Original Paper

Public Health Genomics

Public Health Genomics
DOI: 10.1159/000293991

Received: April 22, 2009
Accepted after revision: September 9, 2009
Published online: March 17, 2010

Influence of Family History of Cardiovascular Disease on Clinicians' Preventive Recommendations and Subsequent Adherence of Patients without Cardiovascular Disease

A.I. Zlot[a] R. Valdez[d] Y. Han[b] K. Silvey[a] R.F. Leman[c]

[a]Oregon Genetics Program, [b]Health Promotion and Chronic Disease Prevention Program and [c]Office of Disease Prevention and Epidemiology, Public Health Division, Oregon Department of Human Services, Portland, Oreg., and [d]Office of Public Health Genomics, Centers of Disease Control and Prevention, Atlanta, Ga., USA

Key Words

Behavior · Cardiovascular diseases · Family health · Heart diseases · Practice guideline · Prevention · Stroke · Surveillance

Abstract

Background: Family history of cardiovascular disease (CVD) is an independent risk factor for CVD. Therefore, efforts to prevent CVD among asymptomatic persons with a family history are warranted. Little is known about preventive recommendations clinicians offer their patients with a family history of CVD, and adherence to preventive recommendations by patients at risk for CVD has not been well described. ***Methods:*** We used the 2007 Oregon Behavioral Risk Factor Surveillance System to evaluate among 2,566 adults without CVD associations between family history of CVD and (a) clinician recommendations; (b) perceived risk of developing CVD; (c) adoption of preventive and screening behaviors; and (d) risk factors of CVD. ***Results:*** Compared with adults with no family history of CVD, those with a family history reported that their clinician was more likely to ask about their family history information (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 make recommendations to prevent CVD (OR = 2.1; 95% CI, 1.7–2.7). Family history and clinician recommendations were associated with a higher likelihood of reported changes in diet or physical activity to prevent CVD (OR = 2.7; 95% CI, 2.3–3.2). Persons with a family history of CVD were more likely to report having high cholesterol, having high blood pressure, taking aspirin, and having had their cholesterol checked. ***Conclusion:*** The presence of a family history of CVD appears to prompt clinicians to recommend preventive changes and may motivate patients without CVD to adopt these recommendations.

Introduction

Cardiovascular disease (CVD) is a complex disease that involves interactions among genes, environment and behaviors. In 2005, 16 million people (7% of the U.S. population) had coronary heart disease and almost 6 million (2.6%) were living with the effects of stroke [1]. Similar to national trends, CVD was the leading cause of death in Oregon, the setting of this study [2].

Numerous studies have shown that a family history of CVD is an independent risk factor for developing CVD [3–9]. Compared to persons with no family history, those

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Amy I. Zlot, MPH
Oregon Genetics Program, Public Health Division
Oregon Department of Human Services
800 NE Oregon Street, Suite 825, Portland, OR 97232 (USA)
Tel. +1 971 673 0271, Fax +1 971 673 0240, E-Mail amy.zlot@state.or.us

with a family history of CVD are 1.5 to 9.0 times more likely to develop CVD, depending on the relation, number and age of onset of the relative(s) [10].

Given the high prevalence of CVD and its far-reaching societal and economic consequences, preventing CVD among persons with a family history, but without signs of the disease, could have a notable public health impact. However, little is known about the type of preventive recommendations offered by clinicians to their patients with a family history of CVD but without CVD. Also, little is known about the extent to which patients follow recommendations to reduce their risk for CVD. This study examines associations between family history of CVD and (a) preventive practices and recommendations issued by clinicians, (b) patients' perceived risk for developing CVD, (c) patients' adoption of preventive and screening behaviors, and (d) presence of risk factors for CVD among persons without CVD.

Methods

This study is based on data from the 2007 Oregon Behavioral Risk Factor Surveillance System (BRFSS), a statewide, random-digit dialed telephone survey of health conditions and risk behaviors among the non-institutionalized Oregon population ≥18 years of age. Detailed information about the Oregon BRFSS is published elsewhere [11]. Data were weighted by age and sex to better reflect the demographic characteristics of adults in Oregon. The Oregon Department of Human Services deemed projects which use BRFSS data, including this project, to be Institutional Review Board (IRB) exempt.

Survey Measures

To determine CVD status, the BRFSS asked all respondents the following questions: (a) 'Has a doctor, nurse or other health professional ever told you that you had a heart attack, also called a myocardial infarction?' (b) 'Has a doctor, nurse or other health professional ever told you that you had angina or coronary heart disease?' (c) 'Has a doctor, nurse or other health professional ever told you that you had a stroke?' Respondents who answered 'yes' to any of these questions were classified as having CVD, and their results are not discussed in this paper. Respondents who answered 'no' to all 3 questions were classified as not having CVD and were asked the following additional question: 'Thinking of your close blood relatives, do you have a parent, brother or sister, or child who has been diagnosed with heart disease or stroke by a health care provider?'

For the purposes of this study, we classified respondents as having a positive family history if they reported that they had at least one first-degree relative (parent, sibling or child) with CVD. Respondents who reported that they had no first-degree relatives with CVD or that they were adopted were classified as having a negative family history.

Respondents without CVD were also asked these questions: (a) 'Has a doctor, nurse or other health care provider ever discussed the chance of you getting heart disease or stroke?' (b) 'Has a health care provider ever recommended changes in eating habits or physical activity to reduce your chances of getting diseases like heart disease or stroke?' (c) 'How likely do you think it is that you will get heart disease or stroke in the future?' (d) 'Have you made changes in your eating habits or physical activity to reduce your chances of getting diseases like heart disease or stroke?'

Only respondents who had no CVD and who reported that their health care provider asked them about their family history of health problems and illnesses in general were then asked: 'Has a health care provider ever asked you about your family history of heart disease or stroke, specifically?'

Covariates

Covariates may affect associations among family history, health care provider (HCP) recommendations, and patient behavior. One or more of the following covariates were used in the analyses shown in tables 2–6: self-reported information on age, sex, education level, annual household income, race and ethnicity, physical activity level, body mass index (BMI), diabetes, fruit and vegetable consumption, hypertension, cholesterol level, cholesterol screening history, smoking status, insurance status, perceived health status, health care access problems, and having a personal doctor or HCP. Physical activity levels were categorized as either meeting or not meeting the 2007 Centers for Disease Control and Prevention (CDC) recommendations. These recommendations could be met by either (a) moderately intense activity during leisure time for ≥30 minutes on ≥5 days per week or (b) vigorous physical activity during leisure time for ≥20 minutes on ≥3 days per week [12]. Respondents were grouped as either meeting or not meeting CDC recommendations of consuming ≥5 servings of fruits and vegetables a day. Obesity was defined as having a BMI ≥30.0 kg/m^2. In this study, current smokers were defined as persons who currently smoked every day or some days and who reported having smoked ≥100 cigarettes during their lifetime. Respondents were also asked whether a doctor, nurse or other health professional had ever told them they had high blood pressure, high cholesterol or diabetes; whether they took aspirin daily or every other day; and when they last had their cholesterol checked.

Data Analysis

We used Pearson χ^2 tests to compare family history status among demographic categories. Pearson χ^2 tests and logistic regression were used to assess the association between respondents' family history and their reports of HCP practices, their perceived risk for CVD, their adoption of preventive behaviors, and their risk factors for CVD. We also used Pearson χ^2 tests and logistic regression to investigate whether persons at average and increased risk for CVD met screening recommendations for lipid disorders issued by the U.S. Preventive Services Task Force (USPSTF) [13]. In our analysis, we focused solely on cholesterol screening by age, sex and family history status. We were unable to analyze the data by age of onset of relatives diagnosed with CVD because those data were not collected in the BRFSS.

Logistic regression was used to evaluate the synergistic effect of HCP recommendations and positive family history on preventive behavior. We calculated odds ratios (OR) that compared the prevalence of preventive behaviors among 2 groups of respondents. One group comprised those having a positive family his-

Table 1. Family history status by selected characteristics among Oregonians without CVD, 2007 Behavioral Risk Factor Surveillance System

Characteristic	Overall n	Family history of CVD	
		negative[a] n (weighted row %)	positive[b] n (weighted row %)
Overall	2,566[c]	1,394 (61.9%)	1,172 (38.1%)
Mean age, years	45.2	42.0	51.2
Sex			
Male	926	578 (68.4%)	348 (31.6%)
Female	1,640	816 (56.0%)	824 (44.0%)
Education			
High school or less	814	476 (67.7%)	338 (32.3%)
Some college	737	358 (55.6%)	379 (44.4%)
College graduate	1,010	556 (61%)	454 (39.0%)
Household income, US dollars			
<25,000	567	317 (64.2%)	250 (35.8%)
25,000–49,999	737	376 (58.4%)	361 (41.6%)
>50,000	1,045	581 (61.6%)	464 (38.4%)
Personal doctor/healthcare provider			
No	444	294 (74.3%)	150 (25.7%)
Yes	2,116	1,094 (57.8%)	1,022 (42.2%)

CVD = Cardiovascular disease.

[a] No first-degree relatives with heart disease or stroke or adopted with unknown family history status of blood relatives. [b] At least one first-degree relative diagnosed with heart disease or stroke. [c] Numbers for some variables do not total 2,566 because of missing data.

tory of CVD and reporting that a HCP had provided recommendations to change their eating habits or physical activity to reduce the risk for developing heart disease or stroke. This group was compared to all other respondents, that is, those not sharing both characteristics.

In the adjusted logistic regression models, only covariates that changed the point estimate of the OR by at least 10% (compared with the full model) were kept in the final models. Interaction terms (family history × sex and family history × age) were included in the logistic regression models only if they were significantly associated with the outcome variables ($p < 0.05$). All analyses were performed by using Stata version 9.2 [14]. The Taylor series linearization method was used to compute the variance of survey estimates in accordance with the complex sample design. Sample sizes (number of survey respondents) were reported as unweighted numbers.

Results

The response rate for the family history questions of the Oregon BRFSS was 47%. Of the 2,985 respondents to the family history questions, we excluded 155 due to missing or unknown information about family history or personal history of CVD. We then excluded 264 additional respondents because they met our criteria for having CVD. Our final sample for this analysis included 2,566 respondents without CVD.

Among our sample, 38% reported having a family history of CVD, which is consistent with the national estimate of 43% of all U.S. adults, with and without CVD, who reported having a family history of CVD [10]. Persons with a positive family history were older (mean age = 51.2 years) than those without a family history (mean age = 42.0 years). A higher proportion of women than men reported having a positive family history of CVD (44.0% vs. 31.6%). Among respondents with a positive family history, 42.2% reported having a personal doctor or HCP, compared with 25.7% who reported no personal physician (table 1).

Adjusted logistic regression analyses showed that, compared with those having a negative family history of CVD, persons with a positive family history had greater odds of reporting that their HCP asked about their family history of heart disease or stroke (OR = 2.6; 95% CI, 1.9–3.4), discussed their risk of developing heart disease

Table 2. Percent distribution and likelihood of reported healthcare provider practices and recommendations by familial risk among Oregonians without CVD, 2007 Behavioral Risk Factor Surveillance System

Dependent variable (for adjusted OR)	Overall n (%)	Family history of CVD		
		negative[a] n (weighted column %)	positive[b] n (weighted column %)	positive adjusted OR (95% CI) (vs. negative family history)
Overall	2,566[c]	1,394 (61.9%)	1,172 (38.1%)	
Collection of family history of heart disease or stroke by healthcare provider[d]				
No	487 (24%)	342 (30.5%)	145 (13.7%)	
Yes	2,001 (76%)	999 (69.5%)	1,002 (86.3 %)	2.6 (1.9–3.4)[e]
Discussion of CVD risk by healthcare provider				
No	1,472 (62.2%)	934 (70.7%)	538 (48.2%)	
Yes	1,052 (37.8%)	439 (29.3%)	613 (51.8 %)	2.0 (1.6–2.5)[f]
Lifestyle change recommendations by healthcare provider				
No	1,500 (63.4%)	935 (71.4%)	565 (50.3%)	
Yes	1,046 (36.6%)	454 (28.6%)	592 (49.7 %)	2.1 (1.7–2.7)[f]

CVD = Cardiovascular disease; OR = odds ratio; CI = confidence interval.

[a] No first-degree relatives with heart disease or stroke, or adopted with unknown family history status of blood relatives. [b] At least one first-degree relative diagnosed with heart disease or stroke. [c] Numbers for some variables do not total 2,566 because of missing data. [d] Among respondents who reported that their health care provider collects general family history information. [e] Adjusted for sex. [f] Adjusted for high cholesterol.

or stroke (OR = 2.0; 95% CI, 1.6–2.5), and recommended changes in eating habits or physical activity to reduce the chances of developing heart disease or stroke (OR = 2.1; 95% CI, 1.7–2.7) (table 2).

Persons with a positive family history of CVD were almost 4 times as likely than those with a negative family history to believe that they were somewhat or very likely to develop heart disease or stroke in the future (OR = 3.7; 95% CI, 3.0–4.5). Compared with those with a negative family history of CVD, persons with a positive family history were more likely to report making lifestyle changes (OR = 1.9; 95% CI, 1.5–2.4) and to report taking aspirin on a regular basis (OR = 1.3; 95% CI, 1.0–1.6) ($p < 0.05$). However, family history was not associated with smoking status or with meeting CDC physical activity or fruit and vegetable consumption guidelines in these adjusted models (table 3).

Overall, persons with a positive family history were more likely to have had their cholesterol screened in the past 5 years than those respondents with a negative family history. Stratifying the population by sex and age based on the USPSTF screening guidelines for lipid disorders showed that family history status was associated with cholesterol screening in women aged 20–44 years (OR = 1.6; 95% CI, 1.0–2.6) ($p < .05$) but not in women of other ages or in men of any age (table 4).

Overall, persons with a positive family history had 60% higher odds of having high blood pressure compared with those having a negative family history (OR = 1.6; 95% CI, 1.3–2.1). Results showed that the effect of family history on hypertension was modified by age. Persons 18–55 years of age with a positive family history were more than twice as likely to have high blood pressure compared with those in the same age group without a family history (OR = 2.4; 95% CI, 1.7–3.5). No significant association between family history and hypertension in the older age groups were found. Although family history of CVD was associated with high cholesterol (OR = 1.5; 95% CI, 1.2–1.8), family history was not associated with diabetes or obesity (table 5).

The joint impact of family history of CVD and HCP recommendations on preventive behaviors and CVD risk factors is shown in table 6. Compared to the influence of family history alone, the combination of a positive fam-

Table 3. Percent distribution and likelihood of perceived risk and preventive behaviors by familial risk among Oregonians without CVD, 2007 Behavioral Risk Factor Surveillance System

Dependent variable (for adjusted OR)	Overall n (%)	Family history of CVD		
		negative[a] n (weighted column %)	positive[b] n (weighted column %)	positive adjusted OR (95% CI) (vs. negative family history)
Overall	2,566[c]	1,394 (61.9%)	1,172 (38.1%)	
Perceived risk of CVD				
Not at all or slightly likely	1,210 (54.1%)	832 (66.1%)	378 (34.7 %)	
Very or somewhat likely	1,182 (45.9%)	457 (33.9%)	725 (65.3%)	3.7 (3.0–4.5)
Reported lifestyle changes				
No	936 (40.8%)	633 (48.8%)	303 (27.9%)	
Yes	1,618 (59.2%)	753 (51.2%)	865 (72.1%)	1.9 (1.5–2.4)[d]
Current smoker				
No	2,193 (84.5%)	1,179 (83.8%)	1,014 (85.8 %)	
Yes	359 (15.5%)	207 (16.2%)	152 (14.2%)	0.9 (0.6–1.1)
Physical activity				
Recommendations not met	1,092 (42.5%)	586 (41.0%)	506 (44.9%)	
Recommendations met	1,335 (57.5%)	736 (59.0%)	599 (55.1 %)	0.9 (0.7–1.0)
Fruit and vegetable consumption				
<5 servings per day	1,832 (72.9%)	1,021 (75.1%)	811 (69.3 %)	
≥5 servings per day	732 (27.1%)	372 (24.9%)	460 (30.7%)	1.1 (0.9–1.4)[d]
Taking low-dose aspirin				
No	1,844 (78.7%)	1,062 (82.4%)	782 (72.7%)	
Yes	720 (21.3%)	331 (17.6%)	389 (27.3%)	1.3 (1.0–1.6)[e, f]

CVD = Cardiovascular disease; OR = odds ratio; CI = confidence interval.

[a] No first-degree relatives with heart disease or stroke or adopted with unknown family history status of blood relatives. [b] At least one first-degree relative diagnosed with heart disease or stroke. [c] Numbers for some variables do not total 2,566 because of missing data. [d] Adjusted for high cholesterol. [e] Adjusted for high cholesterol and high blood pressure. [f] $p < 0.05$.

Table 4. Cholesterol screening within the past five years by family history, sex, and age among Oregonians without cardiovascular disease[a], 2007 Behavioral Risk Factor Surveillance System

	Cholesterol screening		
	negative family history of CVD[b] n (weighted row %)	positive family history of CVD[c] n (weighted row %)	positive family history of CVD adjusted OR (95% CI) (vs. negative family history)
Overall (all ages, males and females)	981 (63.3%)	997 (82.6%)	1.5 (1.0–2.3)[d]
Males			
Age 20–34 years	39 (39.5%)	11 (52.9%)	0.7 (0.1–4.6)
Age ≥35 years	354 (75.1%)	277 (85.2%)	1.3 (0.6–2.5)[d]
Females			
Age 20–44 years	173 (57.1%)	101 (66.5%)	1.6 (1.0–2.6)[e]
Age ≥45 years	408 (87.9%)	608 (93.8%)	1.4 (0.7–2.6)[d]

OR = Odds ratio; CI = confidence interval.

[a] Based on US Preventive Services Task Force screening recommendations for lipid disorders in adults. [b] No first-degree relatives with heart disease or stroke, or adopted with unknown family history status of blood relatives. [c] At least one first-degree relative diagnosed with heart disease or stroke. [d] Adjusted for high cholesterol. [e] $p < 0.05$.

Table 5. Percent distribution and likelihood of CVD risk factors by familial risk among Oregonians without CVD, 2007 Behavioral Risk Factor Surveillance System

Dependent variable (for adjusted OR)	Overall n (%)	Family history of CVD		
		negative[a] n (weighted column %)	positive[b] n (weighted column %)	positive adjusted OR (95% CI) (vs. negative family history)
	2,566[c]	1,394 (61.9%)	1,172 (38.1%)	
High blood pressure				
No	1,769 (76.8%)	1,049 (82.7%)	720 (67.2%)	
Yes	795 (23.2%)	345 (17.3%)	450 (32.8%)	Overall: 1.6 (1.3–2.1)[d] Age 18–54 years: 2.4 (1.7–3.5)[e] Age 55–64 years: 1.2 (0.8–1.7) Age ≥65 years: 1.0 (0.7–1.5)[d]
High cholesterol				
No	1,311 (71.3%)	727 (71.3%)	584 (59.5%)	
Yes	836 (28.7%)	362 (28.7%)	474 (40.5%)	1.5 (1.2–1.8)[f]
Diabetes				
No	2,367 (94.5%)	1,304 (95.7%)	1,063 (92.6%)	
Yes	198 (5.5%)	89 (4.3%)	109 (7.4%)	1.2 (0.8–1.7)[g]
Obesity				
BMI <30	1,847 (75.3%)	1,023 (76.3%)	824 (73.6%)	
BMI >30	616 (24.7%)	316 (23.7%)	300 (26.4%)	1.0 (0.8–1.3)[h]

CVD = Cardiovascular disease; OR = odds ratio; CI = confidence interval.

[a] No first-degree relatives with heart disease or stroke or adopted with unknown family history status of blood relatives. [b] At least one first-degree relative diagnosed with heart disease or stroke. [c] Numbers for some variables do not total 2,566 because of missing data. [d] Adjusted for high cholesterol and obesity. [e] Adjusted for having a personal doctor/health care provider. [f] Adjusted for age. [g] Adjusted for high cholesterol. [h] Adjusted for high blood pressure.

Table 6. Combined provider recommendations and family history as predictors of preventive behaviors among Oregonians without cardiovascular disease, 2007 Behavioral Risk Factor Surveillance System

Dependent variable	Respondents with positive family history and HCP recommendations vs. all others, adjusted OR (95% CI)
Reported lifestyle changes	2.7 (2.3–3.2)[a]
Current smoker	1.0 (0.8–1.2)
Physical activity (recommendations met vs. recommendations not met)	0.9 (0.7–1.0)
Fruit and vegetable consumption (≥5 servings per day vs. <5 servings per day)	1.1 (0.9–1.2)
Taking low-dose aspirin	1.5 (1.3–1.7)[a]

HCP = Health care provider; OR = odds ratio; CI = confidence interval.

[a] Adjusted for high cholesterol

ily history and HCP recommendations increased the odds of 2 preventive behaviors: reported lifestyle changes (OR = 2.7; 95% CI, 2.3–3.2) and taking low-dose aspirin (OR = 1.5; 95% CI, 1.3–1.7) (table 6).

Conclusion

Our study demonstrated that family history of CVD is associated with greater likelihood of people reporting that their clinician asked about their family history, discussed with them the risk of CVD and recommended lifestyle changes to reduce their risk for developing heart disease or stroke. We found a positive association between family history and individuals' efforts to reduce their risk for developing CVD by changing their eating habits or increasing physical activity (Lifestyle changes, table 3). Persons with a family history also had a higher likelihood of having high cholesterol, high blood pressure, taking aspirin, and having had their cholesterol checked.

Healthcare Provider Recommendations

Our findings are consistent with those of other studies concluding that few clinicians use family history in screening, prevention or treatment efforts [15, 16]. Our data showed that persons with a positive family history were more than twice as likely as those with a negative family history to report that their HCP discussed risk for CVD and made recommendations to decrease risk. However, in absolute terms, only about half of those with a positive family history reported engaging in discussions about risk with their HCP or receiving recommendations that could assist in preventing CVD (table 2). While it is possible that some of the reported lack of discussion on these important topics represents lapse in memory of conversations that did, in fact, occur, this low percentage suggests many missed opportunities to educate persons at increased risk of CVD about that risk, and about steps that could be taken to prevent CVD.

Family history information can be used to identify persons who are at increased risk for CVD and who thus may be receptive to and benefit more from interventions aimed at preventing CVD than patients with no family history [10]. Presently, clinicians are hampered in their efforts to use family history to improve health by inconsistent risk assessment algorithms and guidelines. For example, the USPSTF, American Heart Association and the recent Reynolds Risk Score incorporate family history information into their risk calculations and recommendations, but the Framingham tool for calculating a 10-year risk for heart attack does not [13, 17–19]. In a recent study in Oregon, Kaiser Permanente clinicians reported that family history information could be more useful if it were integrated into algorithms and tools already used in clinical decision-making. Clinicians reported that they do not use family history information in isolation in their practices but adopt a holistic approach and use family history in addition to other risk factors (e.g. personal medical history and age) [20].

Our study confirmed that people with a family history of CVD are more likely than those without a family history to have a regular doctor (table 1).

Perceived Risk

We found that people with a family history of CVD were almost 4 times more likely to believe that they would develop heart disease or stroke in the future compared to those without a family history. Other studies exploring the connection between family history and perceived risk for developing a health condition or family history and behavior change to decrease risk show inconsistent findings. A qualitative study of primary care patients found that perceptions of risk based on family history may vary by individual and by disease. Specifically, persons who perceived that their risk was hereditary and those with a family history of cancer were more likely to feel more susceptible, while those who believed that changing their lifestyle could help prevent the disease felt more empowered [21]. This and other research support the view that family history can be used to encourage preventive behaviors in individuals [21, 22]. Nevertheless, having a perception of risk does not necessarily translate into positive behavioral changes. Some research suggests that increased perception of familial risk does not lead to changed behavior; some people may even adopt a fatalistic outlook and make no efforts to decrease their risk [23–25]. Other studies found that having a close family member with a chronic disease may increase perception of risk and encourage health-promoting behaviors, such as weight control and fruit and vegetable consumption [26, 27].

Cholesterol Screening

Given the evidence that CVD can be prevented or delayed, identifying asymptomatic individuals at highest risk could reduce CVD morbidity and mortality if effective interventions are implemented [28]. The USPSTF, American Heart Association and the National Cholesterol Education Program use family history information to determine which adults should be screened and the age at which screening should begin [28]. Looking at our sample as a whole, individuals with a family history of CVD were more likely to have their cholesterol screened within the past 5 years than those without a family history. However, when the data were stratified by age and sex categories used by USPSTF, this association of family history and cholesterol screening was explained by differences in young females. Screening levels based on family history were not significantly different for older females or males of any age. It should be noted that the sample size for young males was small, creating wide confidence intervals. Our findings suggest that a positive family history may be most effective in motivating young women to have their cholesterol screened. A larger sample size of young men is needed to help resolve the impact of family history on cholesterol screening in young men.

Behavior Change and Modifiable Risk Factors

Research suggests that, compared to persons with a negative family history, those at increased familial risk for CVD may benefit most from lifestyle changes and other preventative measures, such as taking low-dose as-

pirin [15]. For example, evidence from several studies suggests that persons who have a family history of heart disease and who engage in moderate physical activity and reduce intake of saturated fat and cholesterol have a reduced risk for developing heart disease [29–31]. Other research has demonstrated that cigarette smoking and a positive family history of coronary heart disease together are particularly deleterious. Smoking cessation could substantially reduce CVD morbidity and mortality in this high-risk population [31–35]. Overall, the literature suggests that the risk associated with family history of CVD may be mitigated by appropriate preventive behaviors [35].

Our study demonstrated that family history of CVD was associated with reported lifestyle change aimed at decreasing CVD risk. However, our study showed no association between family history status and actually meeting CDC physical activity recommendations or fruit and vegetable consumption guidelines. These results may indicate that people with a family history of CVD are changing their behavior in small increments, but not enough to meet current physical activity or nutrition recommendations [36]. Although we cannot verify this observation in our cross-sectional data, another possible explanation is that respondents with a positive family history of CVD had lower baseline physical activity and nutrition levels than those with a negative family history; consequently, those with a family history may have made positive lifestyle changes over time, but not enough to meet national guidelines. Our findings are comparable to those of other studies that suggest that, although persons may report making lifestyle changes, only a small proportion are sustaining behaviors that reduce the risk of CVD over the long term [10, 37].

The USPSTF strongly recommends that clinicians discuss aspirin use with adults who are at increased risk for coronary heart disease. Increased risk is based on a number of factors, including family history in younger adults [38]. Similar to results from another study of U.S. adults, we found more prevalent aspirin use among those with a positive family history compared to persons with a negative family history [10]. Our study also showed that the combination of a positive family history and clinician recommendations increased regular aspirin use. This finding is consistent with results from a study of Health Maintenance Organization members ≥ 40 years of age, in which clinician recommendations to use aspirin were highly correlated with actual aspirin use among patients [39].

We acknowledge that motivations for behavior changes are multifaceted and that family history of CVD alone may not prompt behavior change [40]. However, the presence of family history is one of several factors that may motivate persons who do not have CVD, but are at high risk for CVD, to engage in healthy, potentially protective behaviors.

Other Risk Factors for CVD

Evidence shows that risk factors for CVD are associated with a positive family history of CVD, but many comorbidities of CVD are not inevitable and can be prevented. Results from a national survey concluded that hypertension, hypercholesterolemia, diabetes, and obesity aggregate in families [9]. The risk for myocardial infarction in persons with hyperlipidemia or hypertension in combination with a family history of myocardial infarction is multiplicative and is higher than the risk attributable to the additive effects of these risk factors [34]. Other studies reported similar interactions for cholesterol and blood pressure but not for diabetes and BMI [33]. Our study also showed that a positive family history of CVD was associated with high cholesterol and high blood pressure but not with diabetes or obesity.

Identifying persons at increased risk for CVD due to family history will also help to recognize those who either have comorbidities (e.g. high blood pressure or elevated cholesterol) or who are at risk for them. Recommendations for lifestyle changes to prevent CVD in this population have the potential to decrease complications of comorbidities as well.

Limitations

Several limitations should be considered when interpreting these findings. First, because we analyzed cross-sectional data, causal inferences cannot be drawn from our results. Second, because survey data were self-reported, they are subject to recall bias. However, one comprehensive study found that most questions on the BRFSS were at least moderately (and many were highly) reliable and valid [41]. Also, studies have shown that people can accurately report their family history of CVD [42–46]. Third, the low response rate (<50%) may have introduced non-response biases, which could have affected the conclusions drawn from this study. Fourth, this study focused solely on the influence that family history has on clinician recommendations and patient adherence to these recommendations. Other factors, including risk factors for CVD, such as smoking status and high cholesterol, could influence clinician practice and patient be-

havior. Although we adjusted for these other factors in our analyses, the factors were not analyzed separately as predictors of clinician recommendations and patient behavior. Fifth, the BRFSS did not ask about age of onset of the relatives diagnosed with CVD. Consequently, we were unable to precisely categorize our respondents into USPSTF risk categories. Sixth, having a family history of CVD could influence how people perceive and interact with their clinicians. For example, people with a positive family history of CVD may be more likely to remember that a clinician collected family history information, discussed risk, and made recommendations, whereas people with a negative family history may be more likely to forget these interactions. Along these same lines, individuals who are attentive about knowing their family history may be more likely to be among the worried well who are vigilant about their health care and health behaviors. Seventh, our study surveyed only the population in Oregon, but we have no reason to believe our results would differ for similar populations around the country [47]. Last, the survey design did not allow for the stratification of the study sample by race and ethnicity.

Implications for Public Health Policy and Future Research

The results of our study combined with other data suggest that identifying people at increased risk for CVD, followed by clinicians recommending lifestyle changes and health screening, may reduce the prevalence of CVD. In order to accomplish this objective, clinicians need efficient decision support tools and consistent evidence-based guidelines related to family history.

Future studies are needed to corroborate our findings, and further research is needed to evaluate the effectiveness of different messages pertaining to family history for promoting preventive lifestyle changes among patients at increased risk for CVD. Also, additional research is needed to determine the best strategies for HCPs to use to motivate their patients to make lifestyle changes aimed at decreasing CVD risk and to follow health screening recommendations. Meanwhile, we agree with previous studies which indicate that prevention efforts targeting persons with a positive family history of CVD is an important and sensible public health intervention [48].

Acknowledgments

This study is dedicated to A.I. Zlot's uncle, Chuck Sabes, and was supported in part by a cooperative agreement from the Centers for Disease Control and Prevention (U58/CCU022779-04), Health Promotion Programs, Component 7, and Genomics and Chronic Disease Prevention.

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