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Screeners vs. Non-screeners for Colorectal Cancer among People over 50 Years of Age: Factual and Psychological Discriminants

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ABSTRACT

Background & Aims: Colorectal cancer (CRC) is the third most frequent form of cancer worldwide, and approximately one third of cases have a positive family history of CRC or associated cancers. Colonoscopy is one of the most effective methods of screening for CRC. Uptake of colonoscopy is suboptimal, and many countries lack a national screening programme. Our study aims at exploring and ranking several factual and psychological variables according to their accuracy in discriminating between screeners and non-screeners for CRC in a convenience sample of people over 50 years of age.
Methods: The study included 103 individuals aged over 50 years, recruited from day centres for the elderly. We explored socio-demographic variables, frequency of colonoscopy, previous recommendations for screening, health literacy and family history of cancer. Receiver operating characteristic (ROC) analysis was used to establish the discriminative value for each variable between the positive and negative decision for colonoscopy screening. Areas under the curve (AUC) and their equivalent Cohen's d values were calculated.
Results: Almost a quarter (25.75%) of participants reported previous colonoscopy screening. ROC curve analysis shows that colonoscopy uptake is best discriminated by perceived benefits of screening (AUC=0.71, d=0.78, p<0.001), previous recommendations for screening (AUC=0.68, d=0.69, p<0.001) and previous recommendations for preventive measures (AUC=0.67, d=0.64, p<0.001).
Conclusions: Recommendations from healthcare professionals lead to improved colonoscopy uptake when emphasising the benefits of screening. Results can further inform psychosocial interventions by bringing empirical evidence to emphasize screening benefits and explicit recommendations for individuals at risk for CRC cancer.

Key words: colonoscopy – colorectal cancer – psychosocial interventions – genetic counselling – prevention – screening.

Abbreviations: AUC: areas under the curve; CRC: colorectal cancer; HBM: health belief model; ROC: receiver operating characteristic.

INTRODUCTION

Worldwide, colorectal cancer (CRC) is the third most frequently diagnosed type of cancer. In Romania, it is the second most frequently diagnosed form of cancer [1]. Recent trends, particularly in Eastern Europe, have shown an increase in both incidence and mortality for CRC [2, 3]. This could be strongly connected with the absence of national screening programs for CRC in many countries from this region. The purpose of screening for CRC is to lower the burden of cancer by detecting and treating the disease in the early stages, hence leading to a decrease in both incidence and mortality. Timely detection of CRC can also prevent unfavourable psychosocial outcomes associated with advanced stages of the disease, such as anxiety and depression [4]. A recent systematic review of CRC guidelines found that the majority of guidelines recommend that screening starts at age 50 [5]. However, the second half of 2018 saw a shift in the recommended age to start regular screening for CRC. For example, the American Cancer Society has lowered the threshold to 45 years old [6]. In the United Kingdom, the invitation screening was initially offered at 60 years old [7], and in 2018 the age was lowered to 50 years old [8].

Adequate adherence to screening recommendations for CRC remains a worldwide concern. Even in countries where a national screening program is in place, the compliance with screening recommendations remains suboptimal [6, 7, 9, 10]. Data about adherence to screening in countries with no national screening programs are clearly more difficult to grasp. According to a report by the European Commission on cancer screening programs in the European Union from 2017 [11] Bulgaria, Greece, Slovakia, and Romania lack a screening program for CRC. The European Commission set up a desirable rate of participation in screening programmes of 65% [12]. In countries with a screening programme in place, participation rates range between 4.5% and 71.3% [11]. In countries without a screening programme, Eurostat surveys [13] shows high rates of individuals aged between 50 and 74 years that have never been screened for CRC: Bulgaria approximately 90%, Greece approximately 77%, Slovakia approximately 52%, and Romania approximately 95% [14-16]. The country rates should be carefully interpreted for two reasons, first information is self-reported by the patients, and second the numbers might be slightly dated as the Eurostat survey on colorectal cancer screening has not been updated since 2014.

Colonoscopy is considered the gold standard in CRC screening due to its high sensitivity and specificity, and the possibility to immediately remove pre-cancerous polyps [5]. Colonoscopy is also the most effective screening strategy in preventing CRC, while having the lowest cost compared to other screening methods [17]. Increased knowledge about colonoscopy does not however, necessarily translate into a better uptake of colonoscopy [18]. Therefore, recent studies are trying to capture and address relevant factors associated with improved CRC screening [19, 20].

Psychological and factual variables involved in the decision for screening

Cognitive dimensions

According to the World Health Organization, health literacy encompasses "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" [21]. Health literacy is recurrently at the centre of public health policies [22]. Low health literacy has been systematically associated with poor health outcomes [23, 24]. Evidence supporting health literacy and CRC screening is still limited and inconclusive [24, 25].

Health belief model (HBM) provides a theoretical framework to explain and predict health behaviours, and over the years has gained strong empirical support, with applications in diverse health behaviours and populations [26]. Adherence to colonoscopy was linked to several HBM dimensions, such as perceived barriers and perceived benefits [27, 28]. Individuals who report fewer barriers towards screening tend to have a higher adherence to colonoscopy [27, 28]: barriers can be related to colonoscopy, knowledge, healthcare provider, practical or emotional barriers [29-31].

In comparison, the impact of perceived benefits of getting screened for CRC has been studied less. Research suggested that perceived benefits could be more important in adhering to colonoscopy than perceived barriers [27, 32]. Benefits reported so far include better health outcomes (e.g., better treatments for early detection), emotional and impact on self (e.g., less worrying), and impact on family (e.g., setting a good example).

Self-efficacy refers to the "individual's belief in his or her capacity to execute behaviours necessary to produce specific performance attainments" [33]. In the health context it has been consistently found to have a positive impact in screening attendance for cervical cancer [34], breast cancer [35] and CRC [28, 36].

Dimensions related to healthcare systems

Healthcare systems where professionals assess each patient and make screening recommendations based on international guidelines seem to be associated with significant improvements in colonoscopy screening adherence [37, 38]. For first screeners and for individuals at a higher risk of CRC, the recommendation from healthcare providers was found to be the best predictor for screening uptake [39, 40]. A letter from the general physician supporting the screening was found to increase the adherence by approximately 6% [41].

For the purpose of this study, and in line with previous literature [4, 25, 28, 39], we refer to cognitive dimensions (e.g. a perceived benefit or barrier, self-efficacy, health-literacy) as psychological discriminants and we include healthcare dimensions and objective measures (e.g. a presence or absence of screening recommendations, uptake of colonoscopy) under factual discriminants.

Our study aimed to explore and rank factual and psychological discriminants between screeners and non-screeners for CRC in a convenience sample of people over 50 years of age. Having a clearer understanding of the contribution of relevant factors impacting on screening behaviours can better inform medical consultations and psychosocial interventions aimed at increasing colonoscopy uptake in specific populations.

METHODS

Procedure and participants

Participants were recruited from 2-day centres for the elderly in urban areas of Romania. Members attended the day centres to socialise and participate in activities such as card games, book reading or foreign language classes. Inclusion criteria consisted of individuals aged over 50 years old, without a personal history of CRC. The questionnaires were distributed in the morning and individuals who agreed to participate in the study returned the completed questionnaires the following day. All procedures performed in the study were in accordance with the ethical standards of the Babeş-Bolyai University institutional research committee. Informed consent was obtained from all individual participants included in the study.

Measures

A brief set of questions was included to assess cancer family history and different aspects related to healthcare. Several questions with "yes" or "no" answers were also asked to evaluate the frequency of colonoscopy and previous recommendations for screening and prevention. The probability and confidence to discuss CRC with a healthcare professional were measured

on a visual analogue scale with a line graded from 0% to 100%, and are referred in this study as discussion probability and discussion confidence.

Health literacy was measured with the European Health Literacy Survey (HLS-EU) [42]. The 47-item questionnaire measures four cognitive domains related to healthcare (accessing, understanding, appraising and applying health related information) applied in 3 different domains (healthcare, disease prevention and, health promotion).

Health belief model dimensions were measured using a 33-item questionnaire adapted for CRC screening [43]. Items are grouped in 4 subscales and formulated in terms of barriers, benefits, self-efficacy, and outlook. Outlook in healthcare context has been defined as views on an optimism-pessimism continuum, and measures individuals' expectations of good/bad health outcomes. Each subscale had a reported alpha Cronbach between 0.82 and 0.96.

Data analysis

In order to explore the discriminative value of each variable between screeners and non-screeners, we used receiver operating characteristic (ROC) analysis. For a more intuitive layout of the differences between groups we also calculated Cohen's d values. ROC analysis can be used to determine the ability of a variable (e.g., sociodemographic data, dimensions of the health belief model, health literacy or other healthcare related factors) to discriminate between two groups (i.e., screeners and non-screeners) [44]. The area under the curve (AUC) represents the overall performance of a test variable [45]; the interpretation of AUC is useful in determining the ability of a test to discriminate between two groups. An AUC between 0.5 and 0.7 represents low accuracy, AUC between 0.7 and 0.9 represents moderate accuracy, and an AUC above 0.9 indicates high accuracy [46]. Effect sizes, quantified by d values, provide an estimate of the strength of the relationship between two variables. A Cohen's d value of 0.2 can be interpreted as a small effect, 0.5 as medium effect size, and 0.8 as large effect size [47]. Additionally, values for sensitivity (e.g., the proportion of actual positives that are correctly identified as such), specificity (e.g., the proportion of actual negatives that are correctly identified as such) and criterion at which maximum accuracy is achieved are also included. Based upon an expected medium effect size (d=0.50), a statistical power of 80% and a $p<0.05$, we calculated using G*power 3.9.1.4 a total required sample size N=102.

RESULTS

We recruited a total number of 103 participants. Fifty-seven women and forty-six men participated in the study. The average age of participants was 63.47 years, with a standard deviation of 8.27. Socio-demographic characteristics are presented in Table I. The most frequent chronic illnesses declared by participants were cardiac conditions, diabetes, gastritis and osteoporosis. Twenty-five participants reported having had at least one colonoscopy in the past.

In Table II, we show the descriptive data for the HBM dimensions (benefits, barriers, self-efficacy, and outlook), and for the probability and confidence to discuss CRC. The

Table I. Participants' characteristics

		Non-Screeners	Screeners
		N=78	N=25
Age	Years (SD)	62.75 (7.80)	65.72 (9.40)
		N (%)	N (%)
Gender	Male	36 (46.2)	10 (40.0)
	Female	42 (53.8)	15 (60.0)
Relationship	Married/ relationship	56 (71.8)	17 (68.0)
	Not in a relationship	1 (1.3)	0 (0)
	Separated/ Divorced	12 (15.4)	1 (4.0)
	Widowed	9 (11.5)	7 (28.0)
Last graduated school	Middle school	5 (6.4)	0 (0)
	High School	20 (25.6)	8 (32.0)
	College	22 (28.2)	3 (12.0)
	University degree	31 (39.7)	14 (56)
Living area	Urban	71 (91)	24 (96.0)
	Rural	7 (9.0)	1 (4.0)
Chronic illness	Yes	38 (48.7)	18 (72.0)
	No	40 (51.3)	7 (28.0)
Family history of cancer	Yes	15 (19.2)	10 (40.0)
	No	63 (80.8)	15 (60.0)
Employment	Employed	21 (26.9)	4 (16.0)
	Retired	57 (73.1)	21 (84.0)

SD: standard deviation

percentage of participants who reported having received recommendations for prevention was 19.4%, and for screening recommendation the proportion was 17.3%. The percentage of participants who said they would consider preventive measures even in the in the absence of recommendations was 58.2% for prophylactic measures and 53.1% for screening measures.

In order to get a better understanding of the motivation behind the decision to opt for screening colonoscopy, we took a closer look at the barriers and benefits reported by both categories of participants (i.e., screeners and non-screeners). For this, first we looked at the differences between groups in terms of barriers and benefits. And second, we calculated the number and percentage of participants with high self-reported scores on the Likert scale (i.e., values 4 - agreement and 5 - strong agreement).

There was no significant difference in terms of perceived barriers for screeners (mean=27.08, standard deviation=3.54) and non-screeners (mean=29.31 standard deviation=8.94); $t(96)=0.958$, $p=0.341$. For the group of participants who had a screening colonoscopy in the past, the biggest barrier was the concern that the test might find something wrong (41.7%). The second reported barrier was the lack of symptoms (37.2%), and the third barrier was that the test was too expensive (33.4%)

Table II. Descriptive statistics of variables investigated

	Non-Screeners	Screeners
	N=78	N=25
Variable	M (SD)	M (SD)
Benefits	24.14 (4.21)	27.00 (13.66)
Barriers	29.31 (8.94)	27.08 (3.54)
Self-Efficacy	33.97 (8.20)	39.91 (8.63)
Outlook (optimism)	20.85 (2.95)	21.04 (4.40)
Discussion Probability	32.50 (30.85)	56.00 (33.97)
Discussion Confidence	63.25 (31.02)	79.58 (25.36)
	N (%) – "yes answers"	
Previous screening recommendation	6 (8.1)	11 (45.8)
Previous prevention recommendation	8 (10.8)	11(45.8)
Screening in absence of recommendation	38 (51.4)	19 (79.2)
Prevention in absence of recommendation	36 (48.6)	16 (66.7)

M: mean; SD: standard deviation.

and the difficulty to return home after the procedure (33.4%). For the group of participants who did not undergo screening, the most frequent barrier was the lack of symptoms, with 62.2% of participants reporting high or very high agreement. The second reported barrier was that the screening was too expensive (32.4%), and the third barrier was the concern that the test might find something wrong (31.1%).

There was a significant difference in the benefits scores for screeners (mean=27.00 standard deviation=13.66) and non-screeners (mean=24.14 standard deviation=4.21); t(96)=-3.07, p<0.003. For the group of participants who reported having done a screening colonoscopy, the greatest benefits were the increased chance of receiving a treatment (95.8%), and that screening is a self-care measure (95.8%). The next reported benefit was the possibility of finding cancer early (91.7%).

The general health literacy index for all participants in the study was 32.98 (standard deviation=5.55), (mean=35.80, standard deviation=6.85 for screeners, and mean=32.06, standard deviation=4.77 for non-screeners), with a significant difference between screeners and non-screeners t(96)=-2.97, p<0.004. Tables III and IV shows the contingency matrix of the

Table III. Descriptive statistics of general health literacy index (screeners)

	Finding M (SD) 35.36 (7.08)	Understanding M (SD) 37.87 (7.48)	Judging M (SD) 35.01 (7.62)	Applying M (SD) 35.10 (7.41)
Health Care 36.63 (6.68)	36.11 (9.49)	39.40 (7.05)	31.42 (9.11)	39.58 (8.05)
Disease Prevention 37. (7.19)	37.67 (8.81)	40.20 (8.17)	37.08 (8.12)	32.17 (10.48)
Health Promotion 33.76 (8.94)	32.91 (8.69)	33.85 (11.54)	36.34 (9.54)	32.81 (11.67)

M: mean; SD: standard deviation.

Table IV. Descriptive statistics of general health literacy index (non-screeners)

	Finding M (SD) 31.34 (5.77)	Understanding M (SD) 33.82 (6.02)	Judging M (SD) 32.18 (6.41)	Applying M (SD) 31.04 (5.49)
Health care 33.48 (5.98)	32.26 (8.39)	35.19 (8.25)	30.06 (8.36)	36.43 (6.79)
Disease prevention 32.73 (5.70)	33.38 (8.23)	36.18 (8.08)	32.65 (7.58)	28.52 (8.64)
Health promotion 30.02 (5.43)	28.96 (6.73)	30.68 (7.82)	34.23 (8.17)	27.53 (9.45)

M: mean; SD: standard deviation

means and standard deviations of all health literacy subscales, for screeners and non-screeners, respectively.

In order to explore the ability of the proposed variables to discriminate between two groups (i.e., screeners and non-screeners) a ROC analysis was performed on each variable. Fig. 1 presents the ROC curves or all significant variables from analysis.

Table V shows the results of the ROC analysis for the discriminants investigated in this study. The most accurate discriminants are the perceived screening benefits of colonoscopy, the perceived probability to open up a discussion with health professionals about screening for CRC, and having received in the past a recommendation to do a colonoscopy. On the health literacy scale, the subscales that discriminated the best between participants who had and those who did not have a colonoscopy in the past, were the disease prevention subscale (DP-HL) and understanding health information subscale (DP-UHI).

DISCUSSION

Perceived benefits of screening, previous recommendations for screening and prevention, and self-efficacy were the best discriminators, with medium effect sizes, between individuals who attended or did not attend colonoscopy screening for CRC. Disease prevention is the most relevant aspect of health literacy to discriminate between screeners and non-screeners. Individuals who reported higher perceived benefits of screening also reported a higher probability of colonoscopy uptake. The accuracy of discrimination reported through AUC and Cohen's d had a medium effect size. Furthermore, there was a significant difference between screeners and non-screeners in terms of perceived benefits, but not in terms of perceived barriers. These findings are in line with previous evidence suggesting that perceived benefits weigh more than perceived barriers in the decision to attend colonoscopy screening for CRC [27, 32]. One of the explanations for these findings could be the difficulty to accurately measure relevant perceived benefits and barriers, and currently available quantitative measures may not be calibrated enough to identify relevant benefits and barriers that may be culturally and socially sensitive [27]. Another contributing explanation for our results could be that perceived barriers are generally important for health-preventive behaviours, whilst perceived benefits are

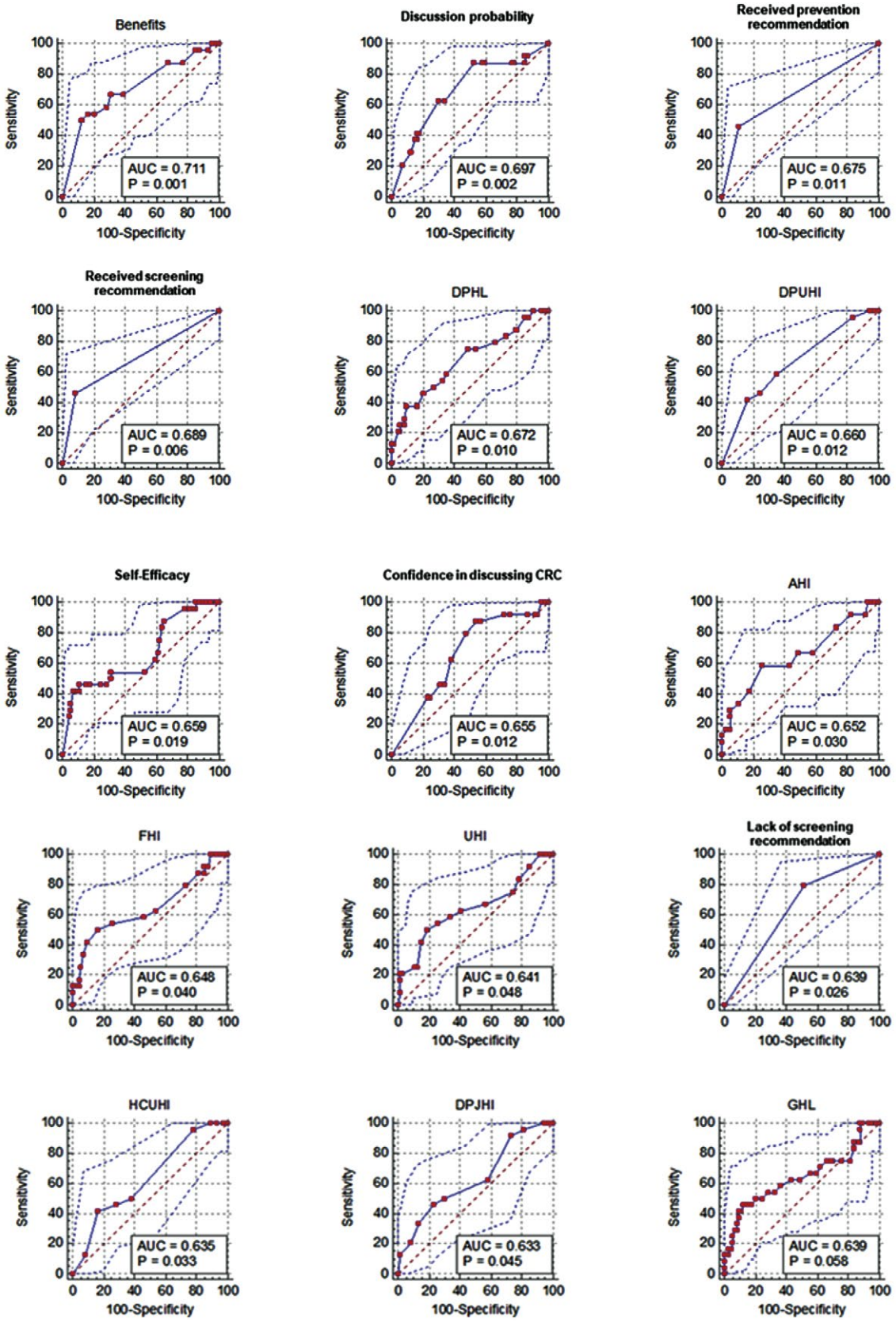

Fig. 1. ROC Analysis. For abbreviations see Table V.

more strongly connected to sick-role behaviours [27]. James et al. [32], suggested that attending colonoscopies might be perceived as a sick-role behaviour; therefore, perceived benefits become more important in shaping the behaviour. Colonoscopy, due to its invasive nature, might in fact be perceived as a sick-role behaviour.

Indeed, Romania does not have yet an official screening policy for CRC, despite previous pilot attempts. However,

Table V. Results of ROC analysis indicators

Discriminator	AUC	Cohen's d	p value	Sensitivity	Specificity	Criterion
Screening Benefits	0.711	0.787	0.001	54.17	83.78	>28
Discussion probability	0.697	0.729	0.002	87.5	47.3	>20
Previous screening recommendation	0.689	0.697	0.007	45.83	91.89	>0
Previous prevention recommendation	0.675	0.642	0.011	45.83	89.19	>0
Self-Efficacy	0.659	0.58	0.019	45.83	89.19	>42
Discussion confidence	0.655	0.564	0.012	87.5	45.95	>60
Screening in absence of recommendation	0.639	0.503	0.026	79.17	48.65	>0
Family history	0.593	0.333	0.183	37.5	81.08	>0
Prevention in absence of recommendation	0.59	0.322	0.173	66.67	51.35	>0
Barriers	0.575	0.268	0.344	33.33	97.3	>13
Outlook	0.515	0.053	0.845	29.17	91.89	>24
G-HL	0.639	0.503	0.057	45.83	87.84	>35.82
DP-HL	0.672	0.63	0.01	37.5	90.54	>38.89
DP-UHI	0.66	0.583	0.012	41.67	83.78	>44.44
AHI	0.652	0.552	0.03	58.33	74.32	>33.33
FHI	0.648	0.537	0.04	50	83.78	>34.62
UHI	0.641	0.511	0.048	50	81.08	>37.88
HC-UHI	0.635	0.489	0.033	41.67	83.78	>41.67
HP-AHI	0.634	0.484	0.051	25	95.95	>41.67
DP-JHI	0.633	0.48	0.045	45.83	77.03	>36.67
HP-FHI	0.629	0.465	0.053	70.83	48.65	>26.67
DP-FHI	0.628	0.462	0.06	37.5	87.84	>41.67
DP-AHI	0.626	0.454	0.06	33.33	87.84	>33.33
HC-FHI	0.618	0.425	0.096	37.5	86.49	>37.5
HC-AHI	0.606	0.38	0.145	50	72.97	>37.5
HC-HL	0.605	0.376	0.143	45.83	82.43	>37.5
HP-HL	0.596	0.344	0.217	41.67	85.14	>34.38
JHI	0.575	0.268	0.285	41.67	79.73	>36.11
HP-UHI	0.57	0.249	0.376	45.83	83.78	>33.33
HP-JHI	0.55	0.177	0.492	33.33	81.08	>38.89
HC-JHI	0.524	0.085	0.73	29.17	81.08	>33.33

GHL: General health literacy; HC-HL: Health care health literacy; DP-HL: Disease prevention health literacy; HP-HL: Health promotion health literacy; FHI: finding health information; UHI: understanding health information; JHI: judging health information; AHI: applying health information; HC-FHI: health care finding health; HC-UHI: health care understanding health information; HC-JHI: health care judging health information; HC-AHI: health care applying health information; DP-FHI: disease prevention finding health information; DP-UHI: disease prevention understanding health information; DP-JHI: disease prevention judging health information; DP-AHI: disease prevention applying health information; HP-FHI: health promotion finding health information; HP-UHI: health promotion understanding health information; HP-JHI: health promotion judging health information; HP-AHI: health promotion applying health information

access to colonoscopy is a simple process and the waiting time is usually 1-2 weeks. Therefore, many opportunistic colonoscopies are performed, sometimes requested by individuals themselves. We can hypothesize several reasons for our unexpected results regarding the apparent high colonoscopy rates in our sample size compared to previous reported data. One reason is the comparison with quite dated information from Eurostat surveys and lack of other more recent systematically gathered data on colonoscopy rates. Another reason for this difference could be the self-reported nature of our survey, with participants reporting having a colonoscopy with a screening purpose, but there might have been other medical reasons behind the procedure. Future studies with more objective measures could answer these questions more clearly. Another reason for the higher number of participants reporting colonoscopies might be that the city

where we collected the data hosts a large medical community from which the inhabitants might greatly benefit.

Individuals' intention to discuss CRC with their doctor is also associated with colonoscopy screening. The accuracy of discrimination reported through AUC and Cohen's d had a medium effect size. Receiving recommendations from healthcare professionals to attend colonoscopy screening and to adopt preventive measures were two of the best discriminating variables. Previous research also found that adherence to colonoscopy is associated with healthcare professional recommendations [37, 39]. Receiving a recommendation for screening from a healthcare provider becomes even more important in the context of opportunistic screening. In this setting, the responsibility for the logistics of screening falls onto the individuals and their healthcare professionals, compared to the context of national screening programmes where the responsibility falls on the healthcare system.

Results also show that self-efficacy is another discriminator between screeners and non-screeners, and this finding is in line with previous research on self-efficacy [27, 48]. The discriminating accuracy of self-efficacy had a medium effect size.

Health literacy was also relevant, especially the disease prevention component. The results suggest that a higher health literacy regarding disease prevention can lead to more frequent colonoscopies. Our analysis indicated a medium effect size. Previous evidence on the importance of health literacy in screening for CRC is mixed. Our results support previous research showing an association between health literacy and colonoscopy adherence [25].

Medical consultations and psychosocial interventions, such as genetic counselling, which directly or indirectly target increasing colonoscopies for at risk individuals, can draw upon the results of this study by emphasizing a conversation based on the perceived benefits of the screening.

Our study has some limitations. Although we were guided by a power analysis in recruiting the participants and our sample is comparable with other similar studies investigating psychosocial aspects of screening for cancer [27, 35, 38], the relatively small sample size we analysed should be factored in when extrapolating results. For results informative on a more general scale, further studies might consider a national representative sample size. Also, due to the self-reported nature of our survey, the degree on which the answers are based on the subjective experience with colonoscopy is unclear. A longitudinal designed study to investigate attitude changes in colonoscopy might answer this limitation.

CONCLUSIONS

The results of our study provide an overview of the main factors associated with colonoscopy screening in people over 50 years of age. Both psychological and factual variables discriminated between screeners and non-screeners. Perceived benefits of screening and perceived probability to discuss screening with a healthcare professional were the best psychological discriminators whilst having received a recommendation for screening from a healthcare provider was the best discriminator in the factual category. Additionally, higher health literacy related to disease prevention can make a positive impact on adherence to colonoscopies. Having a recommendation from a healthcare provider, with an emphasis on screening benefits, is very likely to be the most useful way to increase screening for CRC. This is a key finding, relevant particularly for healthcare systems where, in the absence of national screening programmes, the main responsibility of screening uptake falls on individuals rather than the healthcare system.

Conflicts of interest: None to declare.

Authors' contributions: All authors contributed to the study conception and design. A.C., R.M., S.P., D.D., A.B. contributed to the material preparation, data collection and statistical analysis. The first draft of the manuscript was written by A.C. and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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REFERENCES

1. World Health Organization. Global Cancer Observatory. 2018. Available at: https://gco.iarc.fr/
2. Arnold M, Sierra MS, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global patterns and trends in colorectal cancer incidence and mortality. Gut 2017;66:683–691. doi:10.1136/gutjnl-2015-310912
3. Valean S, Chira R, Dumitrascu D. Epidemiological trends in digestive cancers in Romania, 1955-2012, compared to alcohol consumption. Correlation or coincidence? Clujul Med 2018;91:376-386. doi:10.15386/cjmed-1067
4. Simon AE, Thompson MR, Flashman K, Wardle J. Disease stage and psychosocial outcomes in colorectal cancer. Colorectal Dis 2009;11:19-25. doi:10.1111/j.1463-1318.2008.01501.x
5. Bénard F, Barkun AN, Martel M, von Renteln D. Systematic review of colorectal cancer screening guidelines for average-risk adults: Summarizing the current global recommendations. World J Gastroenterol 2018;24:124-138. doi:10.3748/wjg.v24.i1.124
6. Wolf AMD, Fontham ETH, Church TR, et al. Colorectal cancer screening for average-risk adults: 2018 guideline update from the American Cancer Society. CA Cancer J Clin 2018;68:250-281. doi:10.3322/caac.21457
7. Cairns S R, Scholefield JH, Steele R J, et al; Association of Coloproctology for Great Britain and Ireland. Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). Gut 2010;59:666-689. doi:10.1136/gut.2009.179804
8. Public Health England. Bowel screening to start at 50. 2018, August 10. Accessed: January 23, 2020. Available at: https://www.gov.uk/government/news/bowel-screening-to-start-at-50
9. The Lancet Gastroenterology Hepatology. Improving uptake of colorectal cancer screening. Lancet Gastroenterol Hepatol 2017;2:767. doi:10.1016/s2468-1253(17)30298-4
10. Sarkar S, Athwal V, Sturgess RP, Lythgoe D, Bodger K. The effect of high quality assurance measures in bowel cancer screening on patient satisfaction of colonoscopy. J Gastrointestin Liver Dis 2012;21:251-258.

11. International Agency for Research on Cancer. Cancer Screening in the European Union (2017). Report on the implementation of the Council Recommendation on cancer screening. Lyon, France. Available at: https://ec.europa.eu/health/sites/health/files/major_chronic_diseases/docs/2017_cancerscreening_2ndreportimplementation_en.pdf
12. United European Gastroenterology. Europe is falling behind America in the fight against colorectal cancer due to low screening uptake say experts. 2013 March 13. Available at: https://ueg.eu/a/192
13. Eurostat. 2014. Period since screening for colorectal cancer, persons aged 50-74 years. Available at: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hlth_ehis_pa5e&lang=en
14. Ionescu EM, Nicolaie T, Gologan SI, et al. Opportunistic colorectal cancer screening using colonoscopy. Comparative results between two historical cohorts in Bucharest, Romania. J Gastrointestin Liver Dis 2015;24:171-176. doi:10.15403/jgld.2014.1121.242.buch
15. Visovan II, Tantau M, Ciobanu L, Pascu O, Tantau A. Increasing prevalence of right-sided colonic adenomas in a high-volume endoscopy department in Romania: implications for colorectal cancer screening. J Gastrointestin Liver Dis 2014;23:147-151. doi:10.15403/jgld.2014.1121.232.iiv1
16. United European Gastroenterology. Coordinating European Action Against Colorectal Cancer. 2020. Available at: https://d3lifzor4hvny1.cloudfront.net/fileadmin/user_upload/images/EU_Affairs/UEG_CRC_Manifesto.pdf
17. Barzi A, Lenz HJ, Quinn DI, Sadeghi S. Comparative effectiveness of screening strategies for colorectal cancer. Cancer 2017;123:1516-1527. doi:10.1002/cncr.30518
18. Basch CH, Basch CE, Zybert P, Wolf RL. Failure of Colonoscopy Knowledge to Predict Colonoscopy Uptake. J Community Health 2016;41:1094-1099. doi:10.1007/s10900-016-0194-6
19. Lowery JT, Horick N, Kinney AY, et al. A randomized trial to increase colonoscopy screening in members of high-risk families in the colorectal cancer family registry and cancer genetics network. Cancer Epidemiol Biomarkers Prev 2014;23:601-10. doi:10.1158/1055-9965.EPI-13-1085
20. Brumbach BH, Birmingham WC, Boonyasiriwat W, Walters S, Kinney AY. Intervention Mediators in a Randomized Controlled Trial to Increase Colonoscopy Uptake Among Individuals at Increased Risk of Familial Colorectal Cancer. Ann Behav Med 2017;51:694-706. doi:10.1007/s12160-017-9893-1
21. Nutbeam D. Health promotion glossary. Health Promotion International 1998;13:349-364. doi:10.1093/heapro/13.4.349
22. Kickbusch I. Health Literacy: engaging in a political debate. Int J Public Health 2009;54:131-132. doi:10.1007/s00038-009-7073-1
23. Berkman ND, Sheridan SL, Donahue KE, et al. Health literacy interventions and outcomes: an updated systematic review. Evid Rep Technol Assess (Full Rep) 2011;(199):1-94.
24. Oldach BR, Katz ML. Health literacy and cancer screening: a systematic review. Patient Educ Couns 2014;94:149-157. doi:10.1016/j.pec.2013.10.001
25. Kobayashi LC, Wardle J, von Wagner C. Limited health literacy is a barrier to colorectal cancer screening in England: evidence from the English Longitudinal Study of Ageing. Prev Med 2014;61:100-105. doi:10.1016/j.ypmed.2013.11.012
26. Janz NK, Becker MH. The Health Belief Model: a decade later. Health Educ Q 1984;11:1-47. doi:10.1177/109019818401100101
27. Williams RM, Wilkerson T, Holt CL. The role of perceived benefits and barriers in colorectal cancer screening in intervention trials among African Americans. Health Educ Res 2018;33:205-217. doi:10.1093/her/cyy013
28. Sohler NL, Jerant A, Franks P. Socio-psychological factors in the Expanded Health Belief Model and subsequent colorectal cancer screening. Patient Educ Couns 2015;98:901-907. doi:10.1016/j.pec.2015.03.023
29. Bauer A, Riemann JF, Seufferlein T, et al. (2018). Invitation to screening colonoscopy in the population at familial risk for colorectal cancer. Dtsch Arztebl Int 2018;115:715-722. doi:10.3238/arztebl.2018.0715
30. Ekberg M, Callender M, Hamer H, Rogers S. Exploring the decision to participate in the National Health Service Bowel Cancer Screening Programme. Eur J Cancer Prev 2014;23:391-397. doi:10.1097/CEJ.0000000000000007
31. Mastrokostas A, Gavana M, Gkrizioti M, et al. (2018). Discrepancies and misconceptions of perceived colorectal cancer screening barriers between primary health professionals and unscreened population. A comparative study in Greece. J BUON 2018;23:67-76.
32. James AS, Campbell MK, Hudson MA. Perceived barriers and benefits to colon cancer screening among African Americans in North Carolina: how does perception relate to screening behavior? Cancer Epidemiol Biomarkers Prev 2002;11:529-534.
33. Bandura A. Self-efficacy mechanism in human agency. Am Psychol 1982;37:122–147. doi:10.1037/0003-066x.37.2.122
34. Majdfar Z, Khodadost M, Majlesi F, Rahimi A, Shams M, Mohammadi G. Relationships between Self-Efficacy and Pap Smear Screening in Iranian Women. Asian Pac J Cancer Prev 2016;17(Suppl 3):263-268. doi:10.7314/apjcp.2016.17.s3.263
35. Jerome-D'Emilia B, Suplee PD. Mammogram Use and Self-Efficacy in an Urban Minority Population. Public Health Nurs 2015;32:287-297. doi:10.1111/phn.12162
36. Klasko-Foster LB, Jandorf LM, Erwin DO, Kiviniemi MT. Predicting Colonoscopy Screening Behavior and Future Screening Intentions for African Americans Older than 50 Years. Behav Med 2019;45:221-230. doi:10.1080/08964289.2018.1510365
37. Symonds EL, Simpson K, Coats M, et al. A nurse-led model at public academic hospitals maintains high adherence to colorectal cancer surveillance guidelines. Med J Aust 2018;208:492-496.
38. Adams LK, Qiu S, Hunt AK, Monahan KJ. A dedicated high-quality service for the management of patients with an inherited risk of colorectal cancer. Colorectal Dis 2019;21:879-885. doi:10.1111/codi.14622
39. Ramdass P, Petraro P, Via C, Shahrokni A, Nawaz H. Providers Role in Colonoscopy Screening for Colorectal Cancer. Am J Health Behav 2014;38:234-244. doi:10.5993/ajhb.38.2.9
40. Ait Ouakrim D, Lockett T, Boussioutas A, Hopper JL, Jenkins MA. Screening participation for people at increased risk of colorectal cancer due to family history: a systematic review and meta-analysis. Fam Cancer 2013;12:459-472. doi:10.1007/s10689-013-9658-3
41. Hewitson P, Ward AM, Heneghan C, Halloran SP, Mant D. Primary care endorsement letter and a patient leaflet to improve participation in colorectal cancer screening: results of a factorial randomised trial. Br J Cancer 2011;105:475–480. doi:10.1038/bjc.2011.255
42. Sørensen K, Van den Broucke S, Pelikan JM, et al. Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). BMC Public Health 2013;13:948. doi:10.1186/1471-2458-13-948
43. Murphy CC, McQueen A, Bartholomew LK, Del Junco DJ, Coan SP, Vernon SW. Factorial Validity and Invariance of Four Psychosocial Constructs of Colorectal Cancer Screening: Does Screening Experience Matter? Cancer Epidemiol Biomarkers Prev 2013;22:2295–2302. doi:10.1158/1055-9965.epi-13-0565

44. Pintea S, Moldovan R. The receiver-operating characteristic (ROC) analysis: Fundamentals and applications in clinical psychology. J Cogn Behav Psychother 2009;9:49–66.
45. Westin LK. Receiver operating characteristic (ROC) analysis. Evaluating discriminance effects among decision support systems. Umea, Sweden 2001. Available at: https://www8.cs.umu.se/research/reports/2001/018/part1.pdf
46. Streiner DL, Cairney J. What's under the ROC? An Introduction to Receiver Operating Characteristics Curves. Can J Psychiatry 2007;52:121–128. doi:10.1177/070674370705200210
47. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, N.J.: L. Erlbaum Associates, 1988.
48. Jimbo M, Sen A, Plegue MA, et al. Correlates of Patient Intent and Preference on Colorectal Cancer Screening. Am J Prev Med 2017;52:443-450. doi:10.1016/j.amepre.2016.11.026