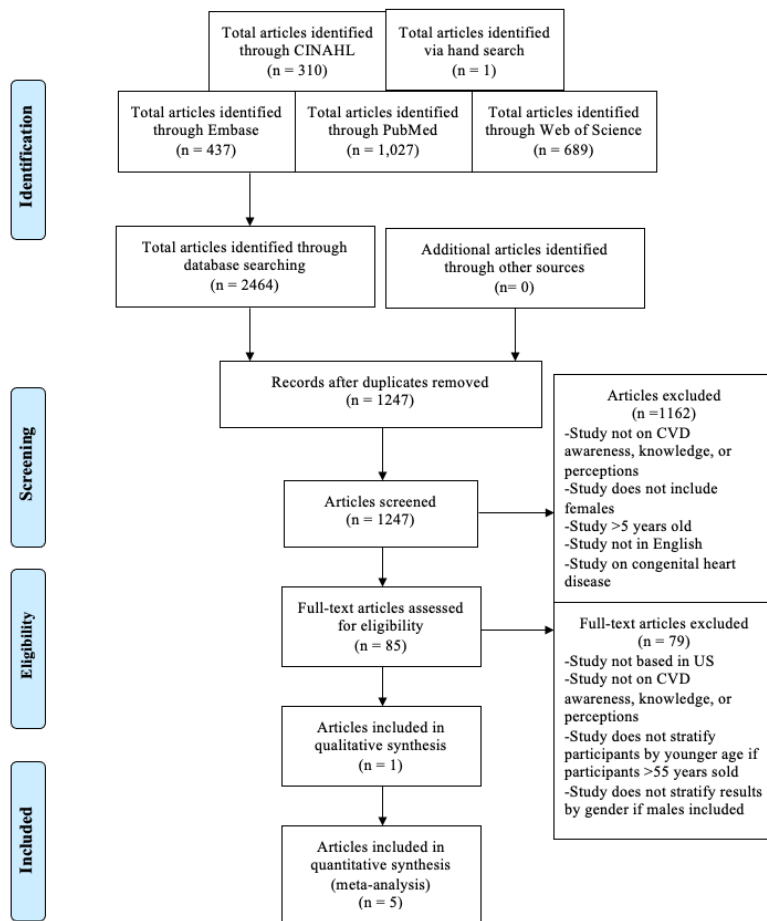
To assess the quality of research articles included in this review, the Crowe Critical Appraisal Tool (CCAT) version 1.4 was used.¹⁶ The CCAT has eight categories: preliminaries, introduction, design, sampling, data collection, ethical matters, results, and discussion. Each category is scored by the appraiser on a 6-point scale ranging from 0 to 5. The total score ranges

from 0 to 40, with a higher score indicating higher quality. No quality standards have been established for the CCAT; however, the total score is helpful in comparing each article to the others.

Search Outcomes

After duplicates were removed, a total of 1247 articles were identified in the initial search (see Figure 1). These articles were screened based on inclusion and exclusion criteria, leaving 85 full text articles that were reviewed for eligibility. Six articles met inclusion criteria and are included in this review.

Figure 1. PRISMA diagram



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Results

Study Characteristics

Study characteristics are summarized in Table 1. Four out of the six studies recruited participants from urban medical centers and/or community clinics.¹⁷⁻²⁰ One study recruited participants online and via random digit dialing,²¹ and one study recruited participants from two universities in Texas.²² Five studies were cross sectional^{17,18,20-22} while one was qualitative¹⁹ and used online focus groups. Two studies conducted secondary analyses of previously published data by the American Heart Association (AHA) Women's Health Study Survey.^{17,18} One study used data from 2019 national AHA Survey of Women's Cardiovascular Disease Awareness.²¹ Two studies used online questionnaires, one developed by a team of experts²² and one adapted from the AHA Survey of Women's Cardiovascular Disease Awareness.²⁰

Cardiovascular Disease Awareness

Study measures are summarized in Table 2. Awareness was assessed with the question, "What is the leading cause of death among all women in the United States?"^{18,20,21} Knowledge was assessed in two different ways, the personal perception of not feeling informed about CVD (asked by a single question)^{17,19} and with a validated tool, the Heart Disease Fact Questionnaire (HDFQ).²⁰ Perceptions were assessed with how susceptible a participant felt they are to CVD (asked via a single question, multiple questions, or through a semi structured focus group depending on the study) and how severe a participant felt CVD would be.^{18-20,22}

Participant Characteristics

Sample sizes ranged from 85-1361, for the five quantitative studies. The sample size was 35 for the qualitative study. Of the six studies, only one included men (64.2% female). Three studies included women as young as 15 years old, but most participants were over 18 with a

range of 15-24 years old. Only one study included participants over 55 years old (mean age 50 years, 41.7% of participants greater than or equal to 55 years old).²¹

Awareness

There were mixed results for CVD awareness, with one study showing CVD awareness as high among young women and two showing CVD awareness as low among young women (see Table 3). Beussink-Nelson et al. looked at women with a recent live birth at a medical center in the US.²⁰ CVD awareness was reported as relatively high, with 62% of participants identifying CVD as the leading cause of death among women. Conversely, Cushman et al found that from 2009 to 2019, CVD awareness decreased among women of all ages from 65% to 44%, and the decrease was found across all races, ethnicities and ages, except for women greater than or equal to 65 years of age.²¹ One of the largest declines was among 25 to 34-year-old women (odds ratio, 0.19; 95% CI, 0.10–0.34). Gooding et al. found that for participants ages 15-24 years old, only 10% identified CVD as the number one cause of death for women, compared to all adult women (64% in 2012) and women ages 25-34 years (53.6%) ($p < 0.01$ for both).¹¹

Knowledge

Liu et al¹⁷ and Gooding et al¹⁸ asked participants whether they were informed about CVD in order to measure their knowledge. In the Liu et al. study, 52% of participants reported not feeling informed about CVD. Similarly, in the Gooding et al. study, 43.5% of participants said they were not at all informed about CVD.

In the Beussink-Nelson et al. study, the authors examined CVD knowledge with the validated Heart Disease Fact Questionnaire (HDFQ).²⁰ The HDFQ has ten questions, where correctly answered question receive 1 point. The range of scores are 0-10, with 10 indicating the highest level of heart disease knowledge on the HDFQ. The authors found no significant

difference in CVD knowledge scores between participants who reported an adverse pregnancy outcome and those who did not (6.9 vs 6.8 out of 10; $p = 0.51$).

Perception

Two domains of perception were evaluated: susceptibility and severity.²³ Beussink-Nelson et al,²⁰ Gooding et al,¹⁸ and Gooding et al¹⁹ evaluated perceived susceptibility to CVD. In the Beussink-Nelson et al. study, participants who had an adverse pregnancy outcome had a higher perception of personal risk for CVD (adjusted odds ratio, 2.64 [95% CI 1.83-3.80]) compared to participants who did not have an adverse pregnancy outcome. However, half of participants who experienced an adverse pregnancy outcome reported perceiving an average, or below average, risk for CVD, despite the adverse pregnancy outcome placing them at increased risk for CVD. In Gooding et al's¹⁸ study, of the young females ages 15-24 years old, most worried little (39.2%) or not at all (38%) about CVD. Young females did report behaviors known to reduce risk of CVD, but not considering oneself at risk for CVD was cited as the number one barrier to adopting prevention behaviors. In the Gooding et al. qualitative study,¹⁹ young women discussed low perceived susceptibility to CVD in terms of age ("I feel like those are things I associate with older people like 40"), gender ("I usually hear more about men suffering from heart problems than women"), and social norms ("we're so pressured just to grow up and [be] more focused on pregnancies or depression or our weight").

Gooding et al¹⁹ and Merianos et al²² evaluated perceived severity of CVD. In the Gooding et al qualitative study, despite perceiving low susceptibility, the participants perceived that CVD was a severe condition. Merianos et al found that across models, females perceived all three cardiometabolic risk factors to be more severe when compared to males ($p < .005$).

Discussion

There were multiple findings from this review, including: (1) Low levels of CVD awareness among women, (2) Knowledge of CVD was low, (3) A high perception of severity of CVD, and (4) Low perceived susceptibility to CVD for young to middle-aged women.

Awareness

In the included articles, there were inconsistent awareness levels among young women, ranging from 10-62%. However, younger age was consistently associated with lower levels of awareness. The range of CVD awareness across articles increased to 44-62% for women over the age of 18. Reaching adulthood and life experiences may be factors that greatly impact awareness of CVD. However, even for adult women ages 18-55 years old, roughly half of women were unaware that CVD was the leading cause of death among women across studies. This could be because young women often fail to recognize their risk for heart disease, may not routinely access primary care, and primary care providers may not recognize young women's risk for heart disease.^{24,25} In the Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients Study, less than half of female participants 18-55 years old who had an acute myocardial infarction had been informed they were at risk for heart disease or had ever had a conversation with their healthcare provider on reducing their risk for CVD.²⁵ This emphasizes the need to specifically target women in conversations about heart disease from a young age, particularly when risk factors are present.

Knowledge

Liu et al¹⁷ and Gooding et al¹⁸ found that 43.5%-52% of participants reported not feeling informed about heart disease, while in the Beussink-Nelson et al study,²⁰ participants, on average, scored below a 70% on the HDFQ. There were inconsistencies with measuring CVD

knowledge and only the Beussink-Nelson study used a validated tool to assess CVD knowledge.²⁰ Investigating ways to increase knowledge of CVD among young to middle-aged women may be an area of future research. Liu et al found a positive association between younger women seeing, hearing, or reading about heart disease and feeling informed about heart disease,¹⁷ with the strongest associations from a friend/relative, the internet, and health care professionals. Beussink-Nelson et al, however, reported that most participants received information from sources other than healthcare professionals, notably the internet, social media, or television.²⁰ Burgess and Feliu also found that social media was the strongest source of health information on CVD among women who had preeclampsia.²⁶ Social media could be a powerful tool to leverage in order to educate women on CVD, which could be explored in future studies.

Perception

There was a perception, among young women, that CVD is a severe condition, but a low perception of susceptibility to CVD, even when risk factors were present.¹⁸⁻²⁰ Risk of CVD increases with age²⁷ so young women do have low susceptibility to CVD. However, intervening with young women to increase their awareness of their risk for CVD in later years is an opportunity for primary prevention. The fact that CVD was perceived to be severe provides further evidence that women may be open to adopting heart healthy behaviors, especially since younger women associate CVD with men and older people.^{19,24} Further investigation into how awareness, knowledge, and perceptions impact engagement in heart healthy behaviors is warranted, particularly in a young population where primordial and primary prevention may have a high lifetime impact.

Limitations

There were limitations to our review. Only research studies conducted in the US were included, so we do not know if awareness, knowledge, and perceptions of risk for CVD vary in countries. Additionally, there were inconsistent age ranges across articles, with one article including women greater than 55 years old and other articles only including women less than 25 years old. There were few studies including women less than 55 years old. Also, most of the data were collected in urban medical centers. Therefore, results may not be generalizable to other areas. There were also inconsistencies in how knowledge and perceptions were measured across studies, making it challenging to compare results.

Conclusion

There was a perception of low susceptibility to CVD among young women, but a high perception that CVD is a severe health issue. Women reported low knowledge of CVD, and younger age was consistently associated with lower CVD awareness levels. Young adult women with low awareness and knowledge of their risk for CVD are an important population to study because it is an optimal time to intervene for primary and primordial prevention. Future studies should address how to reach younger and middle-aged women in order to increase their awareness and knowledge of CVD, leveraging their perception that CVD is a severe health issue.

Table 1. Study Characteristics.

Authors Date	Study Design	Purpose	Sample/Setting	Quality Score
Beussink- Nelson et al (2022) ²⁰	Cross-sectional	Evaluate knowledge and perception of CVD in young females; Determine whether these factors differ based on adverse pregnancy outcomes	N= 714 females Age: Mean 34(±4) Time: January 1, 2020- July 1, 2020 Setting: Urban medical center in United States (US)	38/40
Cushman et al (2021) ²¹	Cross-sectional	Evaluate longitudinal trends in CVD awareness among women	N=1158 females (2009); N=1345 females (2019) Age: Mean 50.0 (2009); Mean 50.6 (2019) Time: January 2009 and January 2019 Setting: 2009: Random digit dialing, online; 2019: Online	39/40
Gooding et al (2019) ¹⁸	Cross-sectional	Assess CVD awareness, CVD risk factors, and preventive behaviors among young women aged 15 to 24 years; Compare responses to women aged 25 years and older	N= 331 females Age: 15-24 Time: September 2017-January 2018 Setting: Urban academic medical center or community health center	37/40
Gooding et al (2020) ¹⁹	8 online semi-structured focus groups	Characterize factors fundamental for improving cardiovascular health among young women	N= 35 females Age: 15-24 Time: 2017-2018 Setting: Two primary care practices in Boston, MA	38/40
Liu et al (2021) ¹⁷	Cross-sectional	Determine whether participants felt informed about heart disease or stroke; exposure to CVD information sources over the past year; if participants ever discussed CVD topics with healthcare providers.	N= 331 females Age: 15-24, mostly 18-21 (42.3%) Time: September 2017- January 2018 Setting: Adolescent clinics at academic medical center or community health practice in Boston, MA	39/40
Merianos et al (2020) ²²	Cross-sectional	Identify factors associated with perceptions about the severity of three cardiometabolic risks (i.e., HTN, obesity, and CVD) among US college students	N= 1361 (64.2% female) Age: Mean 20.97 (±2.7) Time: Two-week period (otherwise not stated) Setting: Two Texas universities	31/40

Notes. Cardiovascular disease: CVD; Time: Time of data collection

Table 2. Study Measures

Citation	Awareness	Knowledge	Perceptions
Beussink-Nelson et al (2022) ²⁰	“What is the leading cause of death for women of all ages?”	Heart Disease Fact Questionnaire, 10 questions, True/False, scored 0-10, higher score reflects higher knowledge	Participants asked one question about their relative risk perception for CVD
Cushman et al (2021) ²¹	“What is the leading cause of death for women of all ages?”	Not included	Not included
Gooding et al (2019) ¹⁸	“What is the leading cause of death for women of all ages?”	Participants asked how informed they feel about heart disease	Participants asked how much they worry about CVD and barriers to CVD preventative behaviors
Gooding et al (2020) ¹⁹	Not included	Not included	Semi structured online focus groups
Liu et al (2021) ¹⁷	Not included	Participants classified as informed about heart disease or stroke by dichotomizing responses to a Likert scale: informed (very well informed, well informed, moderately informed) versus not informed (not at all informed)	Not included
Merianos et al (2020) ²²	Not included	Not included	51-item questionnaire developed by team of experts, asking about health behaviors, family health history, and severity perceptions about cardiovascular-related consequences

Notes. CVD: Cardiovascular disease

Table 3. Study Results

Citation	Awareness	Knowledge	Perceptions
Beussink-Nelson et al ²⁰	62% identified CVD as leading cause of death in females	No significant difference in CVD knowledge scores between participants with APO and those without (6.9 vs 6.8 out of 10; p = 0.51)	Participants with an APO had higher perception of personal risk for CVD (adjusted odds ratio, 2.64 [95% CI 1.83-3.80]) compared with participants without APO Half of participants with an APO reported perceiving average or below average risk for CVD
Cushman et al ²¹	Identifying CVD as leading cause of death in females declined from 65% to 44% from 2009-2019, except for females ≥65 years old Greatest declines among Hispanic females, non-Hispanic Black women, and 25- to 34-year-olds (odds ratio, 0.19 [95% CI, 0.10–0.34])	Not included	Not included
Gooding et al ¹⁸	33 (10.0%) identified CVD as leading cause of death in females This was significantly lower than awareness among all adult females in 2012 (785 [64.0%]) and among women aged 25 to 34 years (90 of 168 [53.6%]) (P<0.01)	144 (43.5%) said they were not at all informed about CVD	Most participants worried little (130 [39.2%]) or not at all (126 [38%]) about CVD. Participants reported CVD preventative behaviors, but not considering oneself at risk for CVD was cited as the number one barrier to taking up preventative behaviors
Gooding et al ¹⁹	Not included	Not included	When discussing reasons for low perceived CVD risk, participants talked about age (“I feel like those are things I associate with older people like 40”), gender (“I usually hear more about men suffering from heart problems than women”), and social norms (“we’re so pressured just to grow up and [be] more

			focused on pregnancies or depression or our weight") There was low perceived susceptibility for CVD among participants, but high perceived severity of CVD
Liu et al ¹⁷	Not included	Over half of participants reported feeling not informed about heart disease (52%) or stroke (59%).	Not included
Merianos et al ²²	Not included	Not included	Across models, females perceived all three cardiometabolic risk factors (HTN, obesity, CVD) to be more severe compared to males (P < .005)

Notes. CVD: Cardiovascular disease; APO: Adverse pregnancy outcomes; HTN: Hypertension

References

1. Virani SS, Alonso A, Aparicio HJ, et al. Heart Disease and Stroke Statistics—2021 Update. *Circulation*. 2021/02/23 2021;143(8):e254-e743. doi:10.1161/CIR.0000000000000950
2. Wenger NK, Speroff L, Packard B. Cardiovascular Health and Disease in Women. *New England Journal of Medicine*. 1993/07/22 1993;329(4):247-256.
doi:10.1056/NEJM199307223290406
3. Gupta A, Wang Y, Spertus JA, et al. Trends in acute myocardial infarction in young patients and differences by sex and race, 2001 to 2010. *Journal of the American College of Cardiology*. Jul 29 2014;64(4):337-45. doi:10.1016/j.jacc.2014.04.054
4. DeFilippis EM, Collins BL, Singh A, et al. Women who experience a myocardial infarction at a young age have worse outcomes compared with men: the Mass General Brigham YOUNG-MI registry. *Eur Heart J*. Nov 7 2020;41(42):4127-4137.
doi:10.1093/eurheartj/ehaa662
5. Arora S, Stouffer GA, Kucharska-Newton AM, et al. Twenty Year Trends and Sex Differences in Young Adults Hospitalized With Acute Myocardial Infarction. *Circulation*. 2019;139(8):1047-1056. doi:doi:10.1161/CIRCULATIONAHA.118.037137
6. Wilmot KA, O’Flaherty M, Capewell S, Ford ES, Vaccarino V. Coronary heart disease mortality declines in the United States from 1979 through 2011. *Circulation*. 2015/09/15 2015;132(11):997-1002. doi:10.1161/CIRCULATIONAHA.115.015293
7. Garcia M, Mulvagh SL, Bairey Merz CN, Buring JE, Manson JE. Cardiovascular Disease in Women. *Circulation Research*. 2016/04/15 2016;118(8):1273-1293.
doi:10.1161/CIRCRESAHA.116.307547

8. Wang MC, Freaney PM, Perak AM, et al. Trends in prepregnancy cardiovascular health in the United States, 2011–2019. *American Journal of Preventive Cardiology*. 2021/09/01/ 2021;7:100229. doi:<https://doi.org/10.1016/j.ajpc.2021.100229>
9. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women—2011 Update. *Circulation*. 2011/03/22 2011;123(11):1243-1262. doi:10.1161/CIR.0b013e31820faaf8
10. McSweeney JC, Rosenfeld AG, Abel WM, et al. Preventing and Experiencing Ischemic Heart Disease as a Woman: State of the Science. *Circulation*. 2016/03/29 2016;133(13):1302-1331. doi:10.1161/CIR.0000000000000381
11. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert MA. Fifteen-year trends in awareness of heart disease in women. *Circulation*. 2013/03/19 2013;127(11):1254-1263. doi:10.1161/CIR.0b013e318287cf2f
12. Mosca L, Ferris A, Fabunmi R, Robertson Rose M. Tracking Women’s Awareness of Heart Disease. *Circulation*. 2004/02/10 2004;109(5):573-579. doi:10.1161/01.CIR.0000115222.69428.C9
13. Mosca L, Mochari-Greenberger H, Dolor Rowena J, Newby LK, Robb Karen J. Twelve-Year Follow-Up of American Women’s Awareness of Cardiovascular Disease Risk and Barriers to Heart Health. *Circulation: Cardiovascular Quality and Outcomes*. 2010/03/01 2010;3(2):120-127. doi:10.1161/CIRCOUTCOMES.109.915538
14. Ramachandran HJ, Wu VX, Kowitlawakul Y, Wang W. Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: An integrative review. *Heart & Lung*. 2016/05/01/ 2016;45(3):173-185. doi:<https://doi.org/10.1016/j.hrtlng.2016.02.004>

15. Trejo R, Cross W, Stephenson J, Edward KL. Young adults' knowledge and attitudes towards cardiovascular disease: A systematic review and meta-analysis. *J Clin Nurs*. Dec 2018;27(23-24):4245-4256. doi:10.1111/jocn.14517
16. Crowe M, & Sheppard, L. A general critical appraisal tool: an evaluation of construct validity. *International Journal of Nursing Studies*. 2011;48(12):1505-1516.
doi:<https://doi.org/10.1016/j.ijnurstu.2011.06.004>
17. Liu J, Patterson S, Goel S, Brown CA, De Ferranti SD, Gooding HC. Helping young women go red: Harnessing the power of personal and digital information to prevent heart disease. *Patient Education and Counseling*. 2021/10/01/ 2021;104(10):2571-2576.
doi:<https://doi.org/10.1016/j.pec.2021.03.008>
18. Gooding HC, Brown CA, Liu J, Revette AC, Stamoulis C, de Ferranti SD. Will Teens Go Red? Low Cardiovascular Disease Awareness Among Young Women. *Journal of the American Heart Association*. 2019/03/19 2019;8(6):e011195. doi:10.1161/JAHA.118.011195
19. Gooding HC, Brown CA, Revette AC, et al. Young Women's Perceptions of Heart Disease Risk. *Journal of Adolescent Health*. 2020;67(5):708-713.
doi:10.1016/j.jadohealth.2020.05.010
20. Beussink-Nelson L, Baldrige AS, Hibler E, et al. Knowledge and perception of cardiovascular disease risk in women of reproductive age. *Am J Prev Cardiol*. Sep 2022;11:100364. doi:10.1016/j.ajpc.2022.100364
21. Cushman M, Shay CM, Howard VJ, et al. Ten-Year Differences in Women's Awareness Related to Coronary Heart Disease: Results of the 2019 American Heart Association National Survey: A Special Report From the American Heart Association. *Circulation*. 2021/02/16 2021;143(7):e239-e248. doi:10.1161/CIR.0000000000000907

22. Merianos AL, Jacobs W, Oloruntoba O, Gittens OE, Smith ML. Perceived Severity of Interrelated Cardiometabolic Risk Factors among U.S. College Students. *American Journal of Health Education*. 2020;51(4):234-243. doi:10.1080/19325037.2020.1765907
23. Champion VL, Skinner CS. *Health Behavior and Health Education*. 4th ed. Jossey-Bass; 2008.
24. Lichtman JH, Leifheit-Limson EC, Watanabe E, et al. Symptom recognition and healthcare experiences of young women with acute myocardial infarction. *Circ Cardiovasc Qual Outcomes*. Mar 2015;8(2 Suppl 1):S31-8. doi:10.1161/circoutcomes.114.001612
25. Lichtman JH, Leifheit EC, Safdar B, et al. Sex Differences in the Presentation and Perception of Symptoms Among Young Patients With Myocardial Infarction: Evidence from the VIRGO Study (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients). *Circulation*. Feb 20 2018;137(8):781-790. doi:10.1161/circulationaha.117.031650
26. Burgess A, Feliu K. Women's Knowledge of Cardiovascular Risk After Preeclampsia. *Nursing for Women's Health*. 2019/10/01/ 2019;23(5):424-432. doi:<https://doi.org/10.1016/j.nwh.2019.07.001>
27. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association. *Circulation*. 2019/03/05 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659

Chapter Three: Awareness, Knowledge, and Perceptions of CVD (Second Manuscript)

Race/Ethnicity is not a Significant Predictor of Awareness, Knowledge, or Perceptions of CVD among Women 25-55 Years Old

Abstract

Background. Risk of CVD is rising in young to middle age and minority women. Few studies have evaluated awareness, knowledge, and perceptions of CVD among young and middle-aged women using validated instruments.

Aims. Determine if there were differences in awareness, knowledge, and perceptions of personal risk for CVD between non-Hispanic white and racial/ethnic minority groups in women 25-55 years and examine whether race/ethnicity and age were significantly associated with awareness, knowledge, and perceptions of CVD after adjusting for potential confounding factors.

Methods. In this cross-sectional, descriptive study, women ages 25-55 without a CVD history were recruited via flyers and social media advertisements. Awareness (“What is the leading cause of death for women in the United States?”), knowledge (Heart Disease Fact Questionnaire, HDFQ), and perceptions (Health Beliefs Related to Cardiovascular Disease, HBCVD) of CVD were measured.

Results. A total of 149 predominantly young (mean=37.15±7.86 years), racial/ethnic minority women (70.5%) were included. Awareness (71.8%) and knowledge (mean HDFQ=22.62±2.33 of 25) were high. Non-Hispanic white women had higher knowledge scores (HDFQ= 23.27±1.72 vs. 22.35±2.50, p=0.011) and lower susceptibility scores (9.86±2.75 vs 11.48±3.53, p=0.003) compared to racial/ethnic minority women. After adjusting for covariates, race/ethnicity was not a significant predictor of awareness, knowledge, or perceptions of CVD.

Conclusion. In this sample of well-educated, predominantly racial/ethnic minority women, awareness and knowledge of CVD was high. DM predicted perceived susceptibility to CVD. Findings suggest that interventions in younger minority women who perceive themselves to be susceptible to CVD would be efficacious in primordial and primary prevention.

Background

Cardiovascular disease (CVD) is the leading cause of death among women and young women are increasingly at risk for CVD.^{1,2} Nearly half of US women 20 years of age or older have a clinical CVD risk factor.^{1,3} High blood pressure (HTN), high cholesterol (HLD), and diabetes (DM) are increasing among young and racial/ethnic minority women, while the prevalence of physical inactivity and unhealthy diet are increasing. Although rates of CVD have declined since the 1970's, rates of decline are lowest among young and middle-aged women 25-55 years old.⁴ Additionally, risk factor profiles for CVD in young and racial/ethnic minority women are worsening.⁵⁻¹⁰

Although risk factors for CVD among young and middle-aged women have increased, awareness and knowledge of CVD is low among young and middle-aged women.¹¹⁻¹⁵ From 2009 to 2019, women's awareness of heart disease as the leading cause of death among women decreased from 65% to 44%.¹⁶ The largest declines in awareness were among Hispanic women, non-Hispanic black women, and women ages 25-34 years old.¹⁶ This could be due to lack of risk assessment from primary care, persistent perceptions from both patients and healthcare providers that women are not at risk for CVD, or lack of consistent primary care.^{15,17} These declines in awareness are devastating for Hispanic and non-Hispanic black women, as CVD is the leading cause of death for both.¹⁸ Non-Hispanic black women have the highest CVD prevalence rates and a life expectancy of 75 years compared to 80 years for non-Hispanic white women.

These trends in risk factor profiles and awareness represent a missed opportunity for CVD prevention, because primordial and primary prevention could be most effective for preventing heart disease in women.^{6,19} Additionally, young and middle-aged women are a key demographic to target for CVD prevention because CVD risk increases following menopause.^{20,21} Therefore, it is critical to study the gap in CVD awareness and knowledge in young and middle-aged women as well as their perceptions of their personal risk for CVD. There are few studies evaluating awareness, knowledge, and perceptions of cardiovascular disease among young adult women using validated tools. The aims of this study were to (1) determine if there were differences in the awareness, knowledge, and perceptions of personal risk factors for CVD between non-Hispanic white racial/ethnic minority groups in women 25-55 years; and (2) examine whether race/ethnicity and age are significantly associated with awareness, knowledge, and perceptions of personal risk factors for CVD after adjusting for potential confounding factors.

Methods

Design, Sample, and Setting

This was a cross-sectional, descriptive study of young women using a self-administered online survey. This study was part of a larger parent study titled, “Increasing Awareness of Heart Disease in Women with an AI-Driven Conversational Agent.” The goals of the parent study were to: 1) develop content and algorithms for a text-based chatbot with natural language capabilities; and 2) pilot test and refine the algorithms and content of the chatbot in 100 women with diverse racial and ethnic backgrounds. Eligibility criteria in the parent study were women ages 25 and older; no self-reported cognitive impairment; no self-reported history of CVD, were not healthcare students, were not working in the healthcare field, were living in the United States,

had the ability to send and receive text messages, and had access to the internet. In this study, we focused on women between 25 to 55 years of age. Participants were recruited via flyers posted at universities and clinics in Northern and Southern California. This recruitment method yielded a disproportionate amount of non-Hispanic white participants, so recruitment was expanded to directly target Hispanic and Black/African American populations with advertisements and boosted posts on social media (Meta-Facebook, Instagram, Reddit, and Twitter). Recruitment and data collection took place from September 2022 to January 2023. IRB approval was obtained from the University of California, Los Angeles, and the University of California, San Francisco (IRB #22-000878 and IRB #22-37159).

Measures

Sociodemographic data. Age, ethnicity/race, education, household income, marital status, employment status, immigration status, primary language spoken at home, and health insurance status were collected. Health information included a family history of CVD, self-report of chronic medical conditions (HTN, HLD, DM), early menses status, and smoking status.

Awareness. CVD awareness was measured with the question, “What is the leading cause of death for women in the United States?” Respondents could choose from: accidental death; AIDS; Alzheimer’s; breast cancer; cancer (general); DM; drug addiction/alcoholism; heart disease/heart attack; lung cancer; osteoporosis; smoking; stroke; violent crime; or suicide.^{16,22} The participant was considered aware of CVD if they answered, “heart disease/heart attack”. This question has been used extensively in previous studies to assess levels of CVD awareness among women of all ages and ethnicities.^{11,16,22}

Knowledge. CVD knowledge was measured using the Heart Disease Fact Questionnaire (HDFQ). The instrument includes 25 true/false questions. Scores range from 0-25 and a higher

score represents higher knowledge of CVD. The HDFQ takes about 10 minutes to complete and is written at a 6th grade reading level. The instrument was originally tested in adults with DM and was found to have adequate internal consistency (Kuder-Richardson-20 formula = 0.77) and criterion-related validity determined by discriminant function analysis.²³ For our study, the HDFQ was found to have adequate internal consistency (Kuder-Richardson-20 formula = 0.70).

Perceptions. CVD perceptions were measured using the Health Beliefs Related to Cardiovascular Disease (HBCVD) instrument. The HBCVD takes an average of 10 minutes to complete and is written at a sixth grade reading level.²⁴ It was originally developed based on the Health Belief Model, which posits that a health behavior is a result of perceived susceptibility to a disease, perceived severity of a disease, and the benefits and barriers to performing a health behavior²⁵. The HBCVD contains 25 items, each measured on a four-point Likert type scale (Strongly Disagree, Disagree, Agree, Strongly Agree). The HBCVD has four subscales and includes: (1) susceptibility (five items, score range 5-20, and a higher score is linked to a belief in higher personal susceptibility to CVD), (2) severity (five items, score range 5-20, and a higher score indicates a higher belief in the severity of CVD), (3) benefits (six items, score range 6-24, and a higher score meaning higher perceived benefits from engaging in CVD risk-reducing behaviors), and (4) barriers (nine items, score range 9-36, and a higher score indicates a higher belief in personal barriers to engaging in CVD risk reducing behaviors). The HBCVD was tested among adults with type 2 DM and was found to have acceptable internal consistency among the subscales (susceptibility: $\alpha= 0.93$; benefits $\alpha= 0.82$; severity $\alpha= 0.71$; barriers $\alpha= 0.62$).²⁶ For our study, the items also had acceptable internal consistency among the subscales with the exception of severity, which was below the acceptable threshold of 0.70 for an established instrument (susceptibility: $\alpha=0.861$; benefits $\alpha= 0.822$; severity $\alpha= 0.631$; barriers $\alpha=0.717$).

Procedures

Participants accessed the screening form, consent, and surveys through the Research Electronic Data Capture website (REDCap).^{27,28} REDCap is a secure web application designed for creating and managing online surveys and databases. To access the online screening, participants had to pass a Google reCAPTCHA test by clicking a checkbox, verifying that the participant is human and not a robot or malicious software.²⁹ Participants then completed a brief online screening form assessing study eligibility. After eligibility was confirmed, participants were emailed a link to the consent form and signed an e-consent. After providing informed consent, a link to the baseline survey questionnaires was emailed to participants. They could complete the questionnaires anywhere and anytime. The research assistant verified that participants used different IP addresses to access the study in order to validate that answers were coming from different participants. Participants received a \$10 e-gift card at the completion of the baseline survey.

Statistical Analysis

Frequency and percentage of correct answers to “What is the leading cause of heart disease in women of all ages?” were calculated to evaluate awareness. Means and standard deviations were used to summarize knowledge (HDFQ) and perception (HBCVD) scores. Since the data for both instruments were normally distributed, T tests were used to compare the awareness, knowledge, and perceptions of personal risk factors for CVD between non-Hispanic white and racial/ethnic minority groups (Aim 1). Potential predictors of awareness were examined using multivariable logistic regression analysis. Potential predictors of knowledge (HDFQ) and perceptions of CVD (HBCVD subscales of benefits, barriers, susceptibility, and severity) were examined using multivariable linear regression analysis, adjusting for recruitment

method (recruited from social media or not recruited from social media), age, household income, immigration status, smoking status, education, DM, and race/ethnicity (classified as non-Hispanic white and racial/ethnic minority due to low group membership) (Aim 2). Statistics were calculated using Statistical Package for the Social Sciences (SPSS) version 28.0 (IBM; Somers, NY).

Results

Characteristics of the Sample

A total of 149 women aged 25 to 55 years (mean age of 37.15 ± 7.86), who were predominately well educated (61.7% college graduates), were enrolled. The majority represented racial and ethnic minority groups. The sample included 65 (43.6%) Black/African American, 25 (16.8%) Hispanic/Latino, 6 (4.0%) Asian, 9 (6.0%) more than one race/ethnicity, and 44 (29.5%) non-Hispanic white women. Table 1 shows the baseline characteristics stratified by non-Hispanic white and racial/ethnic minority groups.

Table 1. Participant Characteristics				
	Total Sample (n=149)	Non-Hispanic White Women (n=44)	Racial/Ethnic Minority Women (n=105)	P value
Variable	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	
Age	37.15 (7.9)	32.93 (4.11)	38.92 (8.38)	< .001
Ethnicity/Race				-
Asian	6 (4.0)	0 (0)	6 (5.7)	
Black/African American	65 (43.6)	0 (0)	65 (61.9)	
Hispanic/Latino	25 (16.8)	0 (0)	25 (22.9)	
More than One Race/Ethnicity	9 (6.0)	0 (0)	9 (8.6)	
White (Non-Hispanic)	44 (29.5)	44 (100)	0 (0)	
Education				< .001
Less than high school	1 (0.7)	0 (0)	1 (1)	
Completed high school	14 (9.4)	0 (0)	14 (13.3)	
Completed some college course work but did not finish	42 (28.2)	3 (6.8)	39 (37.1)	
Completed college (4 years)	55 (36.9)	22 (50)	33 (31.4)	
Completed graduate school	37 (24.8)	19 (43.2)	18 (17.1)	
Household income				< .001
Less than \$20,000	16 (10.7)	0 (0)	16 (15.2)	
\$20,001- 40,000	31 (20.8)	2 (4.5)	29 (27.6)	
\$40,001- 75,000	38 (25.5)	8 (18.2)	30 (28.6)	
> \$75,000	61 (40.0)	34 (77.3)	27 (25.7)	
Don't know	3 (2.0)	0 (0)	3 (2.9)	
Marital status				< .001
Never married	42 (28.2)	3 (6.8)	39 (37.1)	
Currently married/cohabitating	95 (63.8)	40 (90.9)	55 (52.4)	
Divorced/widowed	12 (8.1)	1 (2.3)	11 (10.5)	
Employment status				.473
Employed for pay full time	82 (55.0)	25 (56.8)	57 (54.3)	
Employed for pay part time	18 (12.1)	7 (15.9)	11 (10.5)	
Unemployed or looking for job	12 (8.1)	2 (3.5)	10 (9.5)	
Student	6 (4.0)	1 (2.3)	5 (4.8)	
Homemaker	22 (14.8)	9 (20.5)	13 (12.4)	
Retired	1 (0.7)	0 (0)	1 (1)	
Disabled	6 (4.0)	0 (0)	6 (5.7)	
Other	2 (1.3)	0 (0)	2 (1.9)	
Do you have children, under the age of 18, living with you at home?				< .001

Yes	111 (74.5)	42 (95.5)	69 (65.7)	
No	38 (25.5)	2 (4.5)	36 (34.3)	
Do you have health insurance?				<.001
Yes, private insurance	104 (69.8)	40 (90.9)	64 (61.0)	
Yes, public insurance	36 (24.2)	4 (9.1)	32 (30.5)	
No insurance	9 (6.0)	0 (0)	9 (8.6)	
Did you immigrate to the United States?				0.024
Yes	17 (11.4)	1 (2.3)	16 (15.2)	
No	20.3 (15.5)	43 (97.7)	89 (84.8]	
CVD Risk Factors				
Have you smoked at least one cigarette in the last 7 days?				.011
Yes	13 (8.7)	0 (0)	13 (12.4)	
No	136 (91.3)	44 (100.0)	92 (87.6)	
Have you ever been told that you high blood pressure (140/90 mmHg or higher) or need medication to control your blood pressure?				0.220
Yes	59 (39.6)	14 (31.8)	45 (42.9)	
No	87 (58.4)	30 (68.1)	57 (54.3)	
Don't know	3 (2.0)	0 (0)	3 (2.9)	
Have you ever been told that you have high cholesterol or need medication to control your cholesterol?				.179
Yes	45 (30.2)	9 (20.5)	36 (34.3)	
No	103 (69.1)	35 (79.5)	68 (64.8)	
Don't know	1 (0.7)	0 (0)	1 (1.0)	
Have you ever been told that you have diabetes or need medication to control your diabetes?				.050
Yes	21 (14.1)	52(4.5)	19 (18.1)	
No	126 (84.6)	42 (95.5)	84 (80.0)	
Don't know	2 (1.3)	0 (0)	2 (1.9)	
Have you ever been told that your mother or sister had a heart attack or stroke before age 65? OR Have you ever been told that your father or brother had a heart attack or stroke before age 55?				.633

Yes	25 (16.8)	6 (13.6)	19 (18.4)	
No/Don't know	122 (81.9)	38 (86.4)	85 (81.6)	
Recruitment Method				<.001
Social Media	86 (57.7)	1 (2.3)	85 (81.0)	
Flyers	63 (42.3)	43 (97.7)	20 (19.0)	

Note: SD is standard deviation. CVD is cardiovascular disease. Bolded p values are statistically significant.

Awareness, Knowledge, and Perception of CVD

The majority (71.8%) of participants were aware that CVD is the number one cause of death for women in the US. The mean score for knowledge of CVD for the entire sample, as measured by the HDFQ, was 22.62 ± 2.33 of a possible 25. For perceptions of personal risk factors for CVD (HBCVD), subscale scores were benefits (22.05 ± 2.38 , range 6-24), barriers (18.60 ± 4.57 , range 9-36), susceptibility (11.00 ± 3.39 , range 5-20), and severity (12.09 ± 2.77 , range 5-20). Table 2 shows baseline Awareness, Knowledge, and Perceptions between Non-Hispanic White vs. Racial/Ethnic Minority Women.

Race/ethnicity. Participants were then stratified by race/ethnicity into two groups, non-Hispanic white and racial/ethnic minorities. All racial/ethnic minority groups were combined into one group due to a small proportion of Hispanic participants and other racial/ethnic groups. Non-Hispanic white participants had a higher level of knowledge compared to racial/ethnic minority participants (23.27 ± 1.7 vs 22.35 ± 2.5 ; $p=.011$). Racial/ethnic minority group participants reported higher susceptibility to CVD scores compared to non-Hispanic white women.

Age. Participants were divided into a younger and older group based on the mean age of the sample. Mean age rather than median age was selected because the ages were reasonably normally distributed. Those 25-37 years were labeled “younger” and those 38-55 were labeled “older”. There was a significant difference in knowledge between the groups (22.99 ± 1.72 vs

22.25±2.80 respectively, p=0.031), but there were no group differences in awareness or perceptions of risk.

Table 2. Awareness, Knowledge, and Perceptions between Non-Hispanic White vs. Racial/Ethnic Minority Women Participants				
	Total Sample (n=149)	Non-Hispanic White Women (n=44)	Racial/Ethnic Minority Women (n=105)	p value
Variable	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	
Awareness (What is the leading cause of death for women in the United States?)				.231
Heart Disease	107 (71.8)	35 (79.5)	72 (68.6)	
Other	42 (28.2)	9 (20.5)	33 (31.4)	
Knowledge (HDFQ Score, Range 0-25)	22.62 (2.3)	23.27 (1.7)	22.35 (2.5)	.011
Perceptions (HBCVD Scores)				
Severity Subscale (Range 5-20)	12.09 (2.8)	12.36 (2.2)	11.98 (3.0)	.386
Susceptibility Subscale (Range 5-20)	11.00 (3.4)	9.86 (2.7)	11.48 (3.5)	.003
Benefits Subscale (Range 6-24)	22.05 (2.4)	21.72 (2.3)	22.18 (2.4)	.280
Barriers Subscale (Range 9-36)	18.60 (4.6)	17.75 (4.4)	18.96 (4.6)	.135

Note: SD is standard deviation; HDFQ is the Heart Disease Fact Questionnaire; HBCVD is Health Beliefs Related to Cardiovascular Disease Questionnaire

Predictors of Awareness, Knowledge, and Perceptions of CVD

Predictors of awareness. Potential predictors were included in the model based on significant differences in the bivariate analyses of non-Hispanic white women compared to racial/ethnic minority women with the exception of number of children and marital status. Number of children and marital status were excluded from the regression model because there is no evidence in the literature that either variable influences awareness, knowledge, or perceptions of heart disease. The variables of recruitment method (recruited from social media or not recruited from social media), age, household income, immigration status, smoking status,

education, DM, and race/ethnicity (classified as non-Hispanic white and racial/ethnic minority due to low group membership) were included in model one as potential predictors of awareness of risk for CVD. The model was not statistically significant ($p=.338$).

Predictors of knowledge. The same variables were included in model 2 as potential predictors of knowledge of CVD. The model was not significant ($p=0.454$).

Predictors of perception. The same variables were added to model 3 as potential predictors of perception of CVD (subscales benefits, barriers, severity, susceptibility). There were no significant predictors for benefits, barriers, or severity. Perceived susceptibility to CVD was significant (adjusted $R^2=0.073$, $p=.025$). DM predicted perceived susceptibility to CVD ($p=0.046$). Race/ethnicity were not significant in the model. Table 3 shows the predictors of awareness, knowledge, and perceptions of CVD.

Table 3. Predictors of Awareness, Knowledge, and Perceptions of CVD			
Multivariate Binary Logistic Regression: Predictors of Awareness			
	p value	OR	95% CI
Overall Model	.338		
Race/Ethnicity	.210	.445	.126- 1.577
Age	.230	.966	.914- 1.022
Income	.122	1.611	.880- 2.949
Education	.236	.700	.388- 1.262
Immigration Status	.281	.511	.151- 1.732
Diabetes	.566	.726	.243- 2.166
Smoking Status	.400	.554	.140- .2.191
Insurance Status (None)	.791		
Insurance Status (Private)	.494	1.833	.323-10.392
Insurance Status (Public)	.620	1.531	.285-8.235
Recruitment Method	.055	3.502	.974-12.599
Multivariate Linear Regression: Predictors of Knowledge as Measured by Heart Disease Fact Questionnaire (HDFQ)			
	p value	Beta	95% CI
Overall Model	0.454		
Race/Ethnicity	.639	-.062	-1.658- 1.211
Age	.077	-.051	-.107-.006
Income	.498	.212	-.405-.829
Education	.816	-.068	-.648-.512
Immigration Status	.830	.150	-1.226-1.525

Diabetes	.524	.380	-.796-1.556
Smoking Status	.774	.218	-1.281-1.717
Insurance Status (Private)	.559	-.572	-2.503-1.358
Insurance Status (Public)	.603	-.496	-2.374-1.382
Recruitment Method	.610	-.350	-1.705-1.005
Multivariate Linear Regression: Predictors of Perception of CVD Risk as Measured by Health Beliefs Related To Cardiovascular Disease Questionnaire (HBCVD) Subscales			
	p value	Beta	95% CI
Benefits			
Overall Model	.806		
Race/Ethnicity	.055	1.340	-.029-2.710
Age	.963	-.001	-.059-.056
Income	.515	.208	-.423-.839
Education	.851	-.056	-.649-.536
Immigration Status	.872	.115	-1.291-1.521
Diabetes	.471	.440	-.762-1.641
Smoking Status	.720	-.278	-1.810-.254
Insurance Status (Private)	.609	-.511	-2.484-1.462
Insurance Status (Public)	.598	-.513	-2.433-1.406
Recruitment Method	.157	-.997	-2.382-.388
Barriers			
Overall Model	.513		
Race/Ethnicity	.713	.486	-2.216-3.098
Age	.379	-.049	-.159-.061
Income	.555	.360	-.843-1.564
Education	.642	-.267	-1.397-.864
Immigration Status	.752	-.430	-3.111-2.252
Diabetes	.364	1.056	-1.237-.348
Smoking Status	.076	2.639	-.284-5.562
Insurance Status (Private)	.638	-.899	-4.663-2.866
Insurance Status (Public)	.219	-2.286	-5.947-1.376
Recruitment Method	.360	1.226	-1.416-3.868
Susceptibility			
Overall Model	.025		
Race/Ethnicity	.975	.029	-1.809-1.868
Age	.837	.008	-.069-.086
Income	.351	.401	-.446-1.248
Education	.109	-.649	-1.445-.147
Immigration Status	.450	-.723	-2.611-1.165
Diabetes	.046	1.643	.029-3.257
Smoking Status	.364	.948	-1.109-3.006
Insurance Status (Private)	.599	-.706	-3.356-1.944
Insurance Status (Public)	.477	-.929	-3.506-1.649
Recruitment Method	.162	1.322	-.538-3.182
Severity			

Overall Model	.332		
Race/Ethnicity	.494	-.541	-2.102-.020
Age	.244	-.039	-.105-.027
Income	.192	.477	-.242-1.196
Education	.861	-.060	-.736-.616
Immigration Status	.042	1.666	.063-3.269
Diabetes	.621	.343	-1.027-1.713
Smoking Status	.122	1.376	-.371-3.124
Insurance Status (Private)	.780	.318	-1.932-2.569
Insurance Status (Public)	.978	.031	-2.220-2.158
Recruitment Method	.369	.721	.859-2.300

Note: OR is Odds Ratio; CI is Confidence Interval

Discussion

In this sample of predominantly racial/ethnic minority and well-educated participants, awareness of CVD was high. Other studies of similarly aged women found CVD awareness rates to be 44-62%^{16,30} and education to be associated with awareness.¹⁶ The high rate of CVD awareness in this study could be due to the socioeconomic status of our sample, participants looking up answers, or participants being primed by the title of the study, “Increasing Awareness of Heart Disease in Women with an AI-Driven Conversational Agent”. Additionally, over half of our sample (57.7%) was recruited from social media and most of our sample (94%) had health insurance. Liu et al. examined sources of heart disease information among young women ages 15-24, with the most commonly reported sources being television (38.2%), social media (30.3%), and the internet (26%).³¹ Additionally, the young women stated that they prefer receiving information from healthcare providers (43.8%) and social media (23.9%).

Knowledge of CVD was high in this sample. The average HDFQ score was 90%. Studies of similarly aged women found HDFQ scores of about 68-78.93%.^{30,32} There were differences in knowledge by race/ethnicity. Prior literature has shown that racial/ethnic minority women have lower rates of heart disease knowledge compared to non-Hispanic white women³³ and our findings were similar. Additionally, race is a social construct based on historically created

phenotypes and ethnicities, causing imbalanced access to power, social resources, and economic resources.^{34,35} These structural inequalities and social determinants of health are important factors when examining CVD knowledge scores between non-Hispanic white women and racial/ethnic minority women, and should be targeted for future interventions. There were also significant differences in age, income, education, immigration status, and insurance status between the two groups, however, these variables were not significant predictors of knowledge.

A belief in susceptibility to CVD was low in this sample even though 39.6% of our sample had high blood pressure and nearly a third had high cholesterol. This may be due to the relatively young age of this sample. Younger women tend to not view themselves as at risk for heart disease and they are correct in that risk increases with age.^{36,37} In our study, racial/ethnic minority women perceived themselves as more susceptible to heart disease compared to non-Hispanic white women, which aligns with their increased risk for CVD compared to non-Hispanic white women.¹⁸ DM was a significant predictor of a belief in susceptibility to CVD, although other risk factors were not. This may indicate a key area for future research because DM is a CVD risk equivalent and individuals with DM are at risk for complications such as acute coronary syndrome or stroke.

Strengths and Limitations

The strengths of this study include a diverse racial and ethnic sample and use of validated instruments to measure knowledge and perceptions of heart disease. Even though the data were collected anonymously online, the investigator interacted with participants on several occasions over text messages, validating the authenticity of individual participation. Google reCAPTCHA was used to validate that the participant was a human being.

There were limitations to the study. Our participants were well-educated with moderate incomes. Our results may not be generalizable to lower income groups. Heart disease risk factors were also self-reported, so we could not validate the accuracy of the participants' health history. Lastly, participants were recruited using two methods, flyers posted in the community and messages on social media. Flyers were limited to a narrow geographical region and yielded a more homogenous sample. Our social media advertisement campaign targeted Black/African American and Hispanic women across the United States. To mitigate for this, we controlled for recruitment method when examining predictors of awareness, knowledge, and perceptions of CVD.

Conclusion

In this sample of well-educated, predominantly racial/ethnic minority women, awareness and knowledge of CVD were high. DM predicted perceived susceptibility to CVD when adjusting for recruitment method, age, income, education, race/ethnicity, immigration status, and smoking status. Findings suggest that interventions in younger minority women who perceive themselves to be susceptible to CVD would be efficacious in primordial and primary prevention.

References

1. Virani SS, Alonso A, Aparicio HJ, et al. Heart Disease and Stroke Statistics—2021 Update. *Circulation*. 2021/02/23 2021;143(8):e254-e743. doi:10.1161/CIR.0000000000000950
2. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association. *Circulation*. 2019/03/05 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659
3. Wenger NK, Lloyd-Jones DM, Elkind MSV, et al. Call to Action for Cardiovascular Disease in Women: Epidemiology, Awareness, Access, and Delivery of Equitable Health Care: A Presidential Advisory From the American Heart Association. *Circulation*. 2022/06/07 2022;145(23):e1059-e1071. doi:10.1161/CIR.0000000000001071
4. Wilmot KA, O’Flaherty M, Capewell S, Ford ES, Vaccarino V. Coronary Heart Disease Mortality Declines in the United States From 1979 Through 2011. *Circulation*. 2015/09/15 2015;132(11):997-1002. doi:10.1161/CIRCULATIONAHA.115.015293
5. Benjamin Emelia J, Virani Salim S, Callaway Clifton W, et al. Heart Disease and Stroke Statistics—2018 Update: A Report From the American Heart Association. *Circulation*. 2018/03/20 2018;137(12):e67-e492. doi:10.1161/CIR.0000000000000558
6. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women—2011 Update. *Circulation*. 2011/03/22 2011;123(11):1243-1262. doi:10.1161/CIR.0b013e31820faaf8
7. Rodriguez Carlos J, Allison M, Daviglius Martha L, et al. Status of Cardiovascular Disease and Stroke in Hispanics/Latinos in the United States. *Circulation*. 2014/08/12 2014;130(7):593-625. doi:10.1161/CIR.0000000000000071

8. Balfour PC, Jr., Ruiz JM, Talavera GA, Allison MA, Rodriguez CJ. Cardiovascular Disease in Hispanics/Latinos in the United States. *J Lat Psychol*. 2016;4(2):98-113. doi:10.1037/lat0000056
9. Mozaffarian D, Benjamin Emelia J, Go Alan S, et al. Heart Disease and Stroke Statistics—2016 Update. *Circulation*. 2016/01/26 2016;133(4):e38-e360. doi:10.1161/CIR.0000000000000350
10. Zhao M, Vaartjes I, Graham I, et al. Sex differences in risk factor management of coronary heart disease across three regions. *Heart*. 2017;103(20):1587. doi:10.1136/heartjnl-2017-311429
11. Giardina E-GV, Mull L, Sciacca RR, et al. Relationship Between Cardiovascular Disease Knowledge and Race/Ethnicity, Education, and Weight Status. <https://doi.org/10.1002/clc.20992>. *Clinical Cardiology*. 2012/01/01 2012;35(1):43-48. doi:<https://doi.org/10.1002/clc.20992>
12. Mosca L, Ferris A, Fabunmi R, Robertson Rose M. Tracking Women's Awareness of Heart Disease. *Circulation*. 2004/02/10 2004;109(5):573-579. doi:10.1161/01.CIR.0000115222.69428.C9
13. Mosca L, Mochari-Greenberger H, Dolor Rowena J, Newby LK, Robb Karen J. Twelve-Year Follow-Up of American Women's Awareness of Cardiovascular Disease Risk and Barriers to Heart Health. *Circulation: Cardiovascular Quality and Outcomes*. 2010/03/01 2010;3(2):120-127. doi:10.1161/CIRCOUTCOMES.109.915538
14. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert Michelle A. Fifteen-Year Trends in Awareness of Heart Disease in Women. *Circulation*. 2013/03/19 2013;127(11):1254-1263. doi:10.1161/CIR.0b013e318287cf2f

15. Bairey Merz CN, Andersen H, Sprague E, et al. Knowledge, Attitudes, and Beliefs Regarding Cardiovascular Disease in Women. *Journal of the American College of Cardiology*. 2017/07/11 2017;70(2):123-132. doi:10.1016/j.jacc.2017.05.024
16. Cushman M, Shay CM, Howard VJ, et al. Ten-Year Differences in Women's Awareness Related to Coronary Heart Disease: Results of the 2019 American Heart Association National Survey: A Special Report From the American Heart Association. *Circulation*. 2021/02/16 2021;143(7):e239-e248. doi:10.1161/CIR.0000000000000907
17. Lichtman JH, Leifheit EC, Safdar B, et al. Sex Differences in the Presentation and Perception of Symptoms Among Young Patients With Myocardial Infarction: Evidence from the VIRGO Study (Variation in Recovery: Role of Gender on Outcomes of Young AMI Patients). *Circulation*. Feb 20 2018;137(8):781-790. doi:10.1161/circulationaha.117.031650
18. Mehta LS, Velarde GP, Lewey J, et al. Cardiovascular Disease Risk Factors in Women: The Impact of Race and Ethnicity: A Scientific Statement From the American Heart Association. *Circulation*. 2023;0(0)doi:doi:10.1161/CIR.0000000000001139
19. Chomistek Andrea K, Chiuve Stephanie E, Eliassen AH, Mukamal Kenneth J, Willett Walter C, Rimm Eric B. Healthy Lifestyle in the Primordial Prevention of Cardiovascular Disease Among Young Women. *Journal of the American College of Cardiology*. 2015/01/06 2015;65(1):43-51. doi:10.1016/j.jacc.2014.10.024
20. McSweeney JC, Rosenfeld AG, Abel WM, et al. Preventing and Experiencing Ischemic Heart Disease as a Woman: State of the Science. *Circulation*. 2016/03/29 2016;133(13):1302-1331. doi:10.1161/CIR.0000000000000381
21. El Khoudary SR, Aggarwal B, Beckie TM, et al. Menopause Transition and Cardiovascular Disease Risk: Implications for Timing of Early Prevention: A Scientific

Statement From the American Heart Association. *Circulation*. 2020/12/22 2020;142(25):e506-e532. doi:10.1161/CIR.0000000000000912

22. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert MA. Fifteen-year trends in awareness of heart disease in women. *Circulation*. 2013/03/19 2013;127(11):1254-1263. doi:10.1161/CIR.0b013e318287cf2f

23. Wagner J, Lacey K, Chyun D, Abbott G. Development of a questionnaire to measure heart disease risk knowledge in people with diabetes: the Heart Disease Fact Questionnaire. *Patient Education and Counseling*. 2005/07/01/ 2005;58(1):82-87.

doi:<https://doi.org/10.1016/j.pec.2004.07.004>

24. Tovar EG, Rayens MK, Clark M, Nguyen H. Development and psychometric testing of the Health Beliefs Related to Cardiovascular Disease Scale: preliminary findings. *J Adv Nurs*. Dec 2010;66(12):2772-84. doi:10.1111/j.1365-2648.2010.05443.x

25. Champion VL, Skinner CS. *Health Behavior and Health Education*. 4th ed. Jossey-Bass; 2008.

26. Tovar E, Clark MC. Knowledge and health beliefs related to heart disease risk among adults with type 2 diabetes. *J Am Assoc Nurse Pract*. Jun 2015;27(6):321-7. doi:10.1002/2327-6924.12172

27. Harris PA, Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. . Research electronic data capture (REDCap)— a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of biomedical informatics*. 2009;42(2):377-381. doi:<https://doi.org/10.1016/j.jbi>

28. Harris PA, Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J., Duda, S. N., REDCap Consortium. The REDCap

consortium: Building an international community of software platform partners. . *Journal of biomedical informatics*. 2019;95(103208)doi:<https://doi.org/10.1016/j.jbi.2019.10320814>

29. Google ReCAPTCHA. 2021. <https://developers.google.com/terms/site-policies>

30. Beussink-Nelson L, Baldrige AS, Hibler E, et al. Knowledge and perception of cardiovascular disease risk in women of reproductive age. *Am J Prev Cardiol*. Sep 2022;11:100364. doi:10.1016/j.ajpc.2022.100364

31. Liu J, Patterson S, Goel S, Brown CA, De Ferranti SD, Gooding HC. Helping young women go red: Harnessing the power of personal and digital information to prevent heart disease. *Patient Education and Counseling*. 2021/10/01/ 2021;104(10):2571-2576. doi:<https://doi.org/10.1016/j.pec.2021.03.008>

32. Konicki AJ. Knowledge of cardiovascular risk factors, self-nurturance, and heart-healthy behaviors in women. *J Cardiovasc Nurs*. Jan-Feb 2012;27(1):51-60. doi:10.1097/JCN.0b013e31820e2f95

33. Ramachandran HJ, Wu VX, Kowitlawakul Y, Wang W. Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: An integrative review. *Heart & Lung*. 2016/05/01/ 2016;45(3):173-185. doi:<https://doi.org/10.1016/j.hrtlng.2016.02.004>

34. Blackburn D. *From Race and Racism in Theory and Practice: Why Race is not a Biological Concept*. Rowman & Littlefield; 2000.

35. Churchwell K, Elkind MSV, Benjamin RM, et al. Call to Action: Structural Racism as a Fundamental Driver of Health Disparities: A Presidential Advisory From the American Heart Association. *Circulation*. 2020/12/15 2020;142(24):e454-e468. doi:10.1161/CIR.0000000000000936

36. Gooding HC, Brown CA, Revette AC, et al. Young Women's Perceptions of Heart Disease Risk. *Journal of Adolescent Health*. 2020;67(5):708-713.
doi:10.1016/j.jadohealth.2020.05.010
37. Trejo R, Cross W, Stephenson J, Edward KL. Young adults' knowledge and attitudes towards cardiovascular disease: A systematic review and meta-analysis. *J Clin Nurs*. Dec 2018;27(23-24):4245-4256. doi:10.1111/jocn.14517

Chapter Four: Stage of Behavior Change (Third Manuscript)

Perceived Susceptibility to and Severity of Cardiovascular Disease is Associated with Intent to Change Behavior Among Women 24-55 Years Old

Abstract

Background. Risk factors for cardiovascular disease (CVD) among young and middle-aged women have increased while knowledge and awareness of CVD remain low. To reverse these trends, it is important to assess whether knowledge and awareness of CVD are associated with intent to change behavior.

Aims. Describe the relationship between stage of behavior change and awareness, knowledge, and perceptions of CVD among women 25-55 years and identify the predictors of stage of behavior change.

Methods. A cross-sectional, descriptive study of women ages 25-55 living in the United States without a self-reported CVD history. Participants were recruited through flyers and social media campaigns. Awareness was measured with the question, “What is the leading cause of death for women in the United States?” Knowledge, perceptions, and stage of behavior change were measured with the Heart Disease Fact, Health Beliefs Related to CVD, and the Precaution Adoption Process Model questionnaires, respectively. All data were collected online via REDCap.

Results. A total of 149 women were included (mean=37.15±7.86 years). Over half (53.7%) of the sample had not decided to make changes in their behavior to reduce their likelihood of getting heart disease. A binary logistic regression of stage of behavior change on awareness, knowledge, and perceptions of CVD showed that the perception subscales of susceptibility and severity were significantly associated with intent to change behavior (OR 1.247, $p<0.001$ and OR

.809, $p=.004$ respectively). Awareness and knowledge of CVD were not associated with stage of behavior change. There were no significant sociodemographic and health condition predictors of stage of behavior change, although susceptibility and severity remained significant when controlling for these covariates (OR 1.242, $p=.002$ and OR=.801, $p=.004$, respectively)

Conclusions. Young and middle-aged women who believed that they were susceptible to CVD and did not perceive CVD as a serious condition were more likely to report an intent to change their behavior to reduce their risk of CVD compared to young and middle-aged women who did not believe they were susceptible to CVD.

Background

Cardiovascular disease (CVD) is the leading cause of death for women in the U.S., accounting for one in every four deaths.¹ Women disproportionately suffer from disease and disability related to CVD compared to men² and women less than 55 years old have seen the least amount of decline in mortality rates over the past 30 years.³

Framingham risk scores have increased among women with myocardial infarction ages 35-54 years.³ Nearly half of women ages 40-59 years of age are classified as obese.⁴ Among women ages 20 to 59 years of age, only 3.2% met recommendations to engage in moderate to vigorous physical activity for 30 minutes on five or more days of the week.⁴ Diabetes is a stronger predictor of CVD mortality in women than in men⁵, and the prevalence of diabetes is increasing in young women.⁶ CVD accelerates as a woman transitions through menopause, around 55 years of age.^{7,8} This makes the premenopausal time period a key time to focus on CVD on risk reduction.⁷

Even though younger women are increasingly at risk for CVD, awareness and knowledge of CVD are extremely low among young women.⁹⁻¹⁴ Over the past ten years, young women,

Hispanic women, and non-Hispanic Black women have experienced the largest declines in CVD awareness.¹⁵ CVD awareness and knowledge may lead to positive health behavior change, ultimately improving CVD outcomes.^{6,16} Ramachandran et al conducted a literature review assessing the relationship between awareness, knowledge, and healthy lifestyle behaviors among women throughout the world, finding that while awareness is generally associated with positive behavior change, the predictive relationship of CVD knowledge on risk factors was split.¹⁷ However, for young women, there has been little scientific literature validating that increasing CVD awareness and knowledge leads to positive behavior change and prevention of CVD. Therefore, the specific aims of this study were to: 1) Describe the relationship between stage of behavior change and awareness, knowledge, and perceptions of CVD among women 25-55 years and 2) identify the predictors of stage of behavior change.

Methods

Design, Sample, and Setting

The study design was cross sectional and descriptive, using an online self-administered survey. This study was part of a larger parent study titled, “Increasing Awareness of Heart Disease in Women with an AI-Driven Conversational Agent”. The goals of the parent study were to: 1) develop content and algorithms for a text-based chatbot with natural language capabilities; and 2) pilot test and refine the algorithms and content of the chatbot in 100 women with diverse racial and ethnic backgrounds. Eligibility criteria in the current study include: women ages 25-55 years of age; no self-reported cognitive impairment or history of CVD history; not healthcare students; not working in the healthcare field; and living in the United States (US). Participants were recruited via flyers posted at universities and clinics in Northern and Southern California. This recruitment method yielded a disproportionately high amount of non-Hispanic white

participants. Therefore, to allow adequate representations of race/ethnicity and inclusion of minority women, recruitment was expanded to directly target Hispanic and Black/African American women with advertisements on social media (Meta-Facebook, Instagram, Reddit, and Twitter). Data collection occurred between September 2022 and January 2023. Institutional Review Board (IRB) approval was acquired from the University of California, Los Angeles, and the University of California, San Francisco (IRB #22-000878 and #22-37159), respectively.

Measures

Sociodemographic data. Demographic data collected were age, ethnicity/race, education, household income, marital status, employment status, immigration status, primary language spoken at home, and health insurance status. Family history of CVD, self-reported history of high blood pressure (HTN), high cholesterol (HLD), and diabetes (DM), early menses status, and smoking status were also collected.

CVD awareness. CVD awareness was measured with the question, “What is the leading cause of death for women in the United States?” Possible answers included accidental death, AIDS, Alzheimer’s, breast cancer, cancer (general), diabetes, drug addiction/alcoholism, heart disease/heart attack, lung cancer, osteoporosis, smoking, stroke, violent crime, and suicide.^{15,18} The participant was considered to be aware of CVD if they correctly selected, “heart disease/heart attack”. This question has been frequently used in prior research to assess levels of CVD awareness among women of all ages and ethnicities.^{10,15,18,19}

CVD knowledge. We measured CVD knowledge with the Heart Disease Fact Questionnaire (HDFQ), a self-administered questionnaire with 25 true/false questions. Scores range from 0-25, with a higher score signifying a higher knowledge of CVD. The HDFQ takes about 10 minutes to complete and is written at a 6th grade reading level. The HDFQ was

originally tested in adults with diabetes. It was determined to have adequate internal consistency (Kuder-Richardson-20 formula = 0.77) and criterion-related validity as determined by discriminant function analysis.²⁰ For our study, the HDFQ was found to have adequate internal consistency (Kuder-Richardson-20 formula = 0.70).

CVD perceptions. CVD perceptions were measured with the Health Beliefs Related to Cardiovascular Disease (HBCVD) instrument. The HBCVD is self-administered, takes approximately 10 minutes to complete, and is written at a 6th grade reading level.²¹ The HBCVD was developed based on the Health Belief Model, which theorizes that humans adopt and maintain health behaviors due to perceived susceptibility and severity of a disease and the benefits and barriers to performing and maintaining a health behavior.²² The HBCVD has 25 items measured on a four-point Likert type scale (Strongly Disagree, Disagree, Agree, Strongly Agree). The HBCVD has four subscales: (1) five items for susceptibility (score range 5-20, a higher score is linked to a belief in higher personal susceptibility to CVD), (2) five items for severity (score range 5-20, a higher score indicating a higher belief in the severity of CVD), (3) six items for benefits (score range 6-24, a higher score indicating higher perceived benefits from engaging in CVD risk reducing behaviors), and (4) nine items for barriers (score range 9-36, a higher score indicating a higher belief in personal barriers to engaging in CVD risk reducing behaviors). The HBCVD was originally tested with adults with diabetes and was determined to have acceptable internal consistency among the subscales (susceptibility: $\alpha=0.93$; benefits $\alpha=0.82$; severity $\alpha=0.71$; barriers $\alpha=0.62$)²³. For our study, the subscales had acceptable internal consistency except for severity, which was below the acceptable threshold of 0.70 for an established instrument (susceptibility: $\alpha=0.861$; benefits $\alpha=0.822$; severity $\alpha=0.631$; barriers $\alpha=0.717$).

Stage of behavior change. We measured stage of behavior change using the Precaution Adoption Process Model Stage (PAPM). The PAPM instrument was originally used to assess the stage of behavior change in women with systemic lupus erythematosus for reducing CVD risk behaviors.²⁴ The instrument gives seven statements correlating to the adoption process model, from stage one (“I don’t think I’m at greater risk of getting heart disease than any other woman”) to stage seven (“I have made changes in my behavior to decrease my chances of getting heart disease for at least six months.”). The participant selects the stage of behavior change which they feel applies to them most at the time they complete the instrument.

Procedures

Participants were able to access the screening form, consent, and study instruments via the Research Electronic Data Capture (REDCap) website.^{25,26} REDCap is a secure web tool for creating and managing online surveys and data. To access the online screening, participants had to pass a Google reCAPTCHA test by clicking a checkbox, confirming that the participant is not a robot or malicious software.²⁷ Participants then completed a brief online screening form assessing study eligibility. After eligibility was confirmed, participants were e-mailed a link to the consent form and then the survey questionnaires. The principal investigator verified that participants used different IP addresses to access the study to validate that answers were coming from different participants. Participants received a \$10 e-gift card once they completed the study.

Statistical Analysis

Frequency and percentage statistics were calculated for awareness (“What is the leading cause of heart disease in women of all ages?”) and stage of behavior change (PAPM) and means and standard deviations were used to summarize knowledge (HDFQ) and perception (HBCVD) measures. Data were normally distributed. Stage of behavior change was divided into two

categories: women who did not decide to make changes to their behavior (stages 1-4) and women who decided to make changes to their behavior (stages 5-7) due to low group membership in individual stages (see Table 2), similar to Aycock et al's study²⁸. A chi square test and t test were used to determine differences between awareness, knowledge, and perceptions for participants who had or had not decided to make change to their behavior. Binary logistic regression (model 1) was used to evaluate the relationship between stage of behavior change and awareness, knowledge, and perceptions (Aim 1). The variables age, education, CVD risk factors (HTN, HLD, DM, and family history of CVD) and race/ethnicity (classified as non-Hispanic white/minority due to low group membership) were included in a binary logistic regression (model 2) as potential predictors of stage of behavior change (see Table 4) (Aim 2). The predictor variables were selected on a theoretical basis.²⁹ Education was used as a proxy for socioeconomic status. Participants who answered "Don't know" to history of HTN, HLD, DM, or CVD family history were excluded from analysis. A third logistic regression model was estimated including the significant predictors from the Aim 1 model, controlling for sociodemographic and health condition variables. Statistics were calculated using Statistical Package for the Social Sciences (SPSS) version 28.0 (IBM; Somers, NY).

Results

Characteristics of the Sample

A total of 149 women were included. The mean age of the participants was 37.15 ± 7.86 years (range 25-55). The majority of participants were members of racial and ethnic minority groups (70.5%), were well educated (61.7% college graduates), and had health insurance (94%) (see Table 1).

Table 1. Participant Characteristics	
	Total Sample (n=149)
Variable	Mean (SD) or n (%)
Age	37.15 (7.9)
Education	
Less than high school	1 (0.7)
Completed high school	14 (9.4)
Completed some college course work but did not finish	42 (28.2)
Completed college (4 years)	55 (36.9)
Completed graduate school	37 (24.8)
Household income	
Less than \$20,000	16 (10.7)
\$20,001- 40,000	31 (20.8)
\$40,001- 75,000	38 (25.5)
> \$75,000	61 (40.0)
Don't know	3 (2.0)
Marital status	
Never married	42 (28.2)
Currently married/cohabitating	95 (63.8)
Divorced/widowed	12 (8.1)
Employment status	
Employed for pay full time	82 (55.0)
Employed for pay part time	18 (12.1)
Unemployed and/or looking for a job	12 (8.1)
Student	6 (4.0)
Homemaker	22 (14.8)
Retired	1 (0.7)
Disabled	6 (4.0)
Other	2 (1.3)
Ethnicity/Race	
Asian	6 (4.0)
Black/African American	65 (43.6)
Hispanic/Latino	25 (16.8)
More than One Race/Ethnicity	9 (6.0)
White (Non-Hispanic)	44 (29.5)
Do you have children, under the age of 18, living with you at home?	
Yes	111 (74.5)
No	38 (25.5)
Do you have health insurance?	
Yes, private insurance	104 (69.8)
Yes, public insurance	36 (24.2)
No insurance	9 (6.0)

Did you immigrate to the United States?	
Yes	17 (11.4)
No	132 (88.6)
CVD Risk Factors	
Have you smoked at least one cigarette in the last 7 days?	
Yes	13 (8.7)
No	136 (91.3)
Have you ever been told that you have high blood pressure (140/90 mmHg or higher) or need medication to control your blood pressure?	
Yes	59 (39.6)
No	87 (58.4)
Don't know	3 (2.0)
Have you ever been told that you have high cholesterol or need medication to control your cholesterol?	
Yes	45 (30.2)
No	103 (69.1)
Don't know	1 (0.7)
Have you ever been told that you have diabetes or need medication to control your diabetes?	
Yes	21 (14.1)
No	126 (84.6)
Don't know	2 (1.3)
Have you ever been told that your mother or sister had a heart attack or stroke before age 65? OR Have you ever been told that your father or brother had a heart attack or stroke before age 55?	
Yes	25 (16.8)
No	122 (81.9)
Don't know	2 (1.3)

Note. SD is standard deviation. CVD is cardiovascular disease.

Awareness, Knowledge, and Perceptions of CVD and Stage of Behavior Change

Most (71.8%) of the participants were aware that CVD is the leading cause of death for women in the US (see Table 2). A little over half (53.7%) of women had not decided to make changes in their behavior to decrease their chance of getting heart disease, indicated by selecting a stage from 1-4 on the PAPM.

Table 2. Awareness, Knowledge, and Perceptions of CVD and Stage of Behavior Change				
	Total Sample (n=149)	PAPM Score 1-4* (n=81)	PAPM Score 5-7* (n=68)	P Value
Awareness (What is the leading cause of death for women in the United States?)	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	
Heart Disease	107 (71.8)	55 (67.9)	52 (76.5)	.276
Other	42 (28.2)	26 (32.1)	16 (23.5)	
Knowledge (HDFQ Score) (Scored 0-25)				
	22.62 (2.3)	22.65	22.59	.864
Perceptions (HBCVD Score) (Four Subscales)				
Severity (Scored 5-20)	12.09 (2.8)	12.56	11.54	.026
Susceptibility (Scored 5-20)	11.00 (3.4)	10.35	11.76	.011
Benefits (Scored 6-24)	22.05 (2.4)	22.06	22.03	.934
Barriers (Scored 9-36)	18.60 (4.6)	18.88	18.28	.429
Stage of Behavior Change (PAPM) (Stages 1-7)				
1. I don't think I'm at greater risk of getting heart disease than any other woman	34 (22.8)	34 (42)	0 (0)	-
2. I know I am at risk for heart disease, but I have not thought about it.	19 (12.8)	19 (23.5)	0 (0)	-
3. I am thinking about changing my behaviors to decrease my chances for getting heart disease, but I haven't made up my mind if it is something I want to do.	23 (15.4)	23 (28.4)	0 (0)	-
4. I have thought about changing some of my behaviors to decrease my chances for getting heart disease, but I have decided against it.	5 (3.4)	5 (6.2)	0 (0)	-
5. I have decided to change some of my behaviors to decrease my chance of heart disease, but I have not started doing them yet.	27 (18.1)	0 (0)	27 (39.7)	-
6. I have recently changed some of my behaviors within the last month to decrease my chances for getting heart disease.	22 (14.8)	0 (0)	22 (32.4)	-
7. I have made changes in my behavior to decrease my chances for getting heart disease for at least 6 months.	19 (12.8)	0 (0)	19 (27.9)	-

Note. CVD is cardiovascular disease; HDFQ is Heart Disease Fact Questionnaire; HBCVD is Health Beliefs Related to Cardiovascular Disease; PAPM is Precaution Adoption Process Model.

*PAPM score of 1-4 indicates the participant is not ready for behavior change. PAPM score of 5-7 indicates the participant has decided to make changes to their behavior.

The Relationship between Stage of Behavior Change and Awareness, Knowledge, and Perceptions of CVD

To determine if there was an association between stage of behavior change and awareness, knowledge, and perceptions of CVD, stage of behavior change was divided into two categories: women who did not decide to make changes to their behavior (stages 1-4) and women who decided to make changes to their behavior (stages 5-7) due to low group membership in individual stages (see Table 2). There were two significant variables in the model (Model 1) that were associated with stage of behavior change, the susceptibility (OR=1.247; CI=1.101-1.414; $p < .001$) and severity (OR=.809; CI=.699-.935; $p = .004$) components of the perception subscale (Table 3). Participants with a higher perception of susceptibility to CVD were more likely to fall into the category of deciding to make changes to their behavior, while participants with a lower perception of CVD severity were more likely to fall into the category of deciding to make changes to their behavior.

Table 3. The Relationship between Stage of Behavior Change and Awareness, Knowledge, and Perceptions of CVD Knowledge, and Perceptions of CVD			
	OR	95% CI	P value
Overall Model			.003
Awareness			
	1.370	.587-3.200	.467
Knowledge (HDFQ Score)			
	.959	.811-1.135	.629
Perceptions (HBCVD Scores)			
Severity Subscale	.809	.699-.935	.004
Susceptibility Subscale	1.247	1.101-1.414	<.001
Benefits Subscale	.961	.826-1.119	.612
Barriers Subscale	.953	.875-.038	.271

Note. CVD is cardiovascular disease; OR is Odds ratio; CI is Confidence Interval; HDFQ is Heart Disease Fact Questionnaire; HBCVD is Health Beliefs Related to Cardiovascular Disease

Predictors of Stage of Behavior Change

The variables age, education, CVD risk factors (HTN, HLD, DM, and family history of CVD) and race/ethnicity (classified as non-Hispanic white/minority due to low group membership) were included in a binary logistic regression (model 2) as potential predictors of stage of behavior change (see Table 4). The model was not statistically significant.

	OR	95% CI	P value
Overall Model			.167
Race/Ethnicity	2.248	.934-5.412	.071
Age	1.035	.986-1.086	.165
Education	.987	.667-1.462	.950
High Blood Pressure	.960	.460-2.003	.912
High Cholesterol	1.404	.648-3.042	.389
Diabetes	.808	.290-2.249	.683
Family History	1.026	.409-2.577	.956

Note. PAM is Precaution Adoption Process Model; OR is Odds Ratio; CI is Confidence Interval

Stage of Behavior Change and Severity and Susceptibility, Controlling for Sociodemographics and Health Conditions

We also tested relationship between the severity and susceptibility variables significantly associated with stage of behavior change in model 1, controlling for the covariates from model 2 (Table 5). Both the susceptibility and severity subscales of CVD perceptions remained significant ($p=.002$ and $p=.004$, respectively).

	OR	95% CI	P Value
Overall Model			.003
Race/Ethnicity	2.110	.838-5.314	.113
Age	1.035	.983-1.090	.188
Education	1.211	.7891-1.861	.381
High Blood Pressure	.711	.314-1.613	.415
High Cholesterol	1.258	.549-2.887	.587
Diabetes	.639	.206-1.976	.436
Family History	1.069	.411-2.777	.891

Susceptibility	1.242	1.081-1.427	.002
Severity	.807	.697-934	.004

Discussion

Stage of Behavior Change

The sample was nearly evenly split on whether or not they have decided to change their behavior to reduce their risk of getting heart disease. Previous studies had comparable findings. Weinstein et al. studied women (mean age 44±14.5) with a history of lupus, and found that over half of the women had decided to change their behavior to reduce their risk for CVD.²⁴ Similarly, Aycock et al. examined a sample of African American women ages 20-35 years old and examined women's intent to change behaviors to reduce the risk for stroke instead of risk for CVD.²⁸ Forty percent of the sample reported they were at a stage of behavior change to reduce stroke risk.

The Relationship between Stage of Behavior Change and Awareness, Knowledge, and Perceptions of CVD

Susceptibility and severity were significantly associated with stage of behavior change, even when controlling for potential confounders. Surprisingly, higher perceived severity of CVD was associated with being in the group that decided not to change their behavior to reduce their risk of heart disease. This could be due to a relatively young sample. Risk of CVD increases with age and it is possible that younger lay women are aware of this and not motivated to change their behavior or feel they have more time before at significant risk. In Gooding et al.'s qualitative study using online focus groups, participants ages 15-24 years stated they did not believe they were susceptible to heart disease, even after learning about the severity of heart disease.³⁰

Reasons for low perceived susceptibility included factors such as age, gender, sociocultural

expectations of women, levels of CVD awareness and knowledge, more immediate competing health concerns, and family health history.

Awareness and knowledge were not significant predictors of stage of behavior change, contrary to findings from other studies. Mosca et al found that CVD awareness was associated with preventative action among women³¹ and Thanavaro et al found that women with higher CVD knowledge were more likely to engage in a health promotion behavior.³² However, similar to our findings, Konicki did not find a relationship between knowledge of CVD risk factors and heart healthy behaviors.³³ Awareness and knowledge are not enough for behavior motivation; susceptibility plays a key role in behavioral intention formation, and many women in this sample had never been told they have HTN, DM, HLD, or a family history of heart disease.³⁴ Their younger age also puts them at lower risk for heart disease, lowering their perceived susceptibility to heart disease and urgency to change. Even though these women had knowledge of heart disease, they were not motivated to change their behavior.

Sociodemographic and Health Condition Predictors of Stage of Behavior Change

There were no significant predictors of stage of behavior change in the regression model. There may be unobserved and/or latent variables that we did not identify that would explain intent to change behavior. Aycock et al. found advancing age and a higher number of perceived risk factors to be associated with increased willingness to change behavior.²⁸ We were unable to confirm this in our study. In Gooding et al's study, participants cited barriers to preventative actions such as lack of access to resources needed for a heart healthy lifestyle, life stressors, and lack of time.³⁰ However, we did not find a correlation between barriers to adopting a healthy behavior and stage of behavior change in our study. Other macro and meso factors may be at play, such as social networks, neighborhood environment, peer influences, and government

policies, all of which can impact environmental structure and agency to adopt a health behavior.³⁵

Strengths and Limitations

The strengths of this study include a diverse racial and ethnic sample and use of validated instruments to measure knowledge and perceptions of heart disease. Even though the data were collected anonymously online, the investigator exchanged text messages with participants on several occasions, further validating the authenticity of different participants. Finally, Google reCAPTCHA was used to validate that the participant was a human being.

There were limitations to the study. Our participants were well-educated with moderate income, so our results may not be generalizable to lower income groups with less education. Heart disease risk factors were also self-reported due to the survey study design, so we could not validate the accuracy of the participants' health history. Also, the PAPM does not measure change in behavior, but a participant's self-reported intent to change behavior. Participants may not actually follow through on their intent to change their behavior. Lastly, participants were recruited using two methods, flyers posted in the community and messages on social media. Flyers were limited to a narrow geographical region and yielded a more homogenous sample. Our social media advertisement campaign targeted Black/African American and Hispanic women across the United States.

Conclusion

Young and middle-aged women who believed that they were susceptible to CVD and perceived CVD as a less serious condition were more likely to be in the category of planning to change their behavior to reduce their risk of CVD. Awareness and knowledge of CVD were not significantly associated with intent to change behavior. Susceptibility to and severity of CVD

may be key factors to leverage when educating young and middle-aged women on heart disease in order to facilitate heart healthy behaviors.

References

1. Benjamin Emelia J, Virani Salim S, Callaway Clifton W, et al. Heart Disease and Stroke Statistics—2018 Update: A Report From the American Heart Association. *Circulation*. 2018/03/20 2018;137(12):e67-e492. doi:10.1161/CIR.0000000000000558
2. Tsao CW, Aday AW, Almarzooq ZI, et al. Heart Disease and Stroke Statistics—2023 Update: A Report From the American Heart Association. *Circulation*. 2023/02/21 2023;147(8):e93-e621. doi:10.1161/CIR.0000000000001123
3. Nabel Elizabeth G. Heart Disease Prevention in Young Women. *Circulation*. 2015/09/15 2015;132(11):989-991. doi:10.1161/CIRCULATIONAHA.115.018352
4. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association. *Circulation*. 2019/03/05 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659
5. Zhao M, Vaartjes I, Graham I, et al. Sex differences in risk factor management of coronary heart disease across three regions. *Heart*. 2017;103(20):1587. doi:10.1136/heartjnl-2017-311429
6. Mosca L, Benjamin EJ, Berra K, et al. Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women—2011 Update. *Circulation*. 2011/03/22 2011;123(11):1243-1262. doi:10.1161/CIR.0b013e31820faaf8
7. El Khoudary SR, Aggarwal B, Beckie TM, et al. Menopause Transition and Cardiovascular Disease Risk: Implications for Timing of Early Prevention: A Scientific Statement From the American Heart Association. *Circulation*. 2020/12/22 2020;142(25):e506-e532. doi:10.1161/CIR.0000000000000912

8. McSweeney JC, Rosenfeld AG, Abel WM, et al. Preventing and Experiencing Ischemic Heart Disease as a Woman: State of the Science. *Circulation*. 2016/03/29 2016;133(13):1302-1331. doi:10.1161/CIR.0000000000000381
9. Giardina E-GV, Sciacca RR, Flink LE, Bier ML, Paul TK, Moise N. Cardiovascular Disease Knowledge and Weight Perception Among Hispanic and Non-Hispanic White Women. *Journal of Women's Health*. 2013/12/01 2013;22(12):1009-1015. doi:10.1089/jwh.2013.4440
10. Giardina E-GV, Mull L, Sciacca RR, et al. Relationship Between Cardiovascular Disease Knowledge and Race/Ethnicity, Education, and Weight Status. <https://doi.org/10.1002/clc.20992>. *Clinical Cardiology*. 2012/01/01 2012;35(1):43-48. doi:<https://doi.org/10.1002/clc.20992>
11. Mosca L, Ferris A, Fabunmi R, Robertson Rose M. Tracking Women's Awareness of Heart Disease. *Circulation*. 2004/02/10 2004;109(5):573-579. doi:10.1161/01.CIR.0000115222.69428.C9
12. Mosca L, Mochari-Greenberger H, Dolor Rowena J, Newby LK, Robb Karen J. Twelve-Year Follow-Up of American Women's Awareness of Cardiovascular Disease Risk and Barriers to Heart Health. *Circulation: Cardiovascular Quality and Outcomes*. 2010/03/01 2010;3(2):120-127. doi:10.1161/CIRCOUTCOMES.109.915538
13. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert Michelle A. Fifteen-Year Trends in Awareness of Heart Disease in Women. *Circulation*. 2013/03/19 2013;127(11):1254-1263. doi:10.1161/CIR.0b013e318287cf2f
14. Bairey Merz CN, Andersen H, Sprague E, et al. Knowledge, Attitudes, and Beliefs Regarding Cardiovascular Disease in Women. *Journal of the American College of Cardiology*. 2017/07/11 2017;70(2):123-132. doi:10.1016/j.jacc.2017.05.024

15. Cushman M, Shay CM, Howard VJ, et al. Ten-Year Differences in Women's Awareness Related to Coronary Heart Disease: Results of the 2019 American Heart Association National Survey: A Special Report From the American Heart Association. *Circulation*. 2021/02/16 2021;143(7):e239-e248. doi:10.1161/CIR.0000000000000907
16. Cubbin C, Winkleby MA. Protective and Harmful Effects of Neighborhood-Level Deprivation on Individual-Level Health Knowledge, Behavior Changes, and Risk of Coronary Heart Disease. *American journal of epidemiology*. 2005;162(6):559-568. doi:10.1093/aje/kwi250
17. Ramachandran HJ, Wu VX, Kowitlawakul Y, Wang W. Awareness, knowledge and healthy lifestyle behaviors related to coronary heart disease among women: An integrative review. *Heart & Lung*. 2016/05/01/ 2016;45(3):173-185.
doi:<https://doi.org/10.1016/j.hrtlng.2016.02.004>
18. Mosca L, Hammond G, Mochari-Greenberger H, Towfighi A, Albert MA. Fifteen-year trends in awareness of heart disease in women. *Circulation*. 2013/03/19 2013;127(11):1254-1263. doi:10.1161/CIR.0b013e318287cf2f
19. Mosca L, Jones WK, King KB, Ouyang P, Redberg RF, Hill MN. Awareness, perception, and knowledge of heart disease risk and prevention among women in the United States. *Archives of family medicine*. 2000;9(6):506-515. doi:10.1001/archfami.9.6.506
20. Wagner J, Lacey K, Chyun D, Abbott G. Development of a questionnaire to measure heart disease risk knowledge in people with diabetes: the Heart Disease Fact Questionnaire. *Patient Education and Counseling*. 2005/07/01/ 2005;58(1):82-87.
doi:<https://doi.org/10.1016/j.pec.2004.07.004>

21. Tovar EG, Rayens MK, Clark M, Nguyen H. Development and psychometric testing of the Health Beliefs Related to Cardiovascular Disease Scale: preliminary findings. *J Adv Nurs*. Dec 2010;66(12):2772-84. doi:10.1111/j.1365-2648.2010.05443.x
22. Champion VL, Skinner CS. *Health Behavior and Health Education*. 4th ed. Jossey-Bass; 2008.
23. Tovar E, Clark MC. Knowledge and health beliefs related to heart disease risk among adults with type 2 diabetes. *J Am Assoc Nurse Pract*. Jun 2015;27(6):321-7. doi:10.1002/2327-6924.12172
24. Weinstein PK, Amirkhosravi A, Angelopoulos TJ, Bushy A, Covelli MM, Dennis KE. Reducing Cardiovascular Risk in Women With Lupus: Perception of Risk and Predictors of Risk-Reducing Behaviors. *Journal of Cardiovascular Nursing*. 2014;29(2)
25. Harris PA, Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. . Research electronic data capture (REDCap)– a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of biomedical informatics*. 2009;42(2):377-381. doi:<https://doi.org/10.1016/j.jbi>
26. Harris PA, Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O’Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J., Duda, S. N., REDCap Consortium. The REDCap consortium: Building an international community of software platform partners. . *Journal of biomedical informatics*. 2019;95(103208)doi:<https://doi.org/10.1016/j.jbi.2019.10320814>
27. Google ReCAPTCHA. 2021. <https://developers.google.com/terms/site-policies>
28. Aycock DM, Clark PC, Anderson AM, Sharma D. Health Perceptions, Stroke Risk, and Readiness for Behavior Change: Gender Differences in Young Adult African Americans. *J Racial Ethn Health Disparities*. Aug 2019;6(4):821-829. doi:10.1007/s40615-019-00581-0

29. Arnett Donna K, Blumenthal Roger S, Albert Michelle A, et al. 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary. *Journal of the American College of Cardiology*. 2019/09/10 2019;74(10):1376-1414.
doi:10.1016/j.jacc.2019.03.009
30. Gooding HC, Brown CA, Revette AC, et al. Young Women's Perceptions of Heart Disease Risk. *Journal of Adolescent Health*. 2020;67(5):708-713.
doi:10.1016/j.jadohealth.2020.05.010
31. Mosca L, Mochari H, Christian A, et al. National study of women's awareness, preventive action, and barriers to cardiovascular health. *Circulation (New York, NY)*. 2006;113(4):525-534. doi:10.1161/CIRCULATIONAHA.105.588103
32. Thanavaro JL, Moore SM, Anthony M, Narsavage G, Delicath T. Predictors of health promotion behavior in women without prior history of coronary heart disease. *Applied nursing research*. 2006;19(3):149-155. doi:10.1016/j.apnr.2005.07.006
33. Konicki AJ. Knowledge of Cardiovascular Risk Factors, Self-nurturance, and Heart-Healthy Behaviors in Women. *J Cardiovasc Nurs*. 2012;27(1):51-60.
doi:10.1097/JCN.0b013e31820e2f95
34. Schuz B, Sniehotta F, Mallach N, Wiedemann A, Schwarzer R. Predicting transitions from preintentional, intentional and actional stages of change. *Health Education Research*. 2009;24(1):64-75.
35. Short SE, Mollborn S. Social determinants and health behaviors: conceptual frames and empirical advances. *Current Opinion in Psychology*. 2015/10/01/ 2015;5:78-84.
doi:<https://doi.org/10.1016/j.copsyc.2015.05.002>

Chapter Five: Dissertation Summary

Significance of the Study

Younger women and racial/ethnic minorities have been historically underrepresented in the scientific literature on cardiovascular disease, and this systematic review and research helps shed light on these populations. From the literature review, there was a gap in the literature concerning young women and CVD awareness, knowledge, and perceptions, revealing the need for more research on young women. For the research study, although awareness and knowledge of CVD were high in this sample, perceived susceptibility to CVD was low. Additionally, CVD awareness and knowledge were not associated with stage of behavior change. Perceived susceptibility to and severity of CVD were associated with behavior change.

Directions for Future Research

This dissertation revealed some directions for future research. Surprisingly, higher perceived severity of CVD was associated with a participant not being in a stage of behavior change where they intend to change their behavior, contradicting prior literature. More research is needed to shed light on this phenomenon. Additionally, susceptibility to CVD was associated with being in a stage of behavior change where the participant intends to change their behavior. This can be leveraged in future intervention studies to promote positive behavior change.