ASSOCIATION OF MARITAL STATUS AND COLORECTAL CANCER
SCREENING IN THE UNITED STATES

BY

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Abstract

Objectives: Colorectal cancer (CRC) is estimated to be the third most common malignancy worldwide, with 945,000 new cases every year and responsible for 492,000 deaths annually. Despite evidence that it decreases mortality, CRC screening in the United States remains underutilized. Marital status has been implicated in some European studies as a factor affecting CRC screening participation, but the effect of marital status on CRC screening participation in the US population is unknown. In this study, we aim to identify the association between marital status and participation in CRC screening in the United States.

Study Design: This is a retrospective data analysis of the 2010 Behavioral Risk Factor Surveillance System survey (BRFSS).

Methods: The population studied included 239,300 participants, aged 50 to 75, who completed the 2010 BRFSS. Individuals were selected randomly using disproportionate stratified random sampling. A logistic regression analysis was conducted to assess the association between colorectal screening status and marital status. Survey stratum and weight were taken into consideration to correct bias.

Results: Individuals who were divorced or separated (OR= 0.92, 95% CI= 0.88-0.97), never-married (OR=0.86; 95% CI= 0.80-0.93), or widowed (OR=0.80, 95% CI= 0.75-0.85]) were less likely to have met CRC screening guidelines compared to married individuals or members of unmarried couples.

Conclusions: This study suggests that individuals living in the United States who are married or are members of an unmarried couple are more likely to be screened for CRC compared to other marital status groups. Public health interventions are needed to promote CRC screening participation in these groups.

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Introduction

Colorectal cancer (CRC) is estimated to be the third most common malignancy worldwide, affecting 945,000 new cases every year and responsible for 492,000 deaths annually.[1] In the United States, colorectal cancer is the second leading cause of cancer death and the third most common cancer, with an estimated age-adjusted incidence of 45.5 per 100,000 persons.[2] Approximately 142,570 new cases of colorectal cancer are diagnosed each year in the United States.[3]

Most colorectal cancers arise from adenomatous polyps that progress from small to large (>1.0 cm) polyps, and then to dysplasia and cancer. Since the pathologic stage at diagnosis is an important prognostic predictor of colorectal cancer,[4] the recent decline in colorectal cancer mortality has been partially attributed to the implementation of effective screening measures allowing the detection of colorectal cancer at an early stage.[5]

The U.S. Preventive Services Task Force (USPSTF) recommends screening for colorectal cancer using high-sensitivity fecal occult blood testing (FOBT), flexible sigmoidoscopy, or colonoscopy beginning at 50 years and continuing until 75 years.[6] Despite evidence that it decreases mortality, CRC screening in the United States remains underutilized.[7] It is estimated that 62.9% of adult US citizens aged 50 to 75 were screened in 2008.[8]

Several factors are implicated in the sub-optimal screening rate, including patient, provider, and system-related issues.[7] Patient-related factors independently associated with lower screening rates include: low socio-economic status, lower education level (less than high school education), and having limited access to care.[8, 9] Marital status has also been implicated as a factor affecting CRC screening participation.[10, 11] Data from a population-

based study of Swedish residents 59 to 61 years suggested that being unmarried (OR = 1.69, 95% CI = 1.23-2.30) or divorced (OR = 1.49, 95% CI = 1.14-1.95) was associated with decreased participation in CRC screening compared to those who were married.[12] Data from the UK Flexible Sigmoidoscopy Trial (1996-1999) suggested that married people were more likely to participate in CRC screening compared to non-married people (OR = 1.23; 95% CI 1.04-1.45).[13] The effect of marital status on colorectal cancer screening participation in the US population is unknown. The aim of this study is to compare the participation rate in colorectal cancer screening among married, separated, widowed, never married, and divorced adults living in the United States.

Methods

Participants

The population studied included 239,300 participants, 50 to 75 years, who completed the 2010 Behavioral Risk Factor Surveillance System survey (BRFSS). Household members with a landline telephone number were eligible for inclusion in this study. These individuals were selected randomly using disproportionate stratified random sampling.[14] Individuals living in vacation homes (not occupied by household members for more than 30 days per year), group homes (sororities and fraternities, halfway houses, shelters), or institutions (nursing homes, college dormitories) were ineligible for the study. Only those who answered the questions regarding completion of a fecal occult blood test, colonoscopy, and/or sigmoidoscopy and when these tests were done were included in this analysis.

Instruments

The Behavioral Risk Factor Surveillance System survey is a cross-sectional health survey of US adults 18 years and older. The survey is conducted annually by state health departments with assistance provided by the Centers for Disease Control and Prevention (CDC). The BRFSS uses a standardized questionnaire to determine the distribution of risk behaviors and health practices among adults. The questionnaire is comprised of three parts: a core component constituted by mandatory questions, optional modules, and state-added questions. Twenty-two mandatory sections were included in the 2010 survey, in addition to 26 optional modules. Every two years, respondents aged 50 and older are asked in the mandatory section if they ever had a FOBT, colonoscopy, and/or sigmoidoscopy, and when these tests were done.

Dependent and Independent Variables

The dependent variable was a dichotoumous colorectal cancer screening status. Possible responses were being up to date or not being up to date on CRC screening according to the U.S. Preventive Services Task Force recommendations. The independent variable was marital status: possible response included being married, members of an unmarried couple, divorced, separated, widowed, and never married. Other demographic and confounding variables were also examined. Demographic variables included age, access to health care, education level, emotional support, place of residence (rural, suburbs, urban) and income level.

Procedures

The Human Subjects Committee at the University of Kansas School of Medicine– Wichita deemed this study to not be human subjects research. The 2010 BRFSS data

were downloaded from the CDC website.[15] Based on the U.S. Preventive Services Task Force[6] recommended screening age; only adults 50 to 75 years were included in the analysis. Participants who refused to answer, reported not knowing, or did not respond to the colorectal cancer screening question were excluded from the analysis.

Statistical Analysis

Data were imported to SAS software for windows Version 9.3(Cary, North Carolina). Based on the U.S. Preventive Services Task Force screening guidlines[6], participants were considered to have met recommended CRC screening guidelines if they have had completed any of three screenings: a FOBT done within the past year, a sigmoidoscopy done within the past five years with sensitive FOBT every three years, or a colonoscopy done within the past 10 years. Otherwise, participants were considered not having met recommended CRC screening guidelines.

The different reported marital statuses were grouped into 4 categories; Married or members of unmarried couples, divorced or separated, widowed and never married; by combining the data of married group with that of members of unmarried couple group as well as the data for the divorced and the separated groups.

Univariate analyses for each variable were presented as means and standard deviations for continuous variable, and frequencies and percentages for categorical variables. A logistic regression analysis was conducted to assess the association between colorectal screening status and marital status. A stepwise logistic regression analysis was conducted to determine which variables were significant to predict the likelihood of having met recommended CRC screening guidelines. To account for the bias in 2010

BRFSS, stratum and weight were taken into consideration. All statistical tests were two-sided. A p-value $\leq$ 0.05 was considered statistically significant.

Results

A total of 239,300 respondents who were 50 to 75 years, were included in the analysis. Fifty-eight percent (58.4%) of the respondents reported being married (n=139,273), 18% reported being divorced (n=35,375), and 7.9% reported being widowed (n=42,906). Sixty-one percent (n=146,904) of the respondents reported being female, and the mean reported age of the respondents was 62 years, SD = 7.2. Among those who reported their race, most reported being Caucasians (61.9%, n=2,448). The highest reported education level was college graduate (33.9%, n=80,965), and the highest reported income level category was greater than or equal to $75,000 per year (25.9%, n=53,637). Having health care coverage, including Medicare and Medicaid, was reported by 91.5% (n= 218,515) of respondents (Table 1).

Sixty-five percent of respondents were up to date on CRC screening according to guidelines (n= 150,558). Rates of CRC cancer screening were highest among married individuals (68.2%, n= 92,229) and lowest in separated individuals (54.9%, n= 2,399) (Table 2). Logistic regression analysis suggested that individuals who were divorced or separated (OR =0.92, 95% CI= 0.88-0.97), never-married (OR =0.86; 95% CI= 0.80-0.93), and widowed (OR=0.80, 95% CI= 0.75-0.85) were less likely to have met CRC screening guidelines compared to married or members of unmarried couples (Table 3).

Individuals with health care coverage were 2.5 times (95% CI =2.30-2.64) more likely to have met CRC screening guidelines than individuals with no health insurance (Table3). Higher education attainment was associated with increased adherence to CRC

screening guidelines. Individuals who attended college or a technical school (OR=1.53; 95% CI =1.41-1.65), graduated high school (OR= 1.31 95% CI= 1.21-1.41), or graduated from college or technical school (OR 1.73 95% CI= 1.60-1.88) were more likely to have been appropriately screened compared to those who never graduated from high school. Similarly, as participants' income level increased, the likelihood of having met CRC screening guidelines increased. Increasing age was associated with an increase in the rate of CRC screening (OR= 1.076; 95% CI =1.073-1.079).

Emotional support played an important role in determining the likelihood of adherence to CRC screening guidelines. Participants who reported emotional support to be present sometimes (OR= 0.87, 95% CI= 0.82-0.92), rarely or never (OR=0.72, 95% CI= 0.67-0.78) were less likely to have followed the recommended CRC screening guidelines compared to individuals who reported emotional support to be present always or usually (Table 3).

Discussion

The results of this study suggest an influence of marital status on colorectal cancer screening participation. This study suggests that, among participants who are age-appropriate for CRC screening (adults 50 to 75 years), married individuals and members of unmarried couples were more likely to be screened compared to individuals who are divorced/separated, never been married, or widowed The findings of this study are particularly important because few studies have been conducted to evaluate the effect of marital status on colorectal cancer screening participation in the US population.   In addition, the results of the study will allow health care professionals and policy makers to

identify and intervene with individuals who might be less likely to participate in CRC screening programs.

The results of the study are concordant with what has been published in the literature. Van Jaarsveld et al[13] reported a higher participation in CRC screening programs among married individuals (OR = 1.23; 95% CI= 1.04-1.45) compared to unmarried individuals. Similar results have been reported by Blom et al.[12] in their study of the causes of non-participation in a colorectal cancer screening program among Swedish residents. The Swedish survey suggested there were higher rates of non-participation in CRC screening among unmarried (OR=1.69, 95% CI= 1.23-2.30) and divorced (OR=1.49, 95% CI= 1.14-1.95) individuals compared to those who were married. [12]

It has been suggested that marriage has a favorable effect on the diagnosis, and the prognosis of cancer. Lai et al.[16] reported that married individuals with colorectal cancer are more likely to be diagnosed at an early stage compared to unmarried people. This might suggest that married individuals are more likely to adhere to screening recommendations than other marital status groups. In addition, marriage has been linked to increased survival among colorectal cancer patients, and the survival benefit of married individuals has been consistent with other types of cancer, including breast cancer, prostate cancer, melanoma, and cervical cancer.[13, 16]

The effect of marriage on colorectal cancer screening participation could be explained by the attempt of spouses to monitor their spouse's health and promote healthy behaviors.[12] Married individuals may have feelings of obligation and responsibility to one another that could facilitate engagement in healthy behaviors.[13, 16] The presence of

emotional support has been implicated as a factor that promote healthy behaviors and increased adherence to cancer screening.[12] In this study, the effect of marriage on the adherence to CRC screening guidelines was independent from the presence of emotional support.

In addition, other variables predicted meeting CRC screening guidelines. For instance, increasing age was associated with improved compliance with CRC screening guidelines. Additionally CRC screening participation increased with the increase in education and among individuals with health insurance. The study results also suggest a higher participation rate in CRC screening in individuals with higher incomes. The positive association between income and CRC screening was linear.

Limitations

This study is subject to several limitations. The BRFSS survey relies on self-reported health behaviors and is prone to recall bias. The BRFSS survey was administered only in English and Spanish and consequently the result of this study could only be generalized to English and Spanish speaking individuals with a landline telephone numbers.[14] Results from the National Health Interview Survey (NHIS) indicated that the number of American homes with only wireless telephones is 29.7%.[18] The same study suggested there are differences in "cell phone only" compared to "landline telephone" populations in demographic, economic, and health characteristics. Cellular phone-only users are more likely to live in poverty, have a lower income, and to be without health care coverage compared to landline only users. In addition, wireless phone-only users are more likely to be African American, American Indian, or

Hispanic.[18] This difference suggests that estimates based on landline telephone surveys may underestimate risks in these groups.

Another limitation is volunteer bias. Individuals with higher education, and individuals with higher socioeconomic statuses are more likely to participate in epidemiologic studies compared to individuals with lower education, and individuals with lower socioeconomic status.[17]

Despite correcting for potential confounders (income, health coverage), this study could not exclude individuals who already had a diagnosis of colorectal cancer or those who had a personal or family history of colorectal cancer, as these questions were not asked. These individuals may have a higher likelihood of seeking medical attention and having met CRC screening guidelines as their risk for having colorectal cancer is higher than that of the average-risk population. This study was also unable to examine the effect of health literacy on the rate of colorectal cancer screening among the survey participants.

Conclusion

This study suggests a positive association between being married or being member of an unmarried couple and having met colorectal cancer screening guidelines. Unmarried, separated or divorced, and widowed individuals appear to be at a higher risk for not receiving colorectal cancer screening within the recommended guidelines' timeframe. Public health interventions are needed to promote colorectal cancer screening participation, especially targeting individuals who might not be compliant with CRC screening recommendation guidelines.

Table 1: Comparison of Predictors among Different Marital status

	Total (N=239,300)	Married or a member of an unmarried couple	Divorced or separated	Widowed	Never married	P Value
Gender						<0.0001
Male	92396 (38.6%)	62752 (44%)	16307 (34.4%)	5022 (16.3%)	7995 (45.4%)	
Female	146904 (61.4%)	79752 (56%)	31128 (65.6%)	25757 (83.7%)	9633 (54.6%)	
Age, Years, Mean ± SD	61.8 ± 7.2	61.3 ± 7.1	61.1 ± 6.8	66.7 ± 6.4	59.2 ± 6.7	<.0001
Race						<.0001
White	2448 (61.9%)	1300 (63.4%)	613 (60.6%)	357 (63.3%)	171 (53.6%)	
Black	374 (9.5%)	121 (5.9%)	133 (13.2%)	60 (10.6%)	58 (18.2%)	
Asian	298 (7.5%)	187 (9.1%)	53 (5.2%)	26 (4.6%)	31 (9.7%)	
Native Hawaiian or Other Pacific Islander	317 (8%)	199 (9.7%)	58 (5.7%)	35 (6.2%)	25 (7.8%)	
Native American	408 (10.3%)	181 (8.8%)	127 (12.6%)	70 (12.4%)	28 (8.8%)	
Other	113 (2.9%)	63 (3.1%)	27 (2.7%)	16 (2.8%)	6 (1.9%)	
Income Level						<.0001
<20000	40949 (19.8%)	10480 (8.5%)	15392 (36.2%)	9788 (37.9%)	5136 (33.1%)	
20000-34999	45832 (22.1%)	21997 (17.9%)	11405 (26.8%)	8427 (32.7%)	3890 (25.1%)	
35000-49999	33069 (16%)	20714 (16.8%)	6266 (14.7%)	3633 (14.1%)	2400 (15.5%)	
50000-74999	33796 (16.3%)	24213 (19.7%)	5078 (11.9%)	2228 (8.6%)	2224 (14.3%)	
≥$75,000	53637 (25.9%)	45594 (37.1%)	4381 (10.3%)	1719 (6.7%)	1867 (12%)	
Health Coverage						<.0001
Yes	218515 (91.5%)	132857 (93.4%)	41050 (86.7%)	28689 (93.4%)	15087 (85.8%)	
No	20373 (8.5%)	9432 (6.6%)	6308 (13.3%)	2035 (6.6%)	2493 (14.2%)	
Education Level						<.0001
Did not graduate High School	21046 (8.8%)	9647 (6.8%)	5067 (10.7%)	4822 (15.7%)	1447 (8.2%)	
Graduated High School	72296 (30.3%)	41788 (29.4%)	14282 (30.2%)	11553 (37.7%)	4482 (25.5%)	
Attended College or Technical School	64318 (27%)	38043 (26.7%)	13830 (29.2%)	7989 (26%)	4240 (24.1%)	
Graduated from College or Technical School	80965 (33.9%)	52744 (37.1%)	14161 (29.9%)	6320 (20.6%)	7422 (42.2%)	
Geographic location						<.0001
Rural	82404 (34.9%)	50926 (36.2%)	15315 (32.7%)	11357 (37.5%)	4576 (26.3%)	
Suburban	31853 (13.5%)	20142 (14.3%)	5707 (12.2%)	4013 (13.2%)	1837 (10.6%)	
Urban	121929 (51.6%)	69708 (49.5%)	25754 (55.1%)	14930 (49.3%)	10975 (63.1%)	

Table 2: Rates of Up to Date CRC screening by Marital Status

Marital Status	N and (%) of individuals who had appropriate CRC screening
Married or members of unmarried couple	94,077(67.9)
Divorced or separated	27,171 (59.1)
Widowed	19,371 (64.9)
Never married	9,481 (55.8)

Table 3: Adjusted logistic regression for CRC screening status

Odds Ratio Estimates		
Effect	**Estimate**	**95% CI**
AGE	1.076	1.073	1.079
Marital status (compared to being married or member of an unmarried couple)			
Divorced or separated	0.923	0.878	0.970
Never married	0.865	0.805	0.930
Widowed	0.797	0.750	0.847
Income status (compared to income >75000)			
20000-34999	0.666	0.627	0.706
35000-49999	0.787	0.742	0.835
50000-74999	0.858	0.811	0.909
<20000	0.572	0.532	0.614
Presence of heath care coverage	2.468	2.308	2.640
Education level (compared to did not graduate high school)			
Attended College or Technical School	1.527	1.410	1.653
Graduated High School	1.306	1.209	1.412
Graduated from College or Technical School	1.735	1.597	1.884
Geographic location (compared to urban)			
Rural	0.810	0.779	0.843
Suburban	1.004	0.954	1.057
Presence of emotional support (compared to always or usually)			
Sometimes	0.870	0.820	0.924
Rarely or never	0.724	0.675	0.776

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