Published in final edited form as:
J Cardiovasc Nurs. 2014 ; 29(2): 108–129. doi:10.1097/JCN.0b013e31827db5eb.

Family history of cardiovascular disease (CVD), perceived CVD risk, and health-related behavior: A review of the literature

Christopher C. Imes, PhD and
University of Pittsburgh, School of Nursing Pittsburgh, PA

Frances Marcus Lewis, PhD
Family and Child Nursing, University of Washington, School of Nursing, Seattle, WA

Abstract

Background—Over 82 million Americans have one or more forms of cardiovascular disease (CVD), accounting for 32.8% of all deaths in the United States. Although the evidence for the familial aggregation of CVD is strong, the relationship between family history (FH) of CVD, perceived risk for CVD and their relationship to health-related behavior is poorly understood.

Objective—The objective of this article is to review and summarize the published research on the relationship between a FH of CVD, an individual's perceived risk, and health-related behavior in order to make recommendations for clinical practice and future research.

Methods—A literature search was conducted using PubMed, CINAHL Plus, and PsycINFO to identify articles that examined the relationship between a FH of CVD, perceived CVD risk, and health-promoting behaviors. A total of 263 unique articles were reviewed. Two hundred thirty-eight were excluded, resulting in a total of 25 articles included in the paper.

Results—There was a positive relationship between a reported FH of CVD and perceived risk. However, the relationship between a FH of CVD and health-related behavior change and perceived risk and behavior change was inconsistent.

Conclusions—A person's awareness of their FH of CVD or their own risk for CVD is not a sufficient predictor of changes in their health-related behavior. Future studies are needed to better explain the processes by which perceived CVD risk or FH of CVD can be used to affect health-related behavior changes. It appears that both FH and perceived personal risk for CVD are necessary but not sufficient conditions to change health-related behavior in high-risk populations. Future studies should also test interventions that help individuals with a FH of CVD attribute increased personal risk to themselves for developing CVD, while providing lifestyle management options to minimize their risk.

Cardiovascular disease (CVD), disease that affects the heart and vessels, includes elevated blood pressure, coronary heart disease (CHD), heart failure, and stroke.[1] Approximately 82 million Americans have one or more forms of CVD, and in 2009, 811,940 deaths were caused by CVD, accounting for 32.8% of all deaths in the United States.[1]

There are two types of risk factors for CVD: non-modifiable and modifiable. The non-modifiable risk factors include genetic factors, ethnicity, gender, and age. The modifiable risk factors include body weight, blood pressure, lipid and lipoprotein levels, and smoking

Corresponding Author: 440 Victoria Building, 3500 Victoria St, Pittsburgh, PA, 412-383-8754, imesc@pitt.edu.

Christopher C. Imes has no financial disclosures or conflicts of interest.
Frances Marcus Lewis has no financial disclosures or conflicts of interest.

status. Health-promoting behaviors aimed at the modifiable risk factors can prevent or reduce CVD. Through exercise, proper diet, medications, and smoking cessation an individual can decrease their risk for developing CVD.[1–4]

There is strong epidemiologic evidence for the familial aggregation of CVD. Researchers from the Framingham Study reported that having CVD in at least one parent doubled the 8-year risk of CVD among men and increased the risk among women by 70%.[5] The excess risk was independent of other risk factors such as age, ratio of total/high-density lipoprotein cholesterol (HDL-C) level, systolic blood pressure (SBP), antihypertensive therapy, diabetes, body mass index (BMI), and current smoking status.[5] Additionally, retrospective studies have estimated the odds ratio (OR) of a lifetime cardiovascular event for an individual with a single first-degree relative (FDR) with a history of a cardiovascular event to be 1.1–2.63.[6–11] The OR increases to 4.1 (95% confidence interval [CI]:2.5–6.7) when the FDR has had a premature cardiovascular event, defined as a cardiovascular event before the age of 55.[7]

Family history (FH) is the medical and health information of your family members. The medical and health information from your first- and second-degree relatives is most informative because an individual shares 50% and 25%, respectively, of their genes with them. FHs serve as a bridge from genetics to genomics in clinical practice because they reflect the presence of not only single-gene disorders, but also of shared genes that may be responsible for polygenic (complex) disorders, environments, and gene-environment interactions that may influence risk.[12] Because FH is an independent risk factor for CVD, it has the potential to become a screening tool to identify people, especially asymptomatic young adults, who are at increased CVD risk.[13]

During the recent National Institutes of Health State-of-the-Science Conference on FH and improving health, the panel “recognized that FH has an important role in the practice of medicine and may motivate positive lifestyle changes, enhance individual empowerment, and influence clinical intervention.”[14] The panel also stated that it is currently unclear how FH information can be effectively gathered and that substantial additional research is needed for FH collection to become an evidenced-based tool.[14]

The objective of this article is to review and summarize the published research on the relationship between a FH of CVD, a person’s perceived risk, and health-related behavior in order to make recommendations for clinical practice and future research. In this paper, CVD is used to include the general term heart disease and the more specific terms of coronary heart disease (CHD) and myocardial infarction (MI). FH will be used to denote the longer term “family history of CVD.” Perceived risk is an individual’s subjective risk for developing CVD in their lifetime or within a certain period of time (10-year CHD risk, for example). An individual’s perceived risk may accurately reflect their objective risk, based on CVD risk factors, or may be higher or lower than their objective risk. Health related-behaviors are the behaviors known to increase or decrease CVD risk, specifically smoking status, diet, and physical activity. The underlying assumption is that a FH results in increased perceived risk, which causes an uptake of positive health-related behaviors (smoking cessation, eating a low-fat, low cholesterol diet, and engaging in adequate physical activity on a weekly basis), decreasing one’s risk factors for CVD. This paper will review the research that has examined all, or parts of, this assumption.

Specific aims of the paper are to: (1) examine the relationship between FH and health-related behavior change when perceived risk is not assessed; (2) examine the relationship between FH and perceived risk; (3) examine the relationship between perceived risk and

health-related behavior change; (4) examine the impact of age and gender on FH information and perceived risk; and (5) recommend directions for future research.

Methods

A literature search was conducted in August 2012 using PubMed, CINAHL Plus, and PsycINFO. In PubMed the following search terms were used: family history CVD perceived risk, family history CVD risk perception, family history heart disease perceived risk, family history heart disease risk perception, family history CVD behavior change, and family history heart disease behavior change. There were no restrictions placed on years searched and the earliest article reviewed was from 1983. A total of 206 PubMed articles were examined, although 56 were duplicates. At a minimum, the abstract for each article was reviewed. A total of 127 articles were eliminated for a number of reasons, the most common being: if the study sample did not have a FH of CVD, if the article examined novel physiological or genetic methods to assess CVD risk, and if the article discussed practice guidelines or evaluated clinicians' practices. A final pool of 23 articles was retained for inclusion in the review.

Similar searches were conducted using CINAHL Plus and PsycINFO with slightly different search terms. A total of 67 (87 articles minus 20 duplicates) unique articles were examined in CINAHL Plus. All but one of the articles were excluded for various reasons. Forty-six (a total of 92 articles minus 46 duplicates) unique PsycINFO articles were examined. Forty-five were excluded. The CINAHL Plus and PsycINFO searches added 2 new articles, bringing the total number of articles reviewed in this paper to 25.

Additionally, Cochrane Reviews were searched using the terms: perceived heart disease risk, FH heart disease, and prevention heart disease. There were no relevant Cochrane Reviews to be included in the review.

Results

Studies included in this review are summarized in Appendix A. Seven studies examined the relationship between FH and health-related behavior change without examining perceived risk.[15–21] Seventeen studies examined the relationship between FH and perceived risk.[22–38] Thirteen were quantitative studies[22–34] and four were qualitative studies.[35–38] Four of the seventeen articles that examined the relationship between FH and perceived risk also examined health-related behavior change. Examining those results will enable us to examine the role of perceived risk on health-related behavior change.[24,25,27,31] One study did not examine perceived risk, but looked at how males and females attributed their CHD risk differently.[39] Each of these studies is discussed in more detail below; see Appendix A for further details.

Relationship between FH of CVD and health-related behavior change

Table 1 provides the results from the seven studies that examined the relationship between FH and health-related behavior change when perceived risk is not assessed. Overall, study participants' awareness of FH had little or no effect on health-related behavior except for following an aspirin regimen and, in a few studies, undergoing cholesterol screening.

Tamragouri and colleagues[15] compared the CVD health knowledge and health behaviors in two groups of college freshman, those with a FH (n=69) and those without a FH (n=155), in a cross-sectional, descriptive comparative study. CVD knowledge, assessed using the Iowa Cardiovascular Health Knowledge Test, was low in both groups with no difference between the FH group and the non-FH group.[15] Students with a FH were less likely to exercise

(OR=0.38,90% CI:0.16–0.91) and were more likely to feel overweight (OR=1.73, 90% CI: 1.02–2.94) compared to the non-FH students.[15] There were no statistically significant differences between the two groups regarding diet, efforts to receive health information, smoking status, or serum cholesterol testing.[15]

Kip and colleagues[16] examined if the occurrence of a heart attack or stroke in a family member affected the health-related behaviors of young adults by studying a cohort over a ten-year period. There were no significant differences in change in weight, physical activity, low-density lipoprotein cholesterol (LDL-C), HDL-C, triglycerides, SBP, diastolic blood pressure (DBP), or likelihood to quit smoking between young adults with FH of heart attack or stroke in the last five years versus those without an event during the same time period.

Kelley and colleagues[17] compared the dietary intake, using a 151-item food frequency questionnaire, of at-risk children (n=68) to non-risk children (n=229) based on their FH. There were no differences between the two groups on intake of macronutrients, fiber, cholesterol, or percentage of calories as fat. For each group, the percentage of calories as fat and saturated fat were higher than recommended.[17] Mean non-fasting cholesterol was significantly greater in the at-risk group compared to the not-at-risk group (4.71 SD ± 0.93 mmol/L vs, 4.35 SD ± 0.92 mmol/L, p=.005).[17]

McCusker and colleagues,[18] using data from the 2001 Healthstyles survey, compared individuals with no reported FH of CVD (average risk) to individuals with one reported relative with a history of CVD (moderate risk) and to individuals with two or more reported relatives with a history of CVD (high risk). After adjusting for age, there were no differences between the average risk group and the combined moderate/high risk group in their health-related behavior.[18] Specifically, there were no differences in cutting back on high-fat foods, increasing consumption of fruits and vegetables, increasing physical activity, or trying to stop smoking (among smokers only).[18] However, the two groups did differ on serum cholesterol testing ($p < 0.01$) and aspirin use ($p = 0.02$).[18]

Thanavaro et al.[19] examined the CVD knowledge, health-promoting lifestyle, and the perceived benefits and barriers to a health-promoting lifestyle in 119 women without a prior history of CHD. Overall the sample had low CHD knowledge (mean score of 60% correct answers on the CHD Knowledge Test) and did not regularly practice health-promotion (mean summed score on the Health-Promoting Lifestyle Profile II was 136.4 with a mean item score of 2.62).[19] However, backward multiple regression analysis showed that FH was a positive predictor of health-promoting behavior in this sample.[19]

A recent study by Andersson and colleagues,[20] used a cross-sectional, descriptive design, to examine the impact of FH of CVD on health-promoting behaviors in a sample of Swedish and Polish participants (2054 individuals surveyed, 424 with a FH). Compared to non-FH individuals, there were no differences in self-reported smoking (OR=0.839, 95% CI: 0.66–1.07; p=.152) and exercise (OR=1.134, 95% CI: 0.88–1.47; p=.344) in individuals with a FH compared to those without a FH.[20] Individuals with a FH were more likely to be obese (OR=0.492, 95% CI: 0.31–0.78; p=.002) compared to non-FH individuals.[20]

Slattery and colleagues[21] examined the prevalence of self-reported FH of heart attack and stroke and health-promoting behaviors among American Indian and Alaska Native people as part of the Education and Research Towards Health Study. Over 50% of participants either preferred not to provide FH information (23.5%) or did not know their FH of heart attack (29.7%) or stroke (32%).[21] Individuals with a FH of heart attack or stroke had higher BMI (31.5 vs. 30.7; p<.001), report less vigorous physical activity (2.6 hours per week vs. 3.2; p<.001), and had higher total serum cholesterol (198.8 mg/dL vs. 188.2 mg/dL; p<.001) and LDL-C (114.8 mg/dL vs. 107.3 mg/dL; p<.001) than those without a FH.[21]

Recall that the studies just reviewed did not directly measure perceived risk. Having family members with CVD does not equate with individuals perceiving themselves as being at increased risk for developing CVD. Perceived risk is distinct from having a FH of risk.

Relationship between FH of CVD and perceived risk

Seventeen articles in this review examined the relationship between a FH of CVD and perceived risk. Thirteen were quantitative studies[22–34] and four were qualitative studies.[35–38] See Table 2 for the results of the quantitative studies only, which are reviewed below.

From the baseline data of the British Family Heart Study, Marteau and colleagues found that the majority of participants with CHD risk factors perceived their 15-year heart attack risk as the same or higher than other people of the same age and sex.[22] Nine hundred-sixty-four participants had at least one FDR with CHD before the age of 65; only 25% of these individuals perceived their risk as lower than others.[22] Among the 488 participants with a BMI > 30, only 25.8% of them perceived their risk as lower than others.[22] Finally, 665 participants had a serum cholesterol level >251 mg/dL and 32.5% of these individuals perceived their risk as lower than others their same age and sex.[22] Overall, the participant's self-assessed CHD risk was strongly positively associated with their epidemiologically based risk ($p<.001$).[22]

In a descriptive, comparative study, Ponder et al.[23] interviewed teenagers (n=58) and their parents (p=54) to examine the extent to which people take their FH into account when considering their health risks. Forty-one percent of the participants perceived their risk for heart disease as higher than their peers and 30% perceived their risk as being the same as their peers.[23] Of the individuals with increased perceived risk, 70% of them attributed their risk to FH.[23] It is important to note that actual risk for heart disease was not calculated as part of the study.

Hunt and colleagues[24] used three cohorts of different ages, around 23, 43, and 63 years old, to examine the relationship between FH and health-related behaviors and attitudes. They found that 76–78% (varied by cohort) of individuals with a FH stated that FH had "quite [an] important effect" or "very important effect" on the etiology of heart disease. The individuals with a FH, perceived their risk for heart disease to be about twice as high as individuals without a FH ($p<.001$).[24] The authors also found that perceived FH of heart disease was significantly related to the number of relatives the participants reported as having heart disease ($p<0.0001$).[24]

Despite these positive findings, Hunt et al.[24] also found a significant number of individuals with two FDRs with heart disease (40% to 52% depending on the cohort) who did not report a FH of heart disease. The percentage of individuals who did not report a FH of heart disease when one FDR had heart disease was even higher (56% to 83%, depending on the cohort).[24] These individuals scored significantly lower on perceived heart disease risk compared to individuals "aware" of their FH ($p <0.001$), despite similar actual risk.[24]

In a descriptive study with 571 sons of men with a premature coronary event, Kavanagh et al.[25] examined the modifiable risk factors in the sample and assessed the personal health initiatives of the offspring. The prevalence of risk factors in the participants was high: almost 50% had less than optimal cardiovascular fitness or a serum cholesterol level > 200 mg/dL and a third were overweight. Forty-two percent of participants rated their concern about their health as high.[25]

Montgomery and colleagues,[26] using a questionnaire that assessed perceived heart disease risk and FH of heart disease, found that in both men (n=196) and women (n=326), a FH of heart disease was associated with higher levels of perceived heart disease risk (p<.001). Patel et al.,[27] discussed in greater detail in the next section, found an increased perceived lifetime risk for premature MI in men and women who reported a FH of MI, compared to those with no FH (in men, 75.0% vs. 48.3%; p=.004; in women, 59.7% vs. 47.4%; p=.001).

The study by Acheson and colleagues[28] examined if FH was related to individuals' perceived risk as part of the Family Healthware Study. Participants completed questionnaires measuring demographics, health-status, disease risk factors, and perceived risk (among other health perceptions).[28] Next, the participants used an on-line questionnaire to record a detailed family medical history.[28] Based on the FH information, familial risk for CHD and stroke was calculated as: weak if the individual had no FDR with the condition, moderate if they had one FDR with the condition, or strong if they had more than one FDR with the condition.[28]

In the study, the majority of people who were at increased risk for heart disease and stroke, based their familial risk, did not consider themselves at increased risk.[28] For CHD, only 30% of individuals with one or more FDR with CHD actually perceived their risk as being above or much above average risk.[28] The percentage of individuals at increased risk for stroke who perceived their risk to be above or much above the average risk was even lower at 21%.[28]

A recently study by Darlow et al.[29] investigated the perceived heart disease risk of 397 overweight or obese women. Demographic information, self-perceived weight status, the degree to which weight was a health problem, and their perceived heart disease risk compared to persons the same age and sex were collected.[29] Perceiving oneself as overweight (OR=4.33, 95% CI: 1.26–14.86) and a FH of heart disease (OR=2.25, 95% CI: 1.08–4.69) were associated with greater perceived risk for heart disease.[29]

Ayanian and Cleary[30] examined the perceived MI risk of 737 current smokers in a cross-sectional, descriptive study. Less than 30% of the current smokers perceived their risk as higher than individuals of the same age and sex.[30] Of the smokers with a FH of MI, only 39% viewed their risk as higher than individuals of the same age and sex, even though they had at least two risk factors for MI.[30]

In a study by Allen and Blumenthal[31] that examined perceived CHD risk in "healthy" offspring of women with premature CHD, about half (47%) of the offspring perceived their CHD risk as equal to or lower than others their age despite being at elevated risk.[31] The majority of the off-spring (77%) had three or more major risk factors.[31] Of those at high risk, 54% perceived themselves at greater risk compared to others their age and gender.[31] An important finding from the study is that only 28% of the sample cited heredity as an important factor in the development of heart disease.[31] Whether or not the offspring were aware of their FH of CHD was not assessed in the study.

A similar cross-sectional, descriptive study by Thompson et al.[32] compared the CVD risk factors in 103 family members of patient's with premature CHD to a general population control group. The FH group had a significantly higher percentage of individuals with an ASSIGN risk score >20% (13% vs. 2%; p<.001) compared to the non-FH group.[32] Only 37% of the FH group were aware they were at increased risk and only 50% had had their blood pressure and cholesterol level checked in the previous three years.[32]

DeSalvo and colleagues[33] examined the characteristics associated with underestimating CVD risk in a sub-sample of 128 African-American women who were enrolled in a

randomized-control trial.[33] CVD risk factors were prevalent in the sample. Over 70% were obese or had hypertension and around 50% had hypercholesterolemia or a FH of heart disease.[33] Seventy-nine percent of the sample had at least three CVD risk factors. Among these individuals, 63% did not perceive themselves to be at risk for heart disease. Within the sample as a whole, perceived CVD risk and objective risk was poorly correlated.[33]

To examine and compare the perceived CVD risk versus actual CVD risk in a Hispanic sample, Diaz et al.[34] surveyed 183 Hispanic adults (51% women). Only 14.8% of respondents underestimated their 10-year risk using the Personal Heart Early Assessment Risk Tool. However, respondents with a FH of heart attack were significantly more likely to underestimate their risk (30% vs. 11.6%; p=.02) compared those without a FH.[34]

Overall, the results from the quantitative studies are mixed. All of the studies reported that some individuals with a FH had increased perceived CVD risk compared people their same age or compared to people without a FH. However, the percentage of people with an increased perceived risk, compared to all at-risk individuals, ranged from as low as 21% to as high as 75%. In most of the studies, at least half of the high-risk individuals felt their risk was the same or lower than the low-risk individuals.

Most of the studies did not examine why some of the at-risk individuals underestimated their risk. It is likely that some individuals with a FH may not even be aware of it or may not fully understand the term “FH.” In two studies, even when study participants could list family members with heart disease, they denied having a FH of heart disease.[24,28] However, in three studies, individuals with an increased perceived risk for heart disease specifically attributed their elevated risk to heredity or FH.[23,24,31] This could suggest that these individual had a better understanding of the concept of FH and its impact on personal health. One study found that perceived risk was associated with the number of relatives the participants reported as having heart disease ($p<0.0001$).[24] This finding was supported by the qualitative studies.

Findings from qualitative studies revealed that age, number and closeness of affected relatives,[35–37] symptoms of heart disease in family members,[36–38] and fatal events, especially premature deaths,[36–38] may influence perceived risk and whether an individual is aware of their FH. However, in two of the qualitative studies, individuals did not always perceive themselves at increased risk based on their FH because they felt they were different in important ways from their affected relatives.[35–37]

Relationship between perceived risk and health-related behavior change

Table 3 provides the results of the four studies that measured perceived risk and health-related behavior change. The results were mixed.[24,25,27,31] As reported earlier, slightly less than 50% of the offspring in the study by Allen and Blumenthal[31] reported that their risk for CHD was less or equal to others despite having a mother with premature CHD. This low perceived risk was reflected in the participants’ health beliefs and behaviors. Almost one third (31%) of participants were smokers, 56% exercised fewer than three times a week, and 48% were overweight. In the year previous to that study, only 26% of participants improved their diet and 15% increased their amount of exercise.[31] Despite having multiple modifiable risk factors and a FH of CHD, the participants did not perceive themselves at risk for heart disease.[31] Due to the low perceived risk, participants did not engage in health-related behaviors that could lower their overall risk.

Hunt et al.[24] examined the relationship between perceived risk and health-promotion attitudes and beliefs. Researchers found that individuals with a reported FH were more likely to “agree” or “strongly agree” that not smoking and exercising were important for

individuals with a FH of heart disease compared to those individuals with no reported FH ($p<0.001$ for smoking and $p<0.001$ for exercise).[24] However, this relationship only occurred in the youngest cohort (around age 23),[24] suggesting that younger individuals may have a greater awareness of the importance of smoking cessation and exercise in decreasing the risk for developing heart disease. The study only examined health promotion attitudes and beliefs; actual behaviors were not measured.

As previously reported, the offspring of men with a premature coronary event, in the study by Kavanagh et al.,[25] had a high level of concern regarding their health. Nonetheless, only 25% exercised regularly and fewer than 50% attempted to eat a low-fat diet.[25] The study also examined the activities of the individuals' family physicians. Over 90% saw their physician regularly, but only 53% had their lipid levels evaluated.[25] Fewer than 10% of these individuals received advice or counseling based on their results.[25] Participants reported that their physician rarely counseled them on lifestyle modification: only 11% were advised on a low-fat diet and 18% were recommended to increase their physical activity.[25]

Patel et al.[27] found an increased perceived lifetime risk for premature MI in men and women with a reported FH of MI. This increased perceived risk resulted in different behaviors in men and women. Men with a FH of premature MI were less likely to be sedentary than men with no FH ($p=.001$).[27] However, women with a FH of premature MI were more likely to smoke than those with no FH ($p<.001$).[27] The women in the study may have had less awareness of CVD risk factors, which resulted in the poor health-related behaviors.[27]

Role of age on FH and perceived risk

Ponder and colleagues' study[23] was the only one that compared perceived risk of heart disease in adolescents and their parents. Adolescents (ages 16 to 18) reported a fewer number of relatives in general compared to their parents' report.[23] Also, the parents were able to report more details (age of relatives, presence or absence of diseases, age at death) about relatives than the adolescents.[23] In fact, none of the FHs reported by the adolescents were identical to the FHs reported by their parents.[23] There was also a significant difference in the number of family members reported as having had heart disease ($p<0005$) between the teenagers and adults.[23]

However, when it came to perceived risk, Ponder and colleague[23] found no significant differences in perceived risk between the two generations. For both generations, less than half of the participants thought they were more likely than their peers to develop heart disease.[23] The study by Hunt at al.[24] also found no difference in perceived risk in three cohorts of study participants (aged 23, 43, and 63) who had a reported a FH of CVD.

Role of gender on FH and perceived risk

The role of gender on FH and perceived risk was not clear in the reviewed studies. Two studies, Hunt et al.[24] and Patel et al.,[27] reported that women were more likely to report a FH of CVD compared to men. In the study by Slattery et al., women were more likely than men to complete the FH portion of the questionnaire and were more likely to know their FH.[21] Diaz and colleagues reported that men more commonly under-estimated their CHD risk compared to women (26.1% of men vs. 3.4% of women; $p<.001$)[34]. The qualitative study by Hunt and colleagues[24] also found that women gave more detailed accounts of their FH compared to men and that men required a greater number of close relatives to be affected in order to perceive a FH. However, in three studies, there were no differences in perceived risk between males and females.[23,26,27]

Astin and Jones (2005), compared men's (n=108) and women's (n= 33) perceived causal attributions for their CHD through semi-structured interviews. Women more frequently cited

FH as the cause of their CHD (41% vs. 28%; p=.001) compared to men.[39] More men attributed their CHD to behavioral causes that could be controlled (51% vs. 23%; p<.001) compared to women; whereas, more women attributed their illness to biological factors that cannot be controlled (42% vs. 24%; p=.04) compared to men.[39]

Critique of articles

The science examining the relationship between FH of CVD and perceived risk and the relationship between FH, perceived risk, and health-related behavior is in its infancy. Knowing about FH of CVD does not consistently relate to perceived risk and does not consistently predict health-related behavior to reduce risk. More studies are needed with both conceptual and methodological refinements in order to advance the science of preventive care for CVD in young, asymptomatic adults.

The studies did not consistently define or measure a FH of CVD. For example, some studies measured FH of CVD, including CHD, MI, and some studies measured the general term "heart disease." As a result, it is not possible to aggregate results across studies. Additionally, the studies included in this paper span 26 years (1986 through 2012). The overall concept of "FH" and its implications on health could have changed significantly during that time period, especially given the advances in genetics and genomics.

Measures of actual family risk, when measured, were inconsistent between studies. Even when a measure attempted to examine study participants' reported family risk, the term was often not defined for study participants prior to obtaining data from them. As a result, it is not known if study participants understood the term in the way the investigators intended. Also, the studies overly relied on self-reported data on FH and health-related behaviors; therefore, the validity of these data is not clear.

The studies did not consistently distinguish between actual FH of CVD and perceived FH of CVD or between perceived FH of CVD and personal risk for CVD. It is one thing to measure reported FH; it is still another to measure perceived personal risk for CVD. Having awareness of one's FH of CVD does not mean that the study participant had personalized that risk. Some studies equated reported FH of CVD with personalized or internalized risk for CVD. As a result, there is inconclusive evidence on perceived risk for CVD or internalized personal risk. For individuals with an actual FH of CVD, the study participant's report of that FH may be a significant mediator or moderator of the participant's health-related behavior, including lifestyle management of risk. But there was a paucity of studies that examined actual FH, reported FH, perceived family risk, and self-reported perceived risk for CVD. Programs and services cannot be evidence-based until the relationships between these variables are more thoroughly examined. Studies are still needed on the effect of personalized or internalized risk on health-promoting behavior for young adults.

Most studies were either atheoretical or the theoretical framework of the study was not explicitly stated in the article. This constrained the degree to which study results could be used to advance evidence-based predictive theories of health behavior.[40] For example, personal risk for CVD, although an important study variable, takes on different definitions and meanings depending on the theory in which it is embedded. In all of the studies in this review, perceived risk was left as a primitive term, that is, an undefined term. For example, perceived risk maybe comparable to perceived susceptibility or seriousness in the Health Belief Model or to personal threat in threat-appraisal models like Precaution Adoption, Stages of Change Theory or the Transtheoretical Model, among others.[40] In the absence of embedding study variables within a stated theory, each study's results are silos of information, not results that can advance evidence-based programs and services.

Discussion

As previous mentioned, the underlying assumption is that a FH leads to increased perceived risk which results in health-promotion that decreases the risk factors for developing CVD. However, this review of the literature has shown that this is not always the case. There is suggestive evidence that an awareness of one's FH of CVD increases the person's perceived CVD risk. This perceived risk has some, albeit inconsistent, effect on a person's health-related behavior and positive lifestyle change. However, being able to list family members with CVD is not the same as being aware of your FH, nor is it the same as being aware of an increased family risk or personal risk for CVD. Future studies need to use consistent notation and rigorously distinguish between these terms and their measurements.

The current paper's examination of the literature shows that previous studies examining the role of FH on perceived risk and health-related behavior and positive lifestyle changes have failed to accurately assess a key variables: awareness of FH and family risk. Prior studies have also failed to consistently define CVD and measures of perceived personal risk for CVD and behavior change. Additionally, no intervention study has been conducted to attempt to increase FH awareness or perceived CVD risk.

Recently, the effect of prevention messages tailored to FH on health behaviors from the Family Healthware Impact Trial was published. The study found that individuals who received tailored messages based on their FH information were more likely to increase their fruit and vegetable consumption (OR=1.29; 95% CI: 1.05–1.58) and increase physical activity (OR=1.47; 95% CI: 1.08–1.98) at six months after the intervention compared to individuals who received standardized messages about healthy lifestyle and screening.[30]

This is early suggestive evidence that the use of tailored messages, based on FH, has the potential to impact the health-related behaviors influencing CVD risk. In the intervention arm, approximately 60% of participants were at moderate or strong risk for CHD and 48% were at moderate or strong risk for stroke based on their FH.[41] However, the authors of the study reported the results in aggregate for the six diseases studied: CHD, stroke, diabetes, colorectal cancer, breast cancer, and ovarian cancer. It is still unknown if a homogenous sample of persons at risk for CVD based on their FH would demonstrate similar results.

In the long-range, both clinicians and scientists need to develop programs and services to identify individuals with a FH in order to enhance their health-promoting behaviors. Clinicians must actively and systematically assess FH for all patients. It is the first step to help patients understand their familial risk and how that risk can personally affect them. One example to assist with FH collection to identify those and high-risk is the use of questionnaires to collect FH. Qureshi et al.[42] examined the feasibility of systematically collecting FH in a primary care setting. Using a matched-pair, cluster randomized, controlled trial of 24 family practices in the United Kingdom, they compared the proportion of participants classified with high cardiovascular risk, defined as a 10-year risk >20%, in practices where FH was systematically collected using a questionnaire versus practices where only FH information from patient records were used.[42] In the practices were FH was collected using the questionnaire, there was a 4.8% increase in participants being classified with high cardiovascular risk compared with a 0.3%increase in the control practices (p=.007 after adjustment for participant and practice characteristics).[42]

Although the study by Kavanagh et al.,[25] which was conducted in Canada, reported poor monitoring of CVD risk factors and counseling on a health-promoting behaviors by physicians for individuals with a FH, Zlot and colleagues[43] found the opposite in the United States. Using the 2007 Oregon Behavioral Risk Factor Surveillance System, they evaluated the results from 2,566 adults without prior CVD but with a FH.[43] Participants with a FH

reported that their clinician was more likely to ask about their FH (OR=2.6, 95% CI: 1.9–3.4), discuss the risk of developing CVD (OR=2.0; 95% CI, 1.6–2.5), and provide counseling on risk-reducing behaviors (OR=2.1; 95% CI, 1.7–2.7) compared to adults without a FH.[43] Individuals with a FH who received recommendations from their clinicians were more likely to have reported changes in diet or physical activity (OR=2.7; 95% CI: 2.3–3.2).[43]

Future studies should include at least 4 distinct variables: FH of CVD, awareness of FH and family risk, perceived personal risk for CVD, and health-related behaviors to reduce or minimize personal risk for CVD. This must include the collection of FH for CVD from the study participant after CVD has been explained to them. If the individual lists family member with CVD, then the impact of the family member's health on that person's CVD risk should be explained. It is not enough to assume that he or she fully understands the implication of their FH. Future studies must include an assessment the participant's perceived risk. This could possibly be done before and after risk due to FH is explained to see what impact, if any, it has on their perceived risk. Finally, the studies should assess the individual's health-related behaviors. Only by examining all of these factors in the same study, can the relationship between the variables become clear.

Studies in the future must focus on developing and testing interventions that examine the effects of FH on perceived personal risk for developing CVD, as well as examining the effects of perceived personal risk on health-promoting behaviors to decrease CVD risk. Potential interventions could build on the results of the Family Healthware Impact Trial by using FH information, along with three-generation pedigrees, to help visualize family inheritance and risk for CVD, and include tailored messages designed to increase both perceived CVD risk and health-promoting behaviors. These interventions need to be based on a theoretical framework and that should be explicated stated when the intervention is discussed in publications. Many theoretical frameworks could be appropriate given the design of the intervention, including the Health Belief Model, Protection Motivation Theory, the Common-Sense Model of self-regulation of health and illness, Precaution Adoption Model, Stages of Change Theory, or the Transtheoretical Model.

Conclusion

A person's awareness of their FH of CVD or their own risk of CVD is not a sufficient predictor of changes in their health-related behavior. Future studies are needed to better explain the processes by which FH of CVD or perceived CVD risk can be used to affect health-related behavior changes. It appears that both FH and perceived personal risk for CVD are necessary but not sufficient conditions to change health-related behavior in high-risk populations. Future studies should also test interventions, based on theoretical frameworks, that help individuals with a FH of CVD attribute increased personal risk to themselves for developing CVD, while providing lifestyle management options to minimize their risk.

Acknowledgments

Funding sources: Grant 5T32NR007106 from the National Institute for Nursing Research of the National Institutes of Health and Grant T32NR009759 from the National Institute for Nursing Research of the National Institutes of Health

References

1. Roger VL, Go AS, Lloyd-Jones DM, et al. Heart disease and stroke statistics—2012 update: a report from the American Heart Association. Circulation. 2012; 125(22):e2–e220. [PubMed: 22179539]

2. Schaefer EJ. Lipoproteins, nutrition, and heart disease. Am J Clin Nutr. 2002; 75(2):191–212. [PubMed: 11815309]

3. Toborek M, Lee YW, Garrido R, Kaiser S, Hennig B. Unsaturated fatty acids selectively induce an inflammatory environment in human endothelial cells. Am J Clin Nutr. 2002; 75(1):119–125. [PubMed: 11756069]

4. Delaney JA, Daskalopoulou SS, Brophy JM, Steele RJ, Opatrny L, Suissa S. Lifestyle variables and the risk of myocardial infarction in the general practice research database. BMC Cardiovasc Disord. 2007; 7:38. [PubMed: 18088433]

5. Lloyd-Jones DM, Nam BH, D'Agostino RB Sr, et al. Parental cardiovascular disease as a risk factor for cardiovascular disease in middle-aged adults: a prospective study of parents and offspring. JAMA. 2004; 291(18):2204–11. [PubMed: 15138242]

6. Ciruzzi M, Schargrodsky H, Rozlosnik J, et al. Frequency of family history of acute myocardial infarction in patients with acute myocardial infarction. Argentine FRICAS (Factores de Riesgo Coronario en America del Sur) Investigators. Am J Cardiol. 1997; 80(2):122–127. [PubMed: 9230145]

7. Silberberg JS, Wlodarczyk J, Fryer J, Robertson R, Hensley MJ. Risk associated with various definition of family history of coronary heart disease: The Newcastle Family History Study II. Am J Epidemiol. 1998; 147(12):1133–1139. [PubMed: 9645791]

8. Friedlander Y, Arbogast P, Schwartz SM, et al. Family history as a risk factor for early onset myocardial infarction in young women. Atherosclerosis. 2001; 156(1):201–207. [PubMed: 11369015]

9. Leander K, Hallqvist J, Reuterwall C, Ahlbom A, de Faire U. Family history of coronary heart disease, a strong risk factor for myocardial infarction interacting with other cardiovascular risk factors: results from the Stockholm Heart Epidemiology Program (SHEEP). Epidemiology. 2001; 12(2):215–221. [PubMed: 11246583]

10. Friedlander Y, Siscovick DS, Arbogast P, et al. Sudden death and myocardial infarction in first degree relatives as predictors of primary cardiac arrest. Atherosclerosis. 2002; 162(1):211–216. [PubMed: 11947916]

11. Bertuzzi M, Negri E, Tavani A, La Vecchia C. Family history of ischemic heart disease and risk of acute myocardial infarction. Prev Med. 2003; 37(3):183–187. [PubMed: 12914823]

12. Khoury MJ. Genetics and genomics in practice: the continuum from genetic disease to genetic information in health and disease. Genet Med. 2003; 5(4):261–268. [PubMed: 12865755]

13. Valdez R, Greenlund KJ, Khoury MJ, Yoon PW. Is family history a useful tool for detecting children at risk for diabetes and cardiovascular diseases? A public health perspective. Pediatrics. 2007; 120 (Suppl 2):S78–86. [PubMed: 17767009]

14. Berg AO, Baird MA, Botkin JR, et al. National Institutes of Health State-of-the-Science Conference Statement: Family History and Improving Health. Ann Intern Med. 2009; 151(12): 872–7. [PubMed: 19884615]

15. Tamragouri RN, Martin RW, Cleavenger RL, Sieber WK. Cardiovascular risk factors and health knowledge among freshman college students with a family history of cardiovascular disease. J Am Coll Health. 1986; 34(5):267–70. [PubMed: 3745691]

16. Kip KE, McCreath HE, Roseman JM, Hulley SB, Schreiner PJ. Absence of risk factor change in young adults after family heart attack or stroke: the CARDIA Study. Am J Prev Med. 2002; 22(4): 258–66. [PubMed: 11988382]

17. Kelley C, Krummel D, Gonzales EN, Neal WA, Fitch CW. Dietary intake of children at high risk for cardiovascular disease. J Am Diet Assoc. 2004; 104(2):222–5. [PubMed: 14760570]

18. McCusker ME, Yoon PW, Gwinn M, Malarcher AM, Neff L, Khoury MJ. Family history of heart disease and cardiovascular disease risk-reducing behaviors. Genet Med. 2004; 6(3):153–8. [PubMed: 15354334]

19. Thanavaro JL, Moore SM, Anthony MK, Narsavage G, Delicath. Predictors of health promotion behavior in women without prior history of coronary heart disease. Appl Nurs Res. 2006; 19(3): 149–55. [PubMed: 16877194]

20. Andersson P, Sjoberg RL, Ohrvik J, Leppert J. The effects of family history and personal experiences of illness on the inclination to change health-related behaviour. Cent Eur J Public Health. 2009; 17(1):3–7. [PubMed: 19418712]
21. Slattery ML, Murtaugh MA, Lanier AP, et al. Family health history and health behaviors in Alaska native and American Indian people. J Health Care Poor Underserved. 2009; 20(3):678–94. [PubMed: 19648697]
22. Marteau TM, Kinmonth AL, Pyke S, Thompson SG. Readiness for lifestyle advice: self-assessments of coronary risk prior to screening in the British family heart study. Br J Gen Pract. 1995; 45(390):5–8. [PubMed: 7779477]
23. Ponder M, Lee J, Green J, Richards M. Family history and perceived vulnerability to some common diseases: a study of young people and their parents. J Med Genet. 1996; 33(6):485–92. [PubMed: 8782049]
24. Hunt K, Davison C, Emslie C, Ford G. Are perceptions of a family history of heart disease related to health-related attitudes and behaviour? Health Educ Res. 2000; 15(2):131–43. [PubMed: 10751372]
25. Kavanagh T, Shephard RJ, Hamm LF, Mertens DJ, Thacker L. Risk profile and health awareness in male offspring of parents with premature coronary heart disease. J Cardiopulm Rehabil. 2000; 20(3):172–9. [PubMed: 10860199]
26. Montgomery GH, Erblich J, DiLorenzo T, Bovbjerg DH. Family and friends with disease: their impact on perceived risk. Prev Med. 2003; 37(3):242–9. [PubMed: 12914830]
27. Patel MJ, de Lemos JA, Philips B, et al. Implications of family history of myocardial infarction in young women. Am Heart J. 2007; 154(3):454–60. [PubMed: 17719289]
28. Acheson LS, Wang C, Zyzanski SJ, et al. Family history and perceptions about risk and prevention for chronic diseases in primary care: a report from the family healthware impact trial. Genet Med. 2010; 12(4):212–8. [PubMed: 20216073]
29. Darlow S, Goodman MS, Stafford JD, Lachance CR, Kaphingst KA. Weight perceptions and perceived risk for diabetes and heart disease among overweight and obese women, Suffolk County, New York, 2008. Prev Chronic Dis. 9:E81. [PubMed: 22480610]
30. Ayanian JZ, Cleary PD. Perceived risk of heart disease and cancer among cigarette smokers. JAMA. 1999; 281(11):1019–21. [PubMed: 10086437]
31. Allen JK, Blumenthal RS. Risk factors in the offspring of women with premature coronary heart disease. Am Heart J. 1998; 135(3):428–34. [PubMed: 9506328]
32. Thompson HJ, Pell ACh, Anderson J, Chow CK, Pell JP. Screening families of patients with premature coronary heart disease to identify avoidable cardiovascular risk: a cross-sectional study of family members and a general population comparison group. BMC Res Notes. 2010; (3):132. [PubMed: 20459771]
33. DeSalvo KB, Gregg J, Kleinpeter M, Pedersen BR, Steptor A, Peabody J. Cardiac risk underestimation in urban, black women. J Gen Intern Med. 2005; 20(12):1127–31. [PubMed: 16423102]
34. Diaz VA, Mainous AG 3rd, Williamson D, Johnson SP, Knoll ME. Cardiovascular and diabetes risk perception in a Hispanic community sample. Ethn Dis. 2012; 22(1):5–11. [PubMed: 22774302]
35. Hunt K, Emslie C, Watt G. Lay constructions of a family history of heart disease: potential for misunderstandings in the clinical encounter? Lancet. 2001; 357(9263):1168–71. [PubMed: 11323044]
36. Walter FM, Emery J. ‘Coming down the line’-- patients’ understanding of their family history of common chronic disease. Ann Fam Med. 2005; 3(5):405–14. [PubMed: 16189056]
37. Walter FM, Emery J. Perceptions of family history across common diseases: a qualitative study in primary care. Fam Pract. 2006; 23(4):472–80. [PubMed: 16608871]
38. Brorsson A, Troein M, Lindbladh E, Selander S, Widlund M, Rastam L. My family dies from heart attacks. How hypercholesterolaemic men refer to their family history. Fam Pract. 1995; 12(4): 433–7. [PubMed: 8826061]
39. Astin F, Jones J. Heart disease attributions of patients prior to elective percutaneous transluminal coronary angioplasty. J Cardiovasc Nurs. 2004; 19(1):41–47. [PubMed: 14994781]

40. Glanz, K.; Rimer, BK.; Lewis, FM. Health behaviors and health education. 3. San Francisco, CA: Josey-Bass; 2002.

41. Ruffin MT 4th, Nease DE Jr, Sen A, et al. Effect of preventive messages tailored to family history on health behaviors: the Family Healthware Impact Trial. Ann Fam Med. 2011; 9(1):3–11. [PubMed: 21242555]

42. Qureshi N, Armstrong S, Dhiman P. Effect of adding systematic family history enquiry to cardiovascular disease risk assessment in primary care: a matched-pair, cluster randomized trial. Ann Intern Med. 2012; 154(4):253–62. [PubMed: 22351711]

43. Zlot AI, Valdez R, Han Y, Silvey K, Leman RF. Influence of family history of cardiovascular disease on clinicians' preventive recommendations and subsequent adherence of patients without cardiovascular disease. Public Health Genomics. 2010; 13(7–8):457–66. [PubMed: 20234120]

Table 1

Relationship between family history and health-related behavior change, exclusive of perceived risk

Study	Relationship	Results
Tamragouri et al.[15]	None/Negative	Students with a FH were less likely to exercise and were more likely to feel overweight compared to students without a FH.
Kip et al.[16]	None	No change in weight, physical activity, LDL-C, HDL-C, triglycerides, SBP, DBP, or likelihood to quit smoking between young adults with FH of heart attack or stoke in the last five years versus those without an event during the same time period.
Kelley et al.[17]	None/Negative	No differences between intake of macronutrients, fiber, cholesterol, or percentage of calories as fat in children at high risk versus children at low risk based on FH. Mean non-fasting cholesterol was significantly greater in the at-risk group compared to the non-at-risk group.
McCusker et al.[18]	Mixed	No differences between the average risk group and the combined moderate/high risk group in cutting back on high-fat foods, increasing consumption of fruits and vegetables, increasing physical activity, or trying to stop smoking (among smokers only). The two groups did differ by serum cholesterol screening and aspirin use.
Thanavaro et al.[19]	Positive	Backward multiple regression analysis showed that FH was a positive predictor of health-promoting behavior in women without current CHD.
Andersson et al.[20]	None/Negative	FH did not result is less smoking or increased physical exercise compared to those without a FH. Individuals with a FH were more obese compared to those without a FH.
Slattery et al.[21]	None/Negative	Individuals with a FH of heart attack or stroke had higher BMI, less physical activity, and higher total serum cholesterol compared to those without a FH.

Abbreviations: DBP, diastolic blood pressure; BMI, body mass index, FH, family history; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure

Table 2

Relationship between family history and perceived risk (quantitative studies only)

Study	Relationship	Results
Marteau et al.[22]	Positive	75% of participants with 1 family member with CHD before age 65 and 73.6% of participants with a parental death from CHD perceived their risk has average or higher than average. Self-assessed CHD risk was strongly positively associated with epidemiologically-based risk.
Ponder et al.[23]	Positive	41% of participants thought they were more likely than their peers to get heart disease based on their FH, 30% reported being equally likely than their peers to get heart disease, and 29% reported that the likelihood was unknown.
Allen & Blumenthal[31]	Mixed	47% of high-risk individuals, based on FH, perceived their risk for future heart attack as less than or equal to others their age. No significant relationship between perceived risk and actual risk based on the Framingham risk score equation.
Ayanian & Cleary[30]	Positive	Among smokers with a FH, 39% viewed their MI risk as higher than someone of the same age and sex.
Hunt et al.[24]	Mixed	Individuals in each cohort (around ages 23, 43, and 63) with a reported FH perceived their risk for heart disease to be about twice as high as individuals without a FH. A significant number of individuals with one or two first-degree relatives with heart disease did not report a FH of heart disease.
Kavanagh et al.[25]	Positive	41.5% of family members of patients with premature CHD rated their level of concern about their health as “high.”
Montgomery et al.[26]	Positive	For both men and women, a positive FH of heart disease was associated with higher levels of perceived risk for heart disease.
DeSalvo et al.[33]	Mixed	37% of individuals at high risk for heart disease, based on risk factors, did perceived their risk to be increased. Among all patients, objective and perceived cardiac risk was poorly correlated.
Patel et al.[27]	Positive	In both men and women, individuals with a FH of premature MI perceived their lifetime risk of MI to be greater than average.
Acheson et al.[28]	Positive	For CHD, 30% of individuals in the “moderate” and “strong” risk categories perceived their risk as being at above or much above the average risk.
Thompson et al.[32]	Positive	The FH group had a significantly higher percentage of individuals with an ASSIGN risk score >20% compared to the non-FH group. 37% of the FH group was aware that they were at increased risk.
Darlow et al.[29]	Positive	FH was associated with greater perceived risk for heart disease.
Diaz et al.[34]	None	Respondents with a FH of heart attack were more likely to underestimate their 10-year CHD risk compared to those without a FH.

Abbreviations: CHD, coronary heart disease; FH, family history; MI, myocardial infarction

Table 3

Relationship between perceived risk and health-related behavior change

Study	Relationship	Results
Allen & Blumenthal[31]	Positive	In the past year, 26% of high-risk individuals reported they had improved their eating habits and 15% reported increasing exercise. Almost two-thirds said they were trying to lose weight. Almost half hoped to increase their exercise, 33% wanted to lose weight, and 23% planned to improve their eating habits over the next year.
Hunt et al.[24]	Mixed	In the youngest cohort only (around age 23), individuals with a reported FH were more likely to "strongly agree" or "agree" that not smoking and exercising is important if "heart disease runs in someone's family" compared to individuals with no reported FH. In all three cohorts (around age 23, 43, and 63), there were no significant differences between individuals with a reported FH compared to those with no reported history regarding the importance of a healthy diet.
Kavanagh et al.[25]	Mixed	Of the study participants, all of which had a FDR with premature CHD, 47.8% attempted to eat a low fat diet, 46% tired follow a regular exercise regimen, and 50.2% attempt to maintain appropriate body weight. Only 25% of the participants exercised regularly.
Patel et al.[27]	Positive (men)	Men with FH premature MI were less likely to be sedentary than men without a FH.
	Negative (women)	Women with a FH of premature MI were more likely to smoke than those without a FH.

Abbreviation: FH, family history; FDR, first-degree relative; MI, myocardial infarction

Appendix A

Evidence table

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
Tamragouri et al., 1986 USA Cross-sectional, comparative study	Group One: 69 freshmen with a FH of CVD; 55% female Group Two: 155 freshmen without a FH; 50.6% female Mean age of sample and race/ethnicity not provided	To compare the cardiovascular health knowledge and health behaviors between college freshmen with and without a FH of CVD Questionnaires with Iowa Cardiovascular Health Knowledge Test, demographics, family characteristics, selected health behaviors, and efforts to acquire health information	Cardiovascular Health Knowledge was low in both groups (18 of 35 questions were incorrectly answered by at least 40% of each group) with no differences between the two groups Students with a FH exercised less (OR=0.38; 90% CI: 0.16-.0.91) and were more likely to feel overweight (OR=1.73; 90% CI: 1.02–2.94) compared to students without a FH Students with a FH were not more likely to eat a low-fat diet (OR=1.85; 90% CI: 0.79–4.35), made no extra effort to receive health education (OR=1.21; 90% CI: 0.90–1.62), were more likely to smoke (OR=1.22; 90% CI: 0.61–1.62), and were less likely to have their cholesterol measured (OR=0.63; 90% CI: 0.29–1.38) compared to students without a FH Note: These differences were not statistically significant
Brorsson et al., 1995 Sweden Qualitative study	63 male participants, 35–45 year-old, diagnosed with moderate hypercholesterolemia (6.5–7.7 mmol/l)	To study the traits and relationship between FH and perceived risk in males with moderate hypercholesterolemia Lifestyle counseling session were audio-taped, transcribed and analyzed Session occurred after participants were newly diagnosed	45% (n=28) mentioned their FH during the counseling session 9% (n=6) specifically mentioned that CHD was part of their FH Fatal events, non-fatal conditions (symptoms of CHD), and premature deaths also emerged as themes that influenced perceived risk Note: The authors assumed that the participants perceived themselves at risk after the diagnosis of hypercholesterolemia (actual perceived risk was not measured)
Marteau et el.; 1995 United Kingdom Baseline, descriptive data from an RCT	3725 participants screened as part of the British Family Heart Study 2246 men (mean age of 50.11) and 1604 (mean age of 47.8) women Race/ethnicity not provided	To examine how individuals perceived their risk for CHD prior to screening To assess the degree of similarity between perceived risk and epidemiologically derived risk score Self-assessed 15-year heart attack risk "… compared with other people of your age and sex?" Epidemiologically-assessed risk based on: years smoking cigarettes, systolic BP, cholesterol level, diagnosis of CHD, diabetes, angina, and FH	Perceived Risk • 964 participants had at least 1 FDR with CHD before age 65; 25% of these individuals perceived their heart attack risk as lower than average • 1071 participants had a parental death from CHD; 27.4% of these individuals perceived their heart attack risk as lower than average • 488 participants had a BMI >30; 25.8% of these individuals perceived their heart attack risk as lower than average • 665 participants had total cholesterol > 251mg/dL (6.5 mmol/L); 32.5% of these individuals perceived their heart attack risk as lower than average Self-assessed risk of CHD was strongly positively associated with quintile (epidemiologically-based) risk (p<.001)
Ponder et al., 1996 United Kingdom Descriptive study	58 teenagers (23 males and 35 females; mean age of 16.8; range 16–18) 54 of their parents (19 fathers and 35 mothers, with a mean age of 46.5, range 36–74)	To examine the extent to which people take account FH when considering their susceptibility to health risks Interviews with teenagers and parents; same protocol for both Two-part interview: • Part 1: Participant was asked, "Compared to other people of your age do you feel that you	Perceived risk • 41% (n=46) of participants thought they were more likely than their peers to get HD • 30% (n=34) reported being equally likely than their peers to get HD • 29% (n=32) reported that the likelihood was unknown

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
		are more likely to get heart disease, or the same?" • Part 2: Taking a FH history and drawing a family tree	• There were no significant differences in perceived risk between males and females and between the two generations Reason why they were more likely to develop HD • 70% (32 of 46) cited their FH • 39% (18 of 46) cited the environment • 30% (14 of the 46) cited their personal actions FH • Teenagers reported fewer relatives in general compared to the parents • Parents knew more details (age of relatives, presence or absence of diseases, age at death) about relatives • There was a significant difference between teenagers and adults in number of family members reported as having had heart disease ($p<0.005$)
Allen & Blumenthal, 1998 United States Cross-sectional, descriptive study	87 apparently healthy off-spring (56 daughters and 31 sons) of women with premature CHD Mean age of 37 (SD ± 7 years), 72% Caucasian	To examine coronary risk factors, related knowledge, attitudes, and beliefs concerning CHD risk Questionnaires, physical examination, and CHD risk biomarkers	Risk Factors • 13% had only one major risk factor, a FH of premature CHD: 10% had two risk factors; 23% had 3; 54% had 4 or more CHD risk factors • 51% offspring had total and LDL cholesterol levels above recommended levels for primary prevention • 31% were current smokers • 56% exercised fewer than three times a week • 48% were overweight HD Knowledge • Offspring most frequently mentioned dietary factors (76%), smoking (47%), lack of exercise (34%), and stress (34%) as the major causes of HD • 25% mentioned high blood cholesterol and 28% cited heredity as an important factor in the development of heart disease Health beliefs and behavior • 75% reported their health as very good or excellent • In the past year, 26% said they had improved their eating habits, and 15% reported increasing exercise • 63% said they were trying to lose weight

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
			• 47% hoped to increase their exercise, 33% wanted to lose weight, and 23% planned to improve their eating habits over the next year to improve their health Perceived Risk • 47% perceived their risk for future heart attack as less than or equal to others their age • 58% rated their concern about future heart attack as an average or below average level of concern • No significant relationship between perceived risk and actual risk based on the Framingham risk score equation • Of those at increased risk based on their actual risk score, only 54% perceived themselves to be at any greater risk than others their age and gender
Ayanian & Cleary, 1999 United States Cross-sectional, descriptive study	737 current smokers (54.6% female; 83.7% Caucasian) Mean age 42.6	To assess smokers perceived risk for MI Self-reported smoking status and numbers of cigarettes smoked daily Self-assessed risk compared to people of the same age and sex	Only 29% of smokers perceived their MI risk as higher than persons of the same age and sex Among smokers with a FH of MI, 39% viewed their risk as higher than persons of the same age and sex
Hunt et al., 2000 United Kingdom Cross-sectional, descriptive study	Three cohorts originally recruited in 1987/88 The youngest cohort was around 23 years old (n = 676), the middle cohort was around 43 years old (n = 754), and the oldest cohort was around 63 (n = 732) Majority of the study participants were female (53% in the youngest cohort, 56.1% in the middle cohort, and 55.7% in the oldest cohort)	To examined the relationship between FH of HD and health-related attitudes and behavior Data used in the study were collected in 1995/96 Nurses collected information designed to explore the relationship between perceptions of FH of illness, health attitudes, health-related behaviors, and asked questions about the health and deaths of family members	FH • Approximately 20% of the participants in each cohort reported a FH of HD • Perception of a FH of HD was significantly related to the number of relatives they reported as having HD ($p<0.0001$) • However, in each cohort, 40% to 52% of the individuals with two parents or siblings with HD did not report a FH of HD • The percentage was higher, 56% to 83%, for individuals with the only 1 parent or sibling with HD • In the two older cohorts, women were significantly more likely to report a FH of HD (15% of males vs. 25% of females in the middle cohort; $p<0.001$ and 16% of males vs. 23% of females in the oldest cohort; $p<0.05$) Perceived heart disease risk • Individuals in each cohort with a reported history of HD were about twice as “likely to get HD” compared to individuals without a reported history of HD ($p<0.001$) • Individuals with a reported history of HD felt that “family illness” played a greater role in the etiology of HD compared to individuals without a reported history of HD ($p< 0.001$ in the youngest cohort, $p< 0.01$ in the middle cohort, and $p< 0.001$ in the oldest cohort)

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
			Health promotion • In the youngest cohort only, individuals with a reported FH of HD were more likely to "strongly agree" or "agree" that not smoking and exercising is important if "HD runs in someone's family" compared to individuals with no reported FH of HD (95% vs. 87%; p<0.001 for smoking and 95% vs. 88%; p<0.001 for exercise) • In all cohorts, there were no significant differences between individuals with a reported FH of HD compared to those with no reported history of HD regarding the importance of a healthy diet
Kavanagh et al., 2000 Canada Cross-sectional, descriptive study with a 2 year follow-up questionnaire	571 sons of men with a premature coronary event Mean age 32.1 (SD ± 7.1) Race/ethnicity not provided	To determine the modifiable risk factors in the male offspring of patients who had a premature coronary event To assess the extent of personal health initiatives being taken by the offspring To estimate, from the perspective of the offspring, the degree to which their family physicians had promoted a healthy lifestyle and carried out risk-reduction counseling Questionnaires: medical history, lifestyle, knowledge of health status and risk factors, and interaction with the family physician Lipid panel drawn	Risk Factors • The prevalence of cardiac risk factors were high: 48% had less than optimal cardiovascular fitness, 34% were overweight, 46% had total cholesterol ≥ 200 mg/dL, 26% had HDL cholesterol ≤ 35 mg/dL, and 16% had LDL cholesterol ≥160 mg/dL (16%) Perceived Risk • 41.5% of respondents rated their level of concern about their health as "high" Healthy Lifestyle • 23% were currently cigarette smokers and 25% exercised regularly • 47.8% attempted to eat a low fat diet, 46% tired follow a regular exercise regimen, and 50.2% attempt to maintain appropriate body weight Interaction with family physician • 90.5% of the offspring had a family physician whom they saw on a regular basis (average 1.8 times the previous year and 4.7 times over the previous 3 years) • 53% had their blood lipids checked and of these, only 9.5% were advised of the actual measurement • 11% were advised on a low-fat diet and were 18% recommended exercise • Of the 58 subjects with known hypercholesterolemia, 35 (60%) received counseling on a low-fat diet
Hunt et al., 2001 United Kingdom Qualitative study	Purposive sampling of 61 men and women who participated in the 1996 Midspan Family Study "Roughly equal numbers of men and women from middle class and working class"	To explore which factors affect whether people regard themselves as having a FH of CHD or not Semi-structured interviews Questions in the interviews covered why some people have more illnesses than others, beliefs about HD, FH of illness or weaknesses, construction of FH tree, and discussion of inheritance in the broadest sense	Genes, or heredity, were mentioned as a cause of HD by more than two-thirds of the respondents Perception of a FH of HD depended on knowledge of the health of family members, the number and closeness of relatives with heart conditions, and the age of affected relatives Women usually gave more detailed accounts than men and needed less encouragement

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
	Between the ages of 40–49 during the 1996 survey		Men, particularly working-class men, required a greater number of close relatives to be affected to perceive that they had a FH Even when respondents judged that HD ran in their family, they did not always perceive themselves as at increased risk because they felt different in crucial ways from their affected relatives
Kip et al., 2002 United States Longitudinal, descriptive study	3950 participants; 77% of total cohort originally approximately equally distributed by age, race/ethnicity, gender, and education	To examine if the occurrence of a heart attack or stroke in an immediate family member had an impact on CVD risk factors in young adults Smoking, physical activity, lipids/lipoproteins, body weight, and blood pressure were recorded over two consecutive 5-year follow-up periods Occurrence of a heart attack or stroke in an immediate family member of the participants was recorded between Year 0 (baseline) and Year 5 and between Year 5 and Year 10	After adjusting for baseline demographics and risk factors, young adults who experienced a change in FH of heart attack or stroke over a 5-year period were no more likely to quit smoking or to experience more positive changes in weight, physical activity, LDL cholesterol, HDL cholesterol, triglycerides, or systolic or diastolic BP compared to young adults without a change in their FH
Montgomery et al., 2003 United States Cross-sectional, descriptive study	522 participants; 62% female and 56% Caucasian Mean age: 39.61 (SD ± 15.29)	To examined if a FH of disease contributes to perceived risk, if a history of disease in a friend or non-blood relative increases perceived risk, and if these effects are similar across genders Participants completed a Health Assessment Personal Protocol Inventory, which included items to assess demographic variables, perceived risk, personal and FH of HD Participants were also asked if they had a friend or non-blood relative with each disease (Friend History)	For both men and women, a positive FH of HD was associated with higher levels of perceived risk for HD ($p<0.0001$) Women only: a positive history of HD in a friend was associated with higher levels of perceived risk for HD ($p<0.0001$)
Astin & Jones, 2004 Australia Descriptive study	141 subjects (108 males) Mean age 63 (SD ± 10.9) 90% European ethnicity	To compare patients' perceived causal attributions for CHD between males and females Semi-structured interviews to elicited information about causal attributions; BMI was recorded at the time of the interview Data about coronary risk factors were extracted from the medical records	Women more frequently cited FH as the cause of their CHD (41% vs. 28%; p=.001) A greater proportion of males than females attributed their illness to behavioral (controllable) causes rather than to biological causes (51% vs. 23%; p<.001) A greater proportion of females than males attributed their illness to biological (uncontrollable) causes (42% vs. 24%; p=.04)
Kelley et al., 2004 United States Cross-sectional, descriptive,	297 participants from the Coronary Artery Risk Detection in Appalachian Communities (CARDIAC) Project All participants were Caucasian, 53% were female, the average age was 10.8 (SD ± 0.6) years for boys and 10.6 (SD ± 0.7) years for girls	To examine if children who were at high-risk for CVD based on FH would have different diets than children from low-risk families All participants were screened for FH of early CVD; had their height, weight, and fingerstick total cholesterol measured; and filled out a 151-item food frequency questionnaires	Children at risk for CVD • 68 (23%) children at risk for CVD based on National Cholesterol Education Program guidelines • Mean non-fasting cholesterol was significantly greater in the at-risk group compared with the not-at-risk group (4.71 SD ± 0.93 mmol/L vs. 4.35 SD ± 0.92 mmol/L; p=.005). • There were no differences in BMI or BP between the two groups Health Promotion • There were no differences between groups in intake of macronutrients, fiber, cholesterol, or percentage of calories as fat • Percentages of calories as fat and saturated fat were higher than recommended for both groups

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
comparative study			
McCusker et al. 2004 United States Cross-sectional, descriptive study	3383 respondents without a personal history of stroke, heart attack, angina, or CHD 63% were female, 75% were Caucasian, 35% were between the ages of 35–44, and 36% were between the ages of 45–64	To examine the association between FH–based HD risk and CVD risk-reducing behaviors Data from the *2001 Healthstyles* survey, a cross-sectional survey of health attitudes, behaviors, conditions, and knowledge, was used The authors compared individuals with no reported FH of CVD (average risk) to individuals with one reported relative with a history of CVD (moderate risk) and individuals with two or more reported relatives with a history of CVD (high risk)	Risk Classification • 57% were classified as having average HD risk • 28% were classified as being at moderate HD risk • 18% were classified as being at high HD risk Health Promotion • After adjusted for age, there were no differences between the average risk group and the combined moderate/high risk group in cutting back on high-fat foods, increasing consumption of fruits and vegetables, increasing physical activity, or trying to stop smoking (among smokers only) • The two groups did differ by serum cholesterol measurement ($p<0.01$) and aspirin use ($p=0.02$)
DeSalvo et al., 2005 United States Baseline, descriptive data from an RCT	128 African American women Mean age 56 (range 35 to 86)	To describe the personal characteristics associated with underestimating CVD in black women Objective risk was determined by counting major cardiac risk factors Perceived risk determined by a survey question about personal cardiac risk	This sample had a high prevalence of cardiac risk factors: 77% were obese; 72% had hypertension; 48% had high cholesterol; 49% had a FH of heart disease; 31% had diabetes, and 22% currently used tobacco Seventy-nine percent had 3 or more cardiac risk factors and were at high risk; 63% of these individuals did not perceived themselves to be at risk for HD Among all patients, objective and perceived cardiac risk was poorly correlated
Walter & Emery, 2005 & 2006 Qualitative study	30 participants (53% females) 40% of were between 20–39 years old, 47% were between 40–59 years old, and 13% were older than 60 years old 93% were Caucasian and 87% married 50% had a FH of heart disease, 47% had a FH of cancer, and 23% had a FH of diabetes	To explore how individuals understand and come to terms with their FH Interviews were conducted with general practice patients who had a FH of cancer, HD, or diabetes The recorded and transcribed data underwent a qualitative constant comparative analysis	Feeling at risk • There are multiple routes to feeling at risk • The emotional impact of witnessing a relative's illness, recovery, or death contributes to the individual perception of personal risk • The course of the illness contributed to the perception • Premature or sudden death adds to the perception of risk more significantly than death in the 60s or 70s. • The survival and return to a normal lifestyle, which often occurs in CHD, results in the FH of heart disease being less threatening • Participants looked for patterns within their FH when considering their own risk including: life events, age of onset of the illness, and the sex of the family members affected Taking control of the threat • Participants attempt to take control of the threat of their FH by changing behavior, taking medication, participating in screening, and obtaining information about the disease • Notions of fatalism sometimes countered their beliefs in the ability to control their disease risk

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
			• Participants reported a greater sense of empowerment over a FH of HD and diabetes compared to cancer • The availability of medications and surgeries to manage HD added to the participants' sense of control over their FH
Thanavaro et al., 2006 United States Correlational cross-sectional design	119 women Mean age 49.4 (SD ± 6.7) 78% Caucasian	To determine HPB and the best predictors of HPB in women without prior history of CHD Study measures: demographic information, perceived CVD risk factors, HPLP II, CHD knowledge, the Benefits Scale, and the Barriers Scale	The sample did not practice HPB regularly (based on the HPLP II) and had low CHD knowledge levels, a high perception level of benefits, and a moderate level of perceived barriers to CHD risk modification Backward multiple regression analysis demonstrated that FH of CHD (p=.05), CHD knowledge levels (p=.005) and perceived barriers to CHD risk modification (p<.001) were the best predictors of HPB in women without CHD
Patel et al., 2007 United States Cross-sectional, descriptive, comparative study as part of the Dallas Heart Study	2404 subjects (1327 women and 1077 men) between the ages of 30 and 50 (mean age of 40) 52% of the women and 47.7% of the men were African American	To examine the role of a FH of premature MI on CVD risk factor burden, atherosclerosis, and risk awareness in young men and women Individuals who did not know or were unclear about their FH were considered has having no FH of premature MI Information about perceived lifetime risk of MI, tobacco use, and physical activity were collected by questionnaire CAC was measured with Imatron 150 XP scanners	FH • Women were more likely to report a FH of premature MI compared to men (12.4% vs. 9.3%; p=0.014) • In women only, a FH of premature MI was associated with an increased composite risk factor burden (defined as having ≥ 2 traditional CVD risk factors) compared to women without a FH (49.1% vs. 39.1%; p=.001) • In women only, a FH of premature MI was independently associated with CAC among women (adjusted OR=2.0; 95% CI: 1.0–4.1) Perceived Risk • In both men and women, individuals with a FH of premature MI perceived their lifetime risk of MI to be greater than average (in women, 59.7% vs. 47.4%; p=.001 and in men, 75.0% vs. 48.3%; p=.004) Health Promotion • Women with a FH of premature MI were more likely to smoke than those without a FH (p<.001) • Men with a FH premature MI were less likely to be sedentary than men without a FH (p=.001)
Andersson et al., 2009 Sweden and Poland Cross-sectional, descriptive study	2054 total participants 1,043 (624 females, 419 males) from Poland 1,011 (554 females, 457 males) from Sweden All participants were 50-years old	To examine how a personal experience of illness and FH of CVD affect risk behavior FH, personal experience of illness and risk behavior (smoking and exercise habits, BMI) were self-report	FH • 21% (n=424) of all participants had a FH of CVD (27% of all Polish participants vs. 14% of all Swedish participants; p<0.002) Personal experiences of CVD • 19% (n=388) of all participants had a personal experience of CVD (27% of all Polish participants vs. 10% of all Swedish participants; p<0.001) Health Promotion

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
			• A personal experience of CVD resulted in less smoking (OR=1.48; 95% CI: 1.14–1.93), but a FH of CVD did not (OR=0.84; 95% CI: 0.66–1.07) • Neither a personal experience of CVD or a FH of CVD predicted more physical exercise • Participants with a personal experience of CVD or a FH of CVD were more obese compared to participants without a personal experience or FH (p<0.001 and p=0.002 respectively)
Slattery et al., 2009 United States Baseline data from a prospective, observational study	10,374 American Indian and Alaska Native people 6489 females Mean age of 39.9 (SD ± 14.4) for all participants	To examine the prevalence of self-reported FH of heart attack and stroke among a cohort of American Indian and Alaska Native people To evaluate the association between having a positive FH among FDR and health behaviors Study measures: health and lifestyle questionnaire that included physical activity, medical conditions, and family health history Medical tests included BP, height, weight, and serum lipid and glucose levels	FH • Over 50% of participants preferred not the answer the FH section of the questionnaire (23.5%) or did not know their FH of HD (29.7%) or stoke (32%) • Among those who knew their FH, 25% reported a FH of heart attack, and 22.1% reported a FH of stroke • Of those who reported the age at diagnosis of their family members, 56.6% reported female relatives younger than 60 years and 36.7% reported male relatives younger than 50 years at diagnosis for heart attack (actually numbers not provided in manuscript) • Women were more likely than men to know their FH and to be willing to complete the questionnaire; education was strongly associated with completing the FH section: participants with a college degree were more likely than those with less than a high school education to know their FH Health Behaviors • Participants with a FH of heart attack or stroke tended to have a higher BMI (p<.001), report less vigorous physical activity (p<.001), have higher total serum cholesterol (p<.001) and LDL cholesterol (p<.001) than those without a FH of heart attack or stroke
Acheson et al., 2010 United States Cross-sectional, descriptive study	2,330 participants completed the study questionnaires 71% were women and were 91% Caucasian Participants' age ranged from 35–65 years (mean age of 50 years)	To determining if FH was related to patients' perceptions of risk, worry, and control over getting six diseases First, participants completed online questionnaires measured demographics, self-reported health status, personal risk factors, and health perceptions for each of the six diseases Secondly, the participants used the web-based Family Healthware questionnaire to record their detailed family medical history Based on the data collected, familial risk for each disease is summarized as weak (similar to general population risk), moderate (having one FDR with the disease), or strong (having more than one FDR with the disease)	Participants rated their level of perceived risk for CHD as 2.71 (on a scale of 1–5), which corresponded to the response "about the same as average" Results were similar for stroke (2.65 on a scale of 1–5) The majority of people determined to be at increase risk for HD and stroke based on the Family Healthware algorithms did not consider themselves to be at increased risk For CHD, 30% of individual actually in the "moderate" and "strong" risk categories perceived their risk as being at above or much above the average risk For stroke, only 21% of the individuals in the "moderate" and "strong" categories perceived their risk as at above or much above the average risk

Authors; Year of Publication; Setting; Study Design	Sample	Purpose; Study Protocol/Measures	Results
Thompson et al., 2010 United Kingdom Cross-sectional, descriptive study	103 family members of patient's with premature CHD 57% females Median age of 41 Race/ethnicity not provided Participants from The Scottish Health Survey were used as the general population control group	To compare the cardiovascular risk factors of family members of individuals with premature CHD to a general population control group Structured, nurse-administered questionnaires to collect data on demographic information, lifestyle cardiovascular risk factors and medical history; anthropometric measurements, resting BP, and fasting blood sample obtained	Five family members (5%) had prevalent CHD A significantly higher percentage had an ASSIGN risk score >20% compared with the general population (13% vs. 2%; p<0.001) 37% of family members were aware they were at increased risk and only 50% had had their BP and serum cholesterol level checked in the previous three years Awareness of increased risk was higher among offspring (48%) than siblings (34%)
Darlow et al., 2012 United States Cross-sectional, descriptive study	397 overweight or obese women based on self-reported weight and height Ages ranged from 18 to 80 (mean, 38.0; SD ± 13.4) 42.8% African American, 29.7% Hispanic, 27.5% Caucasian	To investigate associations between weight perceptions and perceived risk for HD among overweight or obese women Study measures: demographic information, self-perceived weight status, degree to which weight was a health problem, perceived risk based on persons the same age and sex, health literacy	Perceiving oneself as overweight (OR, 4.33; 95% CI, 1.26–14.86) and FH of HD (OR=2.25; 95% CI: 1.08–4.69) were associated with greater perceived risk for HD For respondents with a lower health literacy, perceiving oneself as overweight was associated with greater perceived risk for HD (OR=4.69; 95% CI: 1.02–21.62)
Diaz et al., 2012 United States Cross-sectional, descriptive study	183 Hispanic adults 51% female Mean age of 36 for females; mean age of 38 for males	To examine and compare perceived versus actual risk for developing CVD in a Hispanic sample Study measures: demographic information, health status, health behaviors, Tool to Assess Likelihood of Fasting Glucose Impairment, Personal Heart Early Assessment Risk Tool, and perceived risk status	14.8% of respondents underestimated their 10-year CHD risk Respondents with diagnosed hypertension (38.8% vs. 5.5; p<.001), high cholesterol (38.5% vs. 5.5%; p<.001) or a FH of heart attack (30% vs. 11.6%; p=.02) were more likely to underestimate their 10-year CHD risk Men were more likely to underestimate their risk for and CHD risk compared to women (26.1% men vs. 3.4% women; p<.001)

Abbreviations: BP, blood pressure; BMI, body mass index; CAC, coronary artery calcification; CHD, coronary heart disease; CVD, cardiovascular disease; CI, confidence interval; FH, family history; FDR, first-degree-relative; HD, heart disease; HPB, health-promoting behavior; HPLP II, Health-Promoting Lifestyle Profile II; HDL, high-density lipoprotein; LDL, low-density lipoprotein; MI, myocardial infarction; OR, odds ratio; RCT, randomized control trial; SD, standard deviation