2009

Examining the Association of Fruit and Vegetable intake and Breast and Prostate Cancer Screening

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Master of Public Health Research Project

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MPH Research Project: EPID 691

Virginia Commonwealth University
Richmond, Virginia

Month/Year
10/09

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Acknowledgements

I want to thank Lisa Anderson for helping me find my preceptor and new advisor for my project. Also for guiding me along the way to my MPH project. I want to also thank Dr. Vance for being understanding and helping me through my transition to my new advisor. I would also like to thank Dr. Resa Jones for helping me with SAS and the analyses in my study. Finally, I would like to thank both my project advisor and preceptor, Irene Lubker and Dr. Diane Wilson. Their guidance and recommendations for my project have been very instrumental to the completion of my project. Their expert opinions and knowledge in nutrition, cancer risk reduction, and public health have greatly aided me throughout the whole MPH project.

Abstract

Breast and prostate cancer incidence and mortality have been steadily decreasing. Reasons for these reductions may be related to increased rates of cancer screening and other factors such as improvements in diet, including consumption of fruits and vegetables. We wanted to determine if individuals who get screened for breast and prostate cancer are more or less likely to consume adequate servings of fruit and vegetables. A cross-sectional study using the BRFSS survey was conducted. Individuals included in this study (n=26,222), were asked about their breast or prostate cancer screening history. They were also asked about their servings per day of fruit and vegetables. Statistical analyses were conducted using the SAS 9.2 software program. Logistic regression analyses were conducted on the variables and potential confounders. Over 40% of individuals who did not screen for breast and prostate cancer were in the 50-59 years of age category. A trend was seen with younger age groups being less likely to consume 3 or more daily servings of fruit and vegetables than their older counterparts. Another trend was seen in education levels. Individuals with lower education were less likely to consume at least 3 daily servings of fruit and vegetables. There was a statistically significant association between cancer screening and servings of fruit and vegetables per day. Individuals who were screened for either breast or prostate cancer were 52% more likely to consume 3 or more servings of fruit and vegetables than those who did not screen for either breast or prostate cancer (OR=1.52, 95% CI: 1.29-1.79). Further research needs to be conducted related to how other health behaviors may be related to cancer screening adherence and fruit/vegetable intake.

Introduction

Previous research has shown that prostate and breast cancer screenings are important for early detection of cancers. In the American Cancer Society's annual Cancer Facts and Figures, it was indicated that breast cancer incidence and mortality have decreased steadily from the 1990's. The breast cancer incidence has decreased 2.2% per year from 1999-2005.[1] Since 1990 mortality rates decreased 3.2% per year for women younger than 50 and 2.0% per year for women over the age of 50.[1] Current recommendation indicates that women should receive mammograms every 1 to 2 years starting at the age of 40.[1,9] Incidence and mortality have also decreased for prostate cancer. Since 2001, the incidence of prostate cancer has decreased 4.4% per year.[1] The current recommendations for PSA tests for prostate screening are not definitive. There is no clear recommendation for routine screening, but it is recommended that men start screening at the age of 40 if they are at higher risk for prostate cancer.[1,9] One study showed a "20 percent reduction in prostate cancer deaths associated with PSA testing every 4 years."[10] These decreases in incidence and mortality for both breast and prostate cancer may be attributed to improved methods of early detection and treatment.[1]

Studies on the benefits of fruit and vegetables on reducing cancer risk and incidence are still not conclusive. Some studies have indicated that "intake of fruit and vegetables was generally unrelated to total cancer incidence"[7,11] ,while other studies have shown that fruits and vegetable intake may reduce cancer at specific sites.[8,12,13,15] "High consumptions of fruit and vegetables is associated with a reduced risk of colorectal cancer (CRC), especially of colon cancer."[6] Research from the American Institute for Cancer Research has shown that "vegetables and fruits probably protect against a range of cancers, including mouth, pharynx, larynx,

esophagus, stomach, lung, pancreas and prostate."[2] The American Cancer Society has recommended eating 5 servings of fruits and vegetables a day, while other studies and organizations have recommended increasing consumption of fruit and vegetables based on the individual.[1,2,5] Further research must be done to clarify and have substantial evidence that fruit and vegetable intake reduces cancer incidence and cancer risk.

Both getting cancer screenings and eating more plant-based foods such as fruits and vegetables are part of an overall lifestyle approach recommended for cancer risk reduction and potentially, cancer recurrence reduction.[1,9] However, whether individuals who get screened also follow nutrition recommendations has not been fully researched and the association between the two is unclear. The study hypothesis is that individuals who are screened for breast or prostate cancer are more likely to consume at least 3 daily servings of fruit and vegetables compared to those not reporting screening. The association that cancer screening has with intake of fruit and vegetables may provide insight into future health recommendations for reducing chronic disease incidence, risk, and mortality.

Objective

In this study we want to determine whether individuals who get screened for breast cancer or prostate cancer are more or less likely to consume adequate servings of fruits and vegetables.

Methods

The study was a cross-sectional study using The Centers for Disease Control and Prevention (CDC) sponsored Behavioral Risk Factor Surveillance System (BRFSS) survey, which is a collaborative project of U.S. states and territories (the District of Columbia, Puerto Rico, Guam,

and the Virgin Islands), to collect uniform, state-specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases in the adult population. Since the public-use dataset contains no personally identifiable information, this study did not require VCU IRB approval. In 2007, 53 states used computer-assisted telephone interviewing (CATI). Following guidelines provided by CDC, state health personnel or trained contractors conducted the interviews. The core portion of the questionnaire lasts an average of 10 minutes. Interview time for modules and state-added questions is dependent upon the number of questions used, but generally extend the interview period by an additional 5 to 10 minutes.

Study Sample

The inclusion criterion for this study was that an individual must have answered the questions regarding breast and prostate cancer screenings in the BRFSS survey and questions related to fruit and vegetable consumption and be 50 years of age or older. Individuals who were younger than 50 or did not answer the questions regarding cancer screenings or fruit/vegetable intake questions were not included in the study, leaving a sample size of 26,996 individuals.

Determinants

Individuals were asked several questions to determine their history of breast cancer or prostate cancer screening. For the screened for breast cancer variable, individuals were asked if they had ever had a mammogram. Individuals who answered “yes” were categorized as having been screened for breast cancer. Individuals who answered “no” were categorized as having not been screened for breast cancer. For the screened for prostate cancer variable, individuals were

asked if they had ever had a Prostate-Specific Antigen (PSA) test. Individuals who answered yes to the question were categorized as having been screened for prostate cancer. Individuals who answered no were categorized as having not been screened for prostate cancer. The screened for breast cancer and screened for prostate cancer variables were combined into a single variable, screened for cancer. Those that responded with a "yes" for either the screened for breast or prostate cancer variables were categorized as having been screened for cancer. If the respondents answered "no" to all of the cancer screening questions, then they were categorized as not having been screened for cancer.

Outcome variable

Individuals were also asked questions in the BRFSS survey regarding the servings of fruits and vegetables consumed per day. Survey items included: how often do you drink fruit juices such as orange, grapefruit, or tomato? Not counting juice, how often do you eat fruit? How often do you eat green salad? How often do you eat potatoes not including french fries, fried potatoes, or potato chips? How often do you eat carrots? And not counting carrots, potatoes, or salad, how many servings of vegetables do you usually eat? Reponses varied from per day, per week, per month, and per year basis. These variables were recoded and recalculated by BRFSS into "summary index for fruits and vegetables calculated variable". The new variable recalculated per day, per week, per month, per year answers into servings per day categories. A previous study broke down fruit and vegetable intake into two categories in order to perform logistic regression.[14] I will follow this similar protocol by creating two fruit and vegetable serving categories, "less than 3 times per day" and "3 or more times per day".

Potential Confounders

We evaluated the following variables for confounding: race/ethnicity, income, sex, age, and education. The BRFSS coded race as White, Black/ African American, Asian, Native Hawaiian/ other Pacific Islander, American Indian/ Alaskan Native, or Other. Income may affect both cancer screening and fruit and vegetable intake. Participants were asked their annual household income. The income categories were collapsed into two categories, low income (less than $35,000 annually), and high income (greater than $35,000 annually). Age was categorized into 3 age groups based on cancer screening guidelines, 50-59, 60-69, and 70 or older. Current clinical guidelines recommend males to receive PSA tests and females to receive mammograms at 50 years of age and 40 years of age, respectively. Education levels were also evaluated in the study and some of the education levels were collapsed due to size. The categories included, "did not graduate high school", "high school graduate/GED", "some college/technical school", and "graduated college".

Analytic Approach

We compared the servings of fruits and vegetables variable by the screened for cancer variable. We then compared the characteristics of participants according to cancer screening. The logistic regression models provided the crude odd ratio, with 95% confidence intervals, of association between cancer screening and fruit and vegetable intake. Effect modification was assessed using the logistic regression model, where any variable with a p-value ≤ 0.05 was considered to be statistically significant. None of the variables were effect modifiers and therefore no stratification was necessary. A model decision making grid was used in conjunction with the logistic regression model to control for confounding. Variables that were considered to

be potential confounders were retained in the model if their presence resulted in greater than 10% change in the odds ratios. None of the variables were found to be confounders, so no adjustments were made on the final odds ratio.

Results

Of the 430,912 individuals who participated in the BRFSS survey, 37,996 were included in this study. The individuals excluded from this study (n=392,916) either did not meet the age criterion, did not answer the questions of interest, or left the questions blank. In addition, any individual who answered by "don't know/not sure" or refused were not included in the study. All of the variables in this study were weight adjusted.

Demographic information and covariates are shown in Table 1. Females were the vast majority in this study, making up 96% of those not screened for cancer and 97% of those screened for cancer. Approximately half of the individuals who did not screen for cancer were in the 50-59 years of age group. The distribution for those screened for cancer was fairly similar to those who did not screen for cancer. Approximately 43% of those "screened for cancer" were in the 50-59 years of age group. The two other age categories, 60-69 and 70 and older, made up approximately 28% and 29% of the individuals screened for cancer, respectively. The majority of the individuals in this study were white, which made up 63% of those "not screened for cancer" and 76% of those "screened for cancer". Approximately 55% of those "screened for cancer" had a high income and approximately 40% of those "not screened for cancer" had a high income. In addition, approximately 60% of those "screened for cancer" had an education level beyond high school, while approximately 50% of those "not screened for cancer" had an education level beyond high school.

The distribution of fruit and vegetable intake in the various demographic variables are presented in Table 2. Seventy-one percent of females in this study consumed 3 or more servings of fruits and vegetables per day, while 60% of the male participants consumed 3 or more servings of fruits and vegetables. Over 65% of each age category consumed 3 or more servings of fruits and vegetables per day, with the 50-59 age category being the lowest at 69%, and the 70 and older age category being the highest, at 75%. Over 60% of each race/ethnicity category also consumed 3 or more servings of fruit and vegetables per day. Seventy-five percent of high income individuals consumed 3 or more servings of fruits and vegetables per day, while 65% of low income individuals consumed 3 or more fruits and vegetables per day. The majority in each education level consumed 3 or more fruits and vegetables per day: 56% of those that "did not graduate high school", 65% of "high school graduates/ GED", 72% of individuals with "some college/ technical school", and 80% of "college graduates".

Table 3 shows the distribution of cancer screening for the age and gender variables; 60% of males screened for prostate cancer, while approximately 70% of the females were screened for breast cancer. The vast majority of the individuals in each age category screened for cancer; ninety-three percent of 50-59 year olds, 95% of 60-69 year olds, and 94% of the 70 or older, reported being screened

Table 4 shows the crude odds ratios for the potential confounders on fruit and vegetable servings per day. Males in this study were 35% less likely to consume 3 or more servings of fruits and vegetables per day compared to females (OR=0.65, 95% CI: 0.54-0.78). Compared to individuals who were 70 or older, the 50-59 age group was 31% less likely to have 3 or more servings of fruit and vegetables per day (OR=0.69, 95% CI: 0.63-0.77) and the 60-69 age group

was 28% less likely to have 3 or more servings of fruit and vegetables per day (OR=0.72, 95% CI: 0.65-0.81). Within the race variable, African Americans were 26% less likely to consume 3 or more servings of fruits and vegetables per day (OR=0.74, 95% CI: 0.64-0.84) and Hispanics were 16% less likely to consume 3 or more servings of fruits and vegetables per day (OR=0.84, 95% CI: 0.72-0.98), when compared to white individuals. The "Other" race category did not show significant differences in fruit and vegetable intake compared to white individuals (OR=0.98, 95% CI: 0.84-1.15). Individuals with a low income were 37% less likely to consume 3 or more servings of fruit and vegetables per day compared to high income individuals (OR=0.63, 95% CI: 0.58-0.69). All of the education levels were less likely to consume 3 or more servings of fruits and vegetables when compared to college graduates. The "did not graduate high school" category had the lowest odds of consuming 3 or more servings of fruits and vegetables per day (OR=0.31, 95% CI: 0.27-0.36).

Table 5 shows the odds ratio from a logistic regression analysis of fruit and vegetable servings per day by cancer screening. There was a significant association between cancer screening and fruit and vegetable intake. The crude odds ratio for individuals who screened for either breast or prostate cancer was 1.52, with a 95% CI ranging from 1.29 to 1.79. The odds ratio indicates that individuals who screened for either breast or prostate cancer were 52% more likely to consume 3 or more servings of fruits and vegetables per day compared to individuals who were not screened for either breast or prostate cancer.

Discussion

Of the 37,996 individuals who answered the cancer screening questions regarding breast and prostate cancer, approximately 86% of the individuals were screened for cancer (N=32,490).

When examining the crude odds ratio, individuals who screened for breast and prostate cancer were more likely to consume 3 or more servings of fruits and vegetables per day compared to those reporting not screening. Thus, the fruit/vegetable intake of these individuals may indicate that they may be more likely to have consumed 5 servings of fruit and vegetables per day as recommended by The American Cancer Society and CDC. [1,5] After further analyses, using the logistic regression model, it was determined that none of the variables in this study were confounders. Due to there being no confounders, there was no need for an adjusted odds ratio.

Looking at the demographic variables in this study, there seemed to be a similar trend in fruit and vegetable intake by age and education level. The trends run parallel to those reported in a study by George et al.[7] After observing the crude odds ratios for the age groups, the study showed an increasing trend of consuming 3 or more servings of fruits and vegetables per day as age increased. This trend indicates that as individuals grow older, they are more likely to consume more servings of fruits and vegetables. A similar trend was seen in education levels. As the education level increased there was an increase in having 3 or more servings of fruits and vegetables per day. This trend also indicates that individuals with higher education levels are more likely to consume higher servings of fruit and vegetables. Higher education is frequently linked with higher socioeconomic status, which may afford these individuals with more luxuries, such as fresh fruits and vegetables. Income level also seems to have an affect on servings of fruit and vegetables. In this study we saw that individuals with lower income were less likely to consume 3 or more servings of fruit and vegetables compared to individuals with higher income. Individuals with lower income may not have the means to purchase fruit and vegetables, which tend to be more expensive than unhealthy alternatives. In addition, “lower-income areas have fewer grocery stores per square mile in which fresh produce is available compared with

convenience-type markets offering more calorie-dense processed foods."[14] Gender also has an effect on fruit and vegetable consumption. This study showed that men are less likely to consume 3 or more fruit and vegetable servings per day. Another study by Baker and Wardle also indicated that women consumed more fruits and vegetables than men.[4] Their study found that men tended to underestimate the number of fruit/vegetable servings recommended compared to servings reported by women.[4] This may be one of several reasons why men may consume less servings of fruits and vegetables than women. A study by Wilson et al. found that "African American women were significantly less likely than white women to report…eating at least 2 servings daily of fruits and vegetables in adjusted analyses."[14] My findings were parallel with the Wilson study and found that African Americans were 21% less likely to consume 3 or more servings of fruits and vegetables compared to white individuals.

There were several strengths and limitations in the study. One of the strengths of the study was the large diverse sample size, which was generalizable to the U.S. population. Another strength of the study was that it exclusively examined the relationship between breast and prostate screening and fruit and vegetable intake. The study limitations include the study design being cross-sectional, in which it is not possible to determine whether exposure preceded or results from the outcome. Various forms of bias were also in the study including recall bias, interviewer bias, or misclassification. The participants in the study may not remember taking a certain cancer screening test, or may mistake one test for another. Participants may also not remember the exact number of servings of fruits and vegetables consumed on a daily basis. In addition, many of the participants may not know what constitutes as a serving of a certain fruit or vegetable. We were only interested in individuals who answered the questions regarding prostate and breast cancer screening. These individuals may introduce bias because they may be more

concerned about healthy lifestyle behaviors and therefore be more likely to have screened for cancer or consumed higher servings of fruits and vegetables. Another limitation of the study was that the vast majority of the participants in this study were women. This means that this study did not represent the national population. Also, screening age categories used in analysis included younger ages than those recommended in clinical guidelines, which may account for the trends towards non-screening among women in the 36-44 year old age group.

Conclusion

This study was able to show that there was a statistically significant association between breast and prostate cancer screening and fruit and vegetable intake. I found that fruit and vegetable intake levels by age, gender, race, and education level were comparable to other studies. The differences seen within these different categories may be explained by various health behaviors, factors that were not included in this study, and the lack of resources available to underserved populations. Other studies have shown that obesity and BMI are associated with sedentary lifestyle and consumption of fewer calorie-dense foods.[14] This may be an important factor in the association between fruit and vegetable intake and cancer screening. This study was also limited to just breast and prostate cancer screenings. Future studies can look at the broader spectrum of cancers and cancer screenings in association to fruit and vegetable intake. Further studies can also be conducted looking at the physicians influence on their patients regarding healthy lifestyle factors, such as fruit and vegetable intake, and cancer screenings. A study by Baker and Wardle suggests that simple written messages tailored to the fruit and vegetable intake and knowledge levels of an individual can modify cancer protective dietary behaviors.[3] Introducing education about healthy lifestyle changes, such as increasing fruit and vegetable servings, into cancer

screening clinics will combine primary and secondary prevention and may increase the overall effectiveness of a clinical visit.

Table 1. Characteristics of Individuals by Screening Status for Breast or Prostate Cancer

	Not Screened	Screened
	N = 5,506	N = 32,490
	Wt. N = 2,959	Wt. N = 15,878
	Weighted N (Column %)	
Gender		
Male	328 (11.09)	489 (3.08)
Female	2631 (88.91)	15389 (96.92)
Age		
35-44	1991 (67.27)	3632 (22.88)
45-54	526 (17.77)	4460 (28.09)
55-64	194 (6.54)	3565 (22.45)
65 or older	249 (8.42)	4221 (26.58)
Race/ Ethnicity		
White	1871 (63.22)	11437 (72.03)
Black	404 (13.66)	1945 (12.25)
Hispanic	326 (11.03)	1362 (8.58)
Other	358 (12.10)	1133 (7.14)
Income		
Low	1168 (39.46)	6117 (38.53)
High	1792 (60.54)	9761 (61.47)
Education Level		
Did not grad. HS	300 (10.15)	1317 (8.29)
HS Graduate/ GED	860 (29.05)	4842 (30.50)
Some College/ Tech.	794 (26.85)	4558 (28.71)
College Grad.	1005 (33.95)	5160 (32.50)

Table 2. Characteristics of Individuals by Fruit and Vegetable Intake

	Less than 3	3 or more
	N = 12,712	N = 25,284
	Wt. N = 6,064	Wt. N = 12,773
	Weighted N (Row %)	
Gender		
Male	218 (40.41)	322 (59.59)
Female	2979 (29.12)	7249 (70.88)
Age		
50-59	1487 (32.16)	3138 (67.84)
60-69	938 (31.10)	2078 (68.90)
70 or older	772 (24.68)	2356 (75.32)
Race/ Ethnicity		
White	2307 (28.63)	5750 (71.37)
Black	381 (35.37)	695 (64.63)
Hispanic	264 (32.47)	549 (67.53)
Other	245 (29.84)	577 (70.16)
Income		
Low	1739 (34.94)	3239 (65.06)
High	1458 (25.17)	4332 (74.83)
Education Level		
Did not grad. HS	488 (44.23)	615 (55.77)
HS Graduate/ GED	1257 (35.51)	2283 (64.49)
Some College/ Tech.	852 (27.94)	2198 (72.06)
College Grad.	601 (19.52)	2476 (80.48)

Table 3. Cancer Screening Status by Age and Gender

	Not Screened N = 5,506 Wt. N = 2959	Screened N = 32,490 Wt. N = 15898
	Weighted N (Row %)	
Gender		
Male	349 (39.81)	528 (60.19)
Female	8635 (30.20)	19955 (69.80)
Age		
50-59	321.07 (6.94)	4304 (93.06)
60-69	143 (4.73)	2873 (95.27)
70 or older	183 (5.86)	2945 (94.14)

Table 4. ORs (95%CI) of Consuming at Least 3 Servings of Fruit and Vegetables Daily by Demographic Characteristics

	Crude Estimates (95% CI)
Gender	
Male	0.65 (0.54-0.78)
Female	1.00
Age	
50-59	0.69 (0.63-0.77)
60-69	0.72 (0.65-0.81)
70 or older	1.00
Race/ Ethnicity	
White	1.00
Black	0.74 (0.64-0.84)
Hispanic	0.84 (0.72-0.98)
Other	0.98 (0.84-1.15)
Income	
Low	0.63 (0.58-0.69)
High	1.00
Education Level	
Did not grad. HS	0.31 (0.27-0.36)
HS Graduate/ GED	0.49 (0.40-0.50)
Some College/ Tech.	0.69 (0.56-0.71)
College Graduate	1.00

Table 5. Crude and Logistic Regression Analysis

	Crude OR (95% CI)	Adjusted*OR (95% CI)
	Fruit and Vegetable Servings per day	
Screened for Breast Or Prostate Cancer		
No	1.00	1.00
Yes	1.52 (1.29-1.79)	

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