Article

The Association between Screening for Colorectal Cancer and Measures of Mental and Physical Health.

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Abstract: Background: Participation is low (43%) in Australia's National Bowel Cancer Screening Program which provides a biennial Fecal Immunochemical Test kit mailed to the home of Australians aged 50-74 years. While several factors for non-participation have been identified, the role of mental and physical health on screening behaviour has not been assessed. Methods: Participants of the Australasian Colorectal Cancer Family Registry Cohort were asked to complete a questionnaire on their colorectal cancer screening in the past five years and a validated measure of mental and physical health. The association between mental and physical health and screening was determined for Australian participants aged 45-75 years who had never been diagnosed with colorectal cancer. Multivariable logistic regression was used to adjust for measured potential confounders. Results: Of the 1130 eligible participants, 819 reported colorectal cancer screening in the past five years (72%). After adjusting for potential confounders, there was no evidence that overall mental or physical health was associated with colorectal cancer screening. However, one specific scale, general health, was positively associated with colorectal cancer screening (p=0.014) with those reporting higher levels of general health undergoing screening. Conclusion: We found limited evidence that mental and physical health, as measured by a short questionnaire, are associated with colorectal cancer screening. A potential limitation is reverse causation where previous screening may have impacted mental or physical health. A more detailed study of physical and mental health as barriers or enablers of screening is needed.

Keywords: Colorectal cancer screening; SF-12

Introduction

Colorectal cancer was the fourth most diagnosed cancer and the second most common cause of cancer-related deaths in Australia in 2021[1] with 15,540 diagnoses and 5,295 deaths. National screening guidelines recommend Fecal Immunochemical Test (FIT) screening for those with no or moderate family history of colorectal cancer and five-yearly colonoscopy for those with a strong family history.[2] The Australian government funds the National Bowel Cancer Screening Program (NBCSP), which provides biennial FIT for all Australians from age 50-74 years. Participation in the NBCSP is currently at 43% [3] with additional opportunistic screening (of unknown prevalence)[4] provided via general practice, referral to gastroenterology, or private purchase of FIT kits from pharmacies.

Identifying the reasons for non-participation in the NBCSP is essential to develop strategies to increase screening. We know that men, those living in remote areas of Australia, those at the younger age within the eligible range, and first-time invitees are less likely to screen.[3] Recent studies have found that the existing barriers to the FIT include: inconvenience of the testing process, aversion to collecting faeces, lack of knowledge of the benefit of screening, fear of a cancer diagnosis, and cultural beliefs and attitudes.[5]

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There have been only a few studies that have examined the role of mental and physical health on colorectal cancer screening and none in the Australian context. There is some evidence that mental or physical health has some association with cancer screening participation. Most of these studies analysed the association between mental or physical health with breast cancer screening or cervical cancer screening. [6-8] Women with mental health problems were less likely to attend national breast cancer or cervical cancer screening programs,[7 9 10] possibly because of barriers due to a range of complex possible factors including low socioeconomic status, poor functioning or cognitive difficulties, stigma, and on-going psychological stress.[9] However, results are inconsistent with one study reporting no differences in mammography rates between women with or without any medically diagnosed mental illness in the United States.[6] A possible explanation for this is women with mental health problems tend to access primary health care more often and therefore have increased access to GP recommendations for cancer screening.[6] Some studies found that people with chronic disease diagnoses have lower participation in colorectal cancer screening programs. [11] People with severe mental illness, e.g., schizophrenia, were less likely to participate in CRC screening. [11 12]

The aims of this study are to measure the association between mental and physical health and screening for colorectal cancer in a large population-based sample.

Methods

Data source

The data for this analysis is the Australasian Colon Cancer Family Registry Cohort, a family cohort resource for research on colorectal cancer prevention, aetiology and prognosis.[13] This is an international consortium of recruitment sites, one of which is the Australasian Colon Cancer Family Registry which adopted a population-based and clinic-based recruitment strategy.[13] Population-based case probands were residents of the Melbourne metropolitan area who were diagnosed with their first primary adenocarcinoma of the colon or rectum between the ages of 18 and 59 years between 1997 and 2006 and were registered with the Victorian Cancer Registry.[13] After recruitment, they were asked if the investigators could contact their first-degree relatives (parents and adult siblings and children) and second-degree relatives (grandparents, and adult uncles, aunts, nieces and nephews) as well as their spouses or partners.[13] These family members were then asked to participate. Clinic-based probands were residents of Australia or New Zealand who had attended a family cancer clinic in Australia or New Zealand because of a family history of colorectal cancer. They were also asked if the investigators could contact their relatives.[13]

All participants (probands and relatives) were asked to complete a baseline questionnaire on their risk factors for colorectal cancer and their relatives' cancer. Attempts were made to follow up with all participants by questionnaire every five years to update their risk factor data and family history of cancer. Questionnaires were administered through face-to-face interviews with the probands and telephone interviews with their relatives. The baseline questionnaire included demography questions such as age, sex, family history of cancer, cancer history, marital status, level of education, cancer history, diet and medication use, alcohol and smoking, weight and height and cancer screening history. The follow-up questionnaires included age of completed follow-up survey, first and last colorectal cancer detection tests in the last 5 years (FIT, sigmoidoscopy, colonoscopy), the reason for the test, and the short form 12 health survey items (see Supplement for the questionnaires).

Definition of screening

Colorectal cancer screening was defined for each modality (FIT, sigmoidoscopy and colonoscopy) as at least one test in the past 5 years reported by the participant in the first

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follow-up questionnaire, i.e., tests between the time of completing the baseline questionnaire and the first follow-up questionnaire. For each modality, the test was defined as a screening test if the reason for the most recent test was routine/yearly exam or check-up, family history, or national screening program.

Definition of physical and mental health

Physical and mental health was assessed using the self-completed SF-12, a multipurpose short-form instrument of 12 questions selected from a longer SF-36 health survey.[14] It provides a standardised and validated generic measure of mental and physical health from the participant's perspective.[14] The SF-12 has been validated in both the general population and in a range of medical conditions.[15] SF-12 measures the impact of health problems on a broad range of eight functional domains (see Table 1.).

Table1. The 8 domains of mental and physical health based and the items of the SF-12 on which they are based.

Domain	SF-12 Items
Physical Functioning (PF)	2. During a typical day, does your health now limit you in moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
	3. During a typical day, does your health now limit you in climbing several flights of stairs?
Role-Physical (RP)	4. During the past 4 weeks, have you accomplished less than you would like as a result of your physical health?
	5.During the past four weeks, were you limited in the kind of work or other activities as a result of your physical health?
Bodily Pain (BP)	8. During the past 4 weeks, how much did pain interfere with your normal work, including both work outside the home and housework?
General Health (GH)	1. In general, would you say your health is... ?
Vitality (VT)	10. During the past four weeks, have you felt like you have a lot of energy?
Social Functioning (SF)	12. During the past four weeks, have your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?
Role-emotional (RE)	6. During the past four weeks, have you accomplished less than you would like as a result of emotional problems?
	7. During the past four weeks, have you done work or other activities less carefully than usual as a result of any emotional problems?
Mental Health (MH)	9. During the past four weeks, have you felt calm and peaceful?
	11. During the past four weeks, have you felt downhearted and depressed?

Scores for overall mental and physical health care are based on weighted combinations of the answers to all 12 questions. Scores are calibrated so that a higher score indicates a better health state.[14] Item responses from the SF-12 questions are converted into summary scores by aggregating the standardized scales for each of the eight domains (weighted by Australian general population means and standard deviations), and then transforming these summary scores into t-scores (See Supplement for detailed statistical method). Each score has a possible range from 0 to 100 and is calibrated so a score indicates a level of health equivalent to the average Australian, and a score above or below 50 indicates better or poorer health respectively.

Analysis

The data were analysed as a case-control study comparing the self-reported mental and physical health of those who did screen for colorectal cancer versus those who did not do screen. These are the inclusion criteria for participants: participated in the first follow-up of the Australian Colorectal Cancer Family Study; nationality is Australian; living

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in Australia at the time of the first follow-up; aged between 45-75 at the time of the first follow-up (chosen to represent the most likely ages for screening given the national guidelines); and have completed the SF-12 questionnaire items in the first follow-up. Participants were excluded in this study if they had been diagnosed with colorectal cancer at any time up to and including the date of the first follow-up questionnaire because these participants were not recommended to have standard screening for colorectal cancer.

The main analysis was a logistic regression to estimate the odds ratio of screening for various measures of mental and physical health. Adjustment was made for these potential confounders: family history of cancer, age at completion of first follow-up, gender, education level, marital status and any previous cancer diagnosis (apart from colorectal cancer). A binominal test for differences in proportions and Students t-test were used to compare means. All statistical analyses were performed using Stata statistical software version 16 (Stata Corporation, College Station, Texas 2019).[16]

Results

In total, there were 1,130 participants eligible for this analysis. Of these 819 (72%) reported undergoing screening for colorectal cancer in the last five years via any modality. Most of these reported screening by colonoscopy (69%). The participants had an average age of 57.8 years, were more likely to be male, were likely to be married or living as married, and most had at least one first-degree family member diagnosed with colorectal cancer (Table 2).

Table 2. Participant characteristics

	All (n=1130)	**Screened for CRC in past 5 years (n=819)**	**Not screened for CRC in past 5 years (n=311)**
Age [a] [b]			
Mean (SD)	57.8 (7.8)	57.3(7.5)	59.0(8.5)
Aged 45 to 60	740 (65.2%)	555 (67.8%)	185 (59.4%)
Aged 61 to 75	390 (34.5%)	264 (32.2%)	126 (40.5%)
Sex [b]			
Male	503 (44.5%)	362 (44.2%)	141 (45.3%)
Female	627 (55.5%)	457 (55.8%)	170 (54.7%)
Education [b]			
High school or less	648 (57.3%)	451 (55.1%)	197 (63.3%)
More than high school	479 (42.4%)	367 (44.9%)	112 (36.7%)
Family history of colorectal cancer [b]			
No first-degree relatives	346 (30.6%)	188 (23.0%)	158 (50.8%)
One first-degree relative	557 (49.3%)	439 (53.6%)	118 (37.9%)
More than one first-degree relative	224 (19.8%)	190 (23.2%)	34 (10.9%)
Marital status [b]			
Currently single	175 (15.5%)	122 (14.9%)	53 (17.0%)
Currently married/living as married	954 (84.4%)	697 (85.1%)	257 (82.6%)
Previous non-colorectal cancer[b]			
No	861 (76.2%)	617 (75.3%)	244 (78.4%)

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Yes	269 (23.8%)	202 (24.6%)	67 (21.5%)

[a] mean and standard deviation, [b] frequency and percentage.
Notes: missing data include: 3 observations for education, 3 observations for family history of colorectal cancer, 1 observation for marital status.

Colorectal cancer screening in the past five years was reported by 819 participants (72.5%). The majority reported screening by colonoscopy (n=307) followed by FIT (n=713) and sigmoidoscopy (n=15), with a small proportion of these screening by multiple modalities.

The mean physical health score for this sample of participants was 51.39 (SD: 11.76) and the mean mental health score in this sample was 49.42 (SD:10.57) (Table 2), which is similar to the average physical health and mental health than the general population (mean of 50.0 for both scales[8]).

Table 3 Participants' score for 8 domains of mental and physical health in the SF-12 score.

	Physical Functioning	Role-Physical	Bodily Pain	General Health	Vitality	Role-emotional	Social Functioning	Mental Health	PHYS	MENT
Mean	48.80	50.13	52.43	50.58	52.77	49.01	52.59	46.90	51.39	49.42
P50	57.03	56.20	61.09	55.99	56.67	54.81	56.18	46.69	55.31	52.74
P25	45.59	46.26	49.32	44.56	44.65	54.81	56.18	39.33	47.07	45.08
P75	57.03	56.20	61.09	55.09	56.67	54.81	56.18	54.04	58.90	56.10
Standard deviation	13.09	10.41	12.39	10.45	9.76	11.80	8.89	10.86	11.76	10.57
min	11.29	16.41	14.01	17.14	20.62	0 [a]	11.40	2.54	5.11	0[a]
max	57.03	56.20	61.09	62.84	68.69	54.80	56.18	61.40	73.80	77.95

[a.] adjusted negative to 0.

Mental physical and health scores had a similar median and interquartile range for participants who screened and did not screen (Table 4).

Table 4. Median and interquartile range of the mental and physical health scores of participants by colorectal cancer screening status.

	Screened	Did not screen
Mental health	52.5 (45.1-56.2)	53.3 (44.6-56.0)
Physical health	55.3 (47.2-58.9)	55.7 (46.3-58.6)

There was no evidence for an association between mental health or physical health and screening before or after adjusting for potential confounders (Table 5). There was no evidence of a linear association (continuous) or for any non-linear association given no quintile was associated with screening and no evidence of a trend in quintiles.

Table 5 Odds ratios and 95% confidence intervals for association between mental and physical health and colorectal cancer screening, adjusted for age, sex, education, family history of colorectal cancer, marital status, and previous non-colorectal cancer.

		Odds ratio	95% Confidence interval	p-value
Mental health				
	continuous	0.9999	(0.9867, 1.0133)	0.991
	Quantile1	Reference		
	Quantile 2	1.00	(0.64, 1.58)	0.99
	Quantile 3	0.99	(0.62, 1.58)	0.98
	Quantile 4	0.70	(0.43, 1.13)	0.14
	Quantile 5	1.12	(0.69, 1.79)	0.65
Physical health				
	continuous	1.0037	(0.9917, 1.0159)	0.549
	Quantile 1	Reference		
	Quantile 2	1.54	(0.97, 2.42)	0.07
	Quantile 3	1.07	(0.68, 1.67)	0.77

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Quantile 4	1.09	(0.68, 1.75)	0.71
Quantile 5	1.27	(0.78, 2.06)	0.34

There was no evidence that colorectal cancer screening was associated with any of the domains of mental and physical health, except for the general health domain. This was positively associated with screening with the odds of screening increasing by approximately two percentage points per point of the General Health module, i.e., higher self-report of general health, i.e., more likely to screen (Table 6).

Table 6 Association between the colorectal cancer screening for each of the scales adjusted for age, sex, education, previous cancer diagnosis other than colorectal cancer, family history of colorectal cancer, marital status.

	Odds ratio	95% Confidence interval	P-value
Physical Functioning	0.996	(0.981, 1.012)	0.641
Role-physical	1.005	(0.983, 1.026)	0.673
Bodily pain	0.990	(0.976, 1.004)	0.173
General health	1.021	(1.004, 1.037)	0.014
Vitality	1.000	(0.982, 1.019)	0.977
Role-emotional	0.994	(0.979, 1.010)	0.453
Social functioning	1.008	(0.987, 1.028)	0.458
Mental health	0.994	(0.978, 1.011)	0.496

Discussion

This research investigated the association between mental and physical health and colorectal cancer screening by analysing questionnaire data from 1,130 Australians aged between 45 and 75. We found no explicit evidence of an association between mental or physical health and colorectal cancer screening either before or after controlling for age, sex, education, other cancer, family history, and marital status. This null finding is consistent with a study in the United States which reported that mental health was not associated breast cancer screening .[6] Expecting a poorer screening uptake in those with poorer mental health, they conjectured that more frequent contact with mental health clinicians might ameliorate some of the barriers to screening participation. [6] We had no measure of clinician contact in our study so could not assess this hypothesis.

We did observe that general health (one of the eight domains of mental and physical health that we assessed) was positively associated with colorectal cancer screening, i.e., greater general health appeared to increase screening likelihood. This association can also be interpreted as people with poor general health are less likely to screen. One possible explanation for this association is that people with poor health are less able to pay attention to their health including prevention. Some studies have shown that people with chronic disease may have both functional limitations and lower socioeconomic status, which could lead to lower screening participation.[11] People with poorer general health may have doubts about health insurance rebates for the test fee. In sum, this finding does suggest a potential strategy to increase participation is to provide additional support to those with poor general health to help them screen.

Strengths

The study has a large sample size, and therefore able to provide more precise estimates of association than previous studies. We have used the SF-12 for the questionnaire items on mental and physical health, which is a standardized, validated and widely used health survey that can be coded for multiple measures of participants' mental and physical health. The SF-12 can examine both mental health and physical health and is an accurate reproduction of average scores for the longer SF-36 questionnaire, and therefore completed more quickly and easily by participants.[14] SF-12 has a 90% validated rate in the US population and is also valid and reliable for the Australian population[8 15]. There was a high level of questionnaire completion by participants (approximately 90% of items were

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complete) which gives confidence that the estimates of association are unlikely to be biased because of non-completion. We were also able to adjust for factors associated with mental and physical health and cancer screening to reduce the risk of confounding.

Limitations.

This analysis was performed on data that focused on the screening period in the five years between baseline and follow-up. As screening outside this period, e.g., after completing the follow-up was not considered, some infrequent screeners would have been defined as non-screeners. If delay in screening was associated with mental or physical health, this could bias the associations. Non-completion of the questionnaires, either due to death or ill health, might limit the generalisability of the findings to relatively healthy people. Even though the data for this analysis came from a cohort study, we were not able to determine the temporal relationship between mental and physical health and screening, so could not be certain that the mental and physical health status predated their screening behaviour. Although the main analyses considered the overall mental and physical health (two factors), we also assessed 8 domains and therefore are subject to multiple testing increasing the risk of false positive findings.

Conclusion

Determining the barriers to colorectal cancer screening is needed to identify opportunities to increase participation. This study focused on perceived mental and physical health as a possible influence on screening participation. Using a large Australian cohort study, we found no evidence of an association between mental or physical health and colorectal cancer overall, but some evidence that a specific sub-category of health, general health, may be associated with screening participation. This provides some support for a possible avenue to increase screening participation by focusing encouragement or support on those with low levels of general health.

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