

# Awareness About Colorectal Cancer among Young Adults in Poland

**Marta Fudalej**

Department of Cancer Prevention, Medical University of Warsaw

**Anna Badowska-Kozakiewicz** (✉ [abadowska@wum.edu.pl](mailto:abadowska@wum.edu.pl))

Department of Cancer Prevention, Medical University of Warsaw

**Julia Pikul**

Students' Scientific Organization of Cancer Cell Biology, Department of Cancer Prevention, Medical University of Warsaw

**Andrzej Deptała**

Department of Cancer Prevention, Medical University of Warsaw

---

## Research Article

**Keywords:** Colorectal cancer (CRC), colorectal cancer epidemiology, Statistical analysis

**Posted Date:** December 14th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-1104910/v1>

**License:** © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

Colorectal cancer (CRC) is one of the most predominant malignancies among the adult population. Most cases of CRC develop from non-malignant precursor lesions called adenomas over a long time, which provides an opportunity for prevention with screening programmes. The aim of the present study was to evaluate the knowledge and awareness level concerning colorectal cancer epidemiology, risk factors, symptoms, and prevention among young society in Poland. The knowledge was examined with an anonymous survey between February and March 2021. Statistical analysis was performed and differences were considered significant if the  $p$ -value obtained was smaller than the assumed level of significance  $p \leq 0.05$ . Respondents were mostly female, living in a city, with a population of over 500 thousand. The study acquired information that might guide educators about knowledge deficit among young society in Poland. The results confirmed that education, family/friends history of CRC and a place of residence differentiate knowledge and awareness about CRC. They revealed a significant knowledge gap between rural and urban inhabitants as well as a medical and non-medical group.

## Introduction

Colorectal cancer (CRC) is one of the most predominant malignancies among the adult population. In Poland, this type of cancer takes third place in cancer incidence among males (following lung and prostate cancer) and second among females (following breast cancer). The most common incidents occur after 60 years of age and are associated with sporadic mutations<sup>1</sup>. Risk factors associated with this malignancy encompass incorrect diet, lack of physical activity, bowel inflammation, or polyps<sup>2-4</sup>. Lynch syndrome is the most common hereditary colorectal cancer and constitutes *circa* 3% of all CRC cases. It is associated with germline alterations in the DNA mismatch repair deficiency and microsatellite instability<sup>5,6</sup>. Familial adenomatous polyposis (FAP) caused by a germline mutation in the adenomatous polyposis coli gene (APC) is an even more rarely occurring one. High gene penetration causes results in developing CRC in every patient with this autosomal dominant syndrome<sup>7</sup>.

CRC diagnosis among people under 50 years of age is rather rare; however, some studies suggest growing incidence in this population. It creates not only a diagnostic problem but a therapeutic one as well. It is believed that early-onset CRC may be correlated, among other things, with an unhealthy lifestyle, leading to the same level of risk in young as in older people<sup>8,9</sup>.

The World Health Organization (WHO) estimated that 40% of cancers could be avoided by prevention and 40% could be cured assuming early detection<sup>10</sup>. Most cases of CRC develop from non-malignant precursor lesions called adenomas over a long time, which provides an opportunity for prevention with screening programmes. Identification of premalignant lesions and detection of asymptomatic early-stage malignancies result in decreased incidence and mortality<sup>11</sup>. In Poland CRC screening programmes encompass colonoscopy; nevertheless, people included in the risk group submit to testing unwillingly<sup>12,13</sup>. The study by Bretthauer *et al.* (2016) showed that Polish people reluctantly underwent colonoscopy.

Only 33% accepted the invitation and took part in this examination <sup>14</sup>. Moreover, screening coverage in Poland, especially concerning CRC was further decreased during the COVID-19 pandemic <sup>15</sup>. On the other hand, the upward trend in the number of deaths from CRC is expected to continue until the 2030s. It highlights the need for increased efforts for optimising educational and screening programmes <sup>16</sup>.

## Aim

The main aim of the study was to evaluate the knowledge and awareness level concerning colorectal cancer epidemiology, risk factors, symptoms, and prevention among young society in Poland.

## Materials And Methods

The knowledge was examined with an anonymous survey shared on social media between February and March 2021. Received data was completely anonymous and the participation was voluntary. Informed consent for participation in the study was obtained from all participants. The survey was carried out in accordance with relevant guidelines and regulations. According to the local ethics committee recommendation, the study did not require committee's approval. The original questionnaire was drafted by the authors through literature review and revised by a panel of clinicians. The part assessing the participants knowledge about CRC consisted of 20 closed questions. 18 questions were single choice and 2, about symptoms and risk factors, were multiple choice (Tab. 1). The maximum score to achieve was 16 points. In single choice questions for every correct answer participants were given one point. In questions with multiple correct answers, 1 point was given only when all of the correct answers were chosen. When the part was chosen correctly [for example 4 correct out of 6, the person was given 2/3 (0.67) of a point]. Subsequently, the results were converted to the percentage scale – the participants could gain from 0 to 100%. The questionnaire also encompassed demographic information including sex, age, educational level, medical background, residence, family or friends history of CRC.

Table 1  
Survey questions with correct answers

	Question	Correct answer
1	Who suffers from colorectal cancer (CRC) more often?	Men
2	In what age group is the disease most common?	Over 60
3	Please evaluate the incidence of CRC in male population in Poland	Third place after lung cancer and prostate cancer
4	Please evaluate the incidence of CRC in female population in Poland	Second place after breast cancer
5	Do you think that CRC is characterised by a high mortality rate?	-
6	Do you think that the mortality rate in a country is associated with a prevention program?	-
7	How many new cases of CRC are identified in Poland annually?	15 – 20 thousand
8	How many people die of CRC in Poland annually?	10 – 15 thousand
9	What is the overall survival rate within 5-years for CRC?	29 – 49%
10	Is there a screening programme for CRC in Poland?	Yes
11	Are there screening programmes for other cancers in Poland?	Yes
12	Is this possible that CRC might develop without causing any symptoms?	Yes
13	Please choose symptoms associated with CRC (multiple choice)	Iron deficiency anaemia Abdominal pain Changed rhythm of bowel movement Weight loss General weakness Blood in stool

	Question	Correct answer
14	Please choose CRC risk factors (multiple choice)	Obesity Smoking Lack of physical activity Alcohol abuse Genetic factors Polyps
15	In which part of the large intestine is the cancer the most commonly located?	Colon
16	Where are distant metastases most common?	Liver
17	What are the possible treatment options for CRC?	All (chemotherapy, radiotherapy, surgery)
18	Do you know what it is the " <i>per rectum</i> " examination?	-
19	Have you heard about CRC in the media?	-
20	Have you heard about prevention actions associated with CRC?	-

## Statistical analysis

Descriptive statistics summarised descriptive information about respondents and responses to awareness, knowledge, and CRC screening items. The Kolmogorov-Smirnov test detected if variables followed a given distribution in a population. All categorical and continuous variables were compared by chi-square tests of heterogeneity and Student's t-tests of independence, respectively. The effect size was measured with Cohen's d. Moreover, in some comparisons, a one-way analysis of variance with F distribution was performed. Subsequently, statistical analysis encompassed *post-hoc* tests. Differences were considered statistically significant if the *p*-value obtained was smaller than the assumed level of significance  $p \leq 0.05$ . The statistical package for social science (SPSS) version 25.0 was used for the analysis.

## Results

### Demography

Respondents (n=1546) were mostly female (81.4%), living in a city, with a population of over 500 thousand (36.8%). The mean age of the participants was 23.1 (standard deviation (SD): 3.71, range: 18-35) years. 53.8% of interviewees had medical education, including the following faculties: medicine,

dentistry, dietetics, obstetrics, medical analysis, public health, pharmacy, nursing, electro-radiology. 29.9% of respondents claimed to have a friend or family member who suffered from colorectal cancer. Detailed participants characteristics are presented in Table 2.

Table 2  
Descriptive characteristics of the participants

<b>Total number</b>	<b>1546</b>	
<b>n</b>		
<b>Age</b>	18 – 35	
Range	23.12 ± 3.71	
Mean ± SD		
	<b>Number of participants</b>	<b>Percentage</b>
<b>Gender</b>	1258	81.37%
Female	288	18.63%
Male		
<b>Residence</b>	350	22.64%
Village	75	4.86%
Small city (<10k)	252	16.30%
Medium city (10k – 100k)	300	19.40%
City (100k – 500k)	569	36.80%
Big city (>500k)		
<b>Profession</b>	832	53.82%
Medical	714	46.18%
Non-medical		
<b>Family/friends history of CRC</b>	462	29.88%
Yes	1084	70.12%
No		

## The General Level Of Knowledge

The questions in the survey presented a diversified difficulty level. The easiest questions were associated with the mortality rate of colorectal cancer and Polish prevention programmes (84.5% correct answers). The most difficult question concerned epidemiological issues - the incidence of CRC among women in Poland (only 18.6% correct answers) and the most common age of morbidity (22.4% correct answers). Answers to the two multiple-choice questions are presented in figures 1 and 2 (Fig. 1, Fig. 2).

Only two respondents gained a maximum score of 16 points. The lowest score was achieved by one respondent and reached 1.63 points (10.19% of correct answers). The mean score equalled 9 points (56.3%) The average score in single choice questions was 8.71 points (SD 2.63). In both multiple-choice questions, participants predominantly chose all of six correct answers (mean 4.38, SD 1.43, and mean 4.21, SD 1.54, respectively).

## Gender And Level Of Knowledge

3 statistically significant differences were obtained in single-choice questions. Men more frequently chose correct answers about the age of morbidity ( $p=0.006$ ), while women about Polish screening programmes for other cancers ( $p=0.001$ ) and CRC treatment ( $p=0.008$ ). It is worth mentioning that the effect size of the aforementioned correlation was low. In terms of multiple-choice questions, women more often obtained correct CRC symptoms, with a very low size effect ( $p=0.029$ , Cohen's  $d=0.15$ ). For other questions, the analysis proved no statistically significant differences. In general, in CRC knowledge described by achieved points, no significant gender-dependent differences were obtained.

## Residence And Level Of Knowledge

One-way analysis of variance revealed that the place of residence differentiates knowledge about CRC ( $F=6.91$ ,  $p<0.001$ ). *Post-hoc* tests confirmed that village inhabitants scored fewer points in comparison to the inhabitants of a city ( $p<0.001$ ) and a big city ( $p=0.001$ ). Moreover, inhabitants of medium-size cities received fewer points than big city occupants ( $p=0.011$ ). Analysis of particular questions proved that village inhabitants chose fewer risk factors and CRC symptoms than a city ( $p=0.012$ ,  $p=0.016$ , respectively) and big-city occupants ( $p<0.001$ ). The definition of a small city, medium city, city, and big city are described in Table 2.

## Friends/family History And Level Of Knowledge

Respondents, in whose social surroundings appeared a person with CRC diagnosis had a higher level of knowledge (95% CI 1.89 – 5.39,  $p<0.001$ ) However, the effect size was low (Cohen's  $d=0.23$ ). Analysing correct answers to the single and multiple-choice questions this group also achieved better outcomes with low effect size (Tab. 3).

Table 3

Differences in the number of correct answers between group with family/friend history of CRC and group without family/friend history of CRC

	Family/friend history of CRC (n = 462)		Without family/friend history of CRC (n = 1084)		p	95% CI		Cohen's d
	M	SD	M	SD		LL	UL	
Number of correct answers to the closed questions	9,11	2,63	8,54	2,62	<b>&lt;0,001</b>	0,29	0,86	0,22
Number of correctly chosen symptoms	4,57	1,40	4,29	1,44	<b>&lt;0,001</b>	0,12	0,43	0,19
Number of correctly chosen risk factors	4,37	1,50	4,15	1,55	<b>0,008</b>	0,06	0,39	0,15
Abbreviations: n – number of participants in the group, M – mean, 95% CI – 95% confidence interval, SD – standard deviation, p – statistical significance, LL – lower limit, UL – upper limit, Cohen's d – size effect								

## Medical Education And Level Of Knowledge

The most differences were noticed between medical and non-medical participants. The general knowledge described by achieved points was higher in medical than in non-medical interviewees (95% CI 2.58 – 3.01,  $p < 0.001$ ) with a high effect size (Cohen's  $d = 1.28$ ). Medical respondents scored statistically significant more in both single-choice and multiple-choice questions (Tab.4). Moreover, analysing particular questions, this group significantly more frequently chose correct answers in 10 out of 14 single-choice questions.

Table 4  
Differences in the number of correct answers between medical and non-medical group.

	Medical background		Non-medical background		p	95% CI		Cohen's d
	(n = 832)		(n = 714)			LL	UL	
	M	SD	M	SD				
Number of correct answers to the closed questions	9,95	2,27	7,26	2,27	<0,001	2,45	2,91	1,18
Number of correctly chosen symptoms	5,00	1,25	3,65	1,27	<0,001	1,23	1,49	1,08
Number of correctly chosen risk factors	4,87	1,33	3,45	1,41	<0,001	1,27	1,55	1,03
Abbreviations: n – number of participants in the group, M – mean, 95% CI – 95% confidence interval, SD – standard deviation, p – statistical significance, LL – lower limit, UL – upper limit, Cohen's d – size effect								

## Discussion

Over the last 2 decades, the prevalence of CRC among people under 40 years of age has been rapidly increasing<sup>17,18</sup>. CRC incidence at an early age may be correlated with modern dietary factors and epidemic obesity<sup>4,19</sup>. Emphasis on medical education is an integral part of the strategy for the decrease of CRC incidence. Therefore, we should put intensified efforts to raise awareness about CRC symptoms, risk factors, and screening programmes among young people. Numerous studies from all over the world confirm that young people knowledge about CRC is inadequate<sup>20-23</sup>. Hussain *et al.* (2021)<sup>21</sup> assessed Pakistan university students overall knowledge and attitude as quite good; however, their practices regarding CRC were deficient. Studies conducted among university students in a Caribbean Territory suggested that predictors for poor CRC knowledge are engaging in unhealthy lifestyles such as frequent or excessive alcohol consumption, low physical activity levels, and male gender. They linked poor overall knowledge with a little number of awareness programmes and educational materials at the tertiary education level in the Caribbean<sup>20</sup>. Our study is not the first one that underlines inadequate knowledge among Polish society. The analysis conducted by Rucinska *et al.* (2021)<sup>24</sup> in Polish high schools revealed that students did not relate cancer development with lifestyle and were not familiar with cancer risk factors. Various studies suggest that social media interventions may improve cancer screening and early diagnosis<sup>25-27</sup>; nevertheless, current trends seem to present less involvement in colorectal cancer issues. This subject is discussed more rarely than malignancies such as breast cancer, prostate cancer, testicular cancer, or cervical cancer<sup>25</sup>. Noar *et al.* revealed the significant role of public figures in the awareness of society. Famous people present influence on raising problems in mass media as well as

behavioural outcomes<sup>28,29</sup>; however, medical educators should fight with confusing misinformation spread by some individuals<sup>30</sup>.

Our study stated no significant difference in CRC knowledge between genders. Female participants had significantly better awareness in only a few questions in comparison to their male counterparts, similarly to a few other studies<sup>23,31</sup>. However, our results suggest that young people are unaware of the frequency of CRC morbidity among the women population – just 18.6% of respondents chose the correct answer indicating that CRC is the second most common female cancer. Similar observations were performed in the study by Rocke *et al.*, in which only half of respondents considered the development of colorectal cancer equally dangerous in both genders<sup>20</sup>. Some analysis concerning CRC confirmed that women were more knowledgeable than men<sup>20,21,32,33</sup>. Recent studies suggest that a higher proportion of women is diagnosed with right-sided CRC, at a more advanced stage<sup>34</sup>. It might be partially associated with hormonal status. In older women, the lack of oestrogen increases the risk of microsatellite instability-high CRC, which more often demonstrates the right-sided prevalence<sup>35,36</sup>. Due to numerous differences between genders, in the review by Kim *et al.* (2015)<sup>37</sup> the authors proposed sex- and gender-specific strategies for screening, treatment and prevention to reduce the morbidity and mortality of CRC in women.

We indicated that people from rural areas present a much lower level of knowledge and awareness concerning CRC in comparison to citizens, especially from large cities. Similar results were obtained in several studies in different countries<sup>38-41</sup>. It was proved that patients with symptomatic colorectal cancer from rural areas had longer diagnostic and health system intervals than urban patients<sup>42</sup>. Longer travel distance was correlated with increased odds of stage IV CRC<sup>43</sup>. Nevertheless, studies conducted in Iran and China claimed significant differences between the urbanization level and the incidence rate of CRC. In this analysis, a higher incidence rate was associated with a higher urbanization level<sup>44,45</sup>. The authors linked these differences with urban lifestyle (low physical activity, processed food) and obesity. Nevertheless, despite the lower reported incidence ratio in the rural areas, disparities in access to information, screening, and prevention techniques should be reduced.

Our study confirmed the correlation between knowing people, who were diagnosed with CRC and higher awareness in this particular population. Experience with this disease in relatives resulted in greater knowledge of symptoms and risk factors. The answer about the possibility of a symptomless course of the CRC was chosen by this group of respondents significantly more frequently. The systemic review conducted in 2016 by Honein-AbouHaidar *et al.*<sup>12</sup> revealed that people who experienced colorectal cancer spread knowledge about the disease and motivate others to be screened. Personal contact with someone who was diagnosed with CRC contributes to a better understanding of the problem. However, it seems that symptoms presented by CRC are embarrassing for individuals thus they try to avoid this subject.

Considering medical participants, they are knowledgeable on the risk factors and symptoms of CRC. In our study, 91.2% of medical respondents perceived CRC screening programmes as an important and

meaningful part of preventing cancer-related deaths. This attitude is significantly different in the non-medical group. Therefore, we might conclude that the attitudes towards screening programmes are associated with knowledge and awareness. As shown in the Table 5 the knowledge gap between medical and non-medical is significant; however, in some aspects such as epidemiology or personalised approach to the patients could be improved. Similar conclusions were presented by researchers from other countries<sup>22,31,32,46,47</sup>. On the other hand, various studies from the Middle East underline limited knowledge and poor attitudes towards CRC screening among medical students<sup>10,48,49</sup>.

Table 5

Differences in the number and percentage of correct answers to the single-choice questions between medical and non-medical groups.

Question	Medical background		Non-medical background		<i>p</i> -value
	<b>Correct answers</b>				
Who suffers from colorectal cancer (CRC) more often?	<i>N</i>	742	558		<i>p</i> < <b>0,001</b>
	%	89,20%	78,20%		
In what age group is the disease most common?	<i>N</i>	249	97		<i>p</i> < <b>0,001</b>
	%	29,90%	13,60%		
Please evaluate the incidence of CRC in male population in Poland	<i>N</i>	555	364		<i>p</i> < <b>0,001</b>
	%	66,70%	51,00%		
Please evaluate the incidence of CRC in female population in Poland	<i>N</i>	159	129		<i>p</i> = 0,599
	%	19,10%	18,10%		
Do you think that CRC is characterised by a high mortality rate?	<i>N</i>	666	553		<i>p</i> = 0,213
	%	80,00%	77,50%		
Do you think that the mortality rate in a country is associated with a prevention program?	<i>N</i>	759	547		<i>p</i> < <b>0,001</b>
	%	91,20%	76,60%		
How many new cases of CRC are identified in Poland annually?	<i>N</i>	407	282		<i>p</i> < <b>0,001</b>
	%	48,90%	39,50%		
How many people die of CRC in Poland annually?	<i>N</i>	228	165		<i>p</i> = 0,053
	%	27,40%	23,10%		
What is the overall survival rate within 5-years for CRC?	<i>N</i>	383	289		<i>p</i> = <b>0,028</b>
	%	46,00%	40,50%		
Is there a screening programme for CRC in Poland?	<i>N</i>	457	77		<i>p</i> < <b>0,001</b>
	%	54,90%	10,80%		
Are there screening programmes for other cancers in Poland?	<i>N</i>	754	461		<i>p</i> < <b>0,001</b>
	%	90,60%	64,60%		
Do you think that CRC might be characterised by an asymptomatic course?	<i>N</i>	657	368		<i>p</i> < <b>0,001</b>
	%	79,00%	51,50%		
In which part of the large intestine is the cancer the	<i>N</i>	282	128		<i>p</i> <

most commonly located?	%	33,90%	17,90%	<b>0,001</b>
Where are distant metastases most common?	<i>N</i>	514	430	<i>p</i> = 0,532
	%	61,80%	60,20%	
What are the possible treatment options for CRC?	<i>N</i>	695	432	<i>p</i> < <b>0,001</b>
	%	83,50%	60,50%	
Do you know what it is the “per rectum” examination?	<i>N</i>	768	307	<i>p</i> < <b>0,001</b>
	%	92,30%	43,00%	

In Polish universities, the uniform curriculum in academic oncology has been introduced since 2010; nevertheless, oncological education at Polish medical universities is evaluated as fragmented and poorly coordinated<sup>50</sup>. Modern educators agree that the information and attitudes acquired in medical school are critical in affecting future practice habits. An enhanced cancer education curriculum for medical students has been introduced in the US since the '90s. Two independent reports proved that students developed their style for cancer prevention and detection activities. Moreover, they demonstrated support for the effects of an enhanced cancer prevention curriculum on medical students knowledge, counselling, and screening skills<sup>51,52</sup>.

Clinical practice is proved to be the most influential in acquiring confidence in basic cancer prevention and detection techniques. Clinical students achieve better results in tests concerning oncological awareness<sup>32</sup>. In the experiment conducted by Hauer *et al.* (2008) students with more experience performed better in history taking, physical examination, and counselling during interaction with the simulated, standardised patient with CRC diagnosis. Therefore, the development of curricula including more diverse clinical experiences than might be found locally may become necessary. US studies suggest creating a simulation-based clinical setting with diverse patients population reflecting various health care needs<sup>31</sup>. Another approach assumes learning by watching how clinicians discuss their attitudes to screening and communicating with patients. In 2020 the 90-minute session for second-year medical students was conducted. Promoters provided a short lecture on colon cancer screening and subsequently a panel of practicing gastroenterologists and a primary care physician discussing their approaches to six hypothetical cases<sup>53</sup>. As result, students gained clinical knowledge and communication skills.

Study limitations encompass the basis of cross-sectional data thus causal inferences cannot be established.

## Conclusions

The present study acquired information that might guide educators about knowledge deficit among young society in Poland. The survey revealed a significant knowledge gap between rural and urban

inhabitants as well as a medical and non-medical group. Participants with a medical background are knowledgeable on the risk factors and symptoms of CRC; however, there remain areas that need to be further addressed. Medical students need more exposure to and a greater understanding of their role in public health. Considering residence, disparities in access to information, screening, and prevention techniques should be reduced. Information about one of the most common cancers should be more available and spread. Higher awareness among young society might result in encouraging older members of the families to pay attention to the possible symptoms and to take part in dedicated screening programmes.

## Declarations

### Funding

The study was conducted under the Programme PW/Z/1/1/20(1), carried out in 2020-2021 and funded by the grant for science, obtained by Medical University of Warsaw.

### Authors contributions

Conception and study design (MF, JP, ABK), literature search and study selection (MF, JP), quality assessment (MF, AD, ABK), interpretation of results (all authors), writing first draft of manuscript (JP, MF), revising draft manuscript (all authors), approval of final version to be published and agreement to be accountable for the integrity and accuracy of all aspects of the work (all authors).

### Competing interests

The authors declare no competing interests.

## References

- 1 Wojciechowska, U., *et al.* Nowotwory złośliwe w Polsce w 2018 roku. Krajowy Rejestr Nowotworów (Cancer morbidity and mortality rates in Poland) <http://onkologia.org.pl/publikacje/> (2018).
- 2 Keum, N. & Giovannucci, E. Global burden of colorectal cancer: emerging trends, risk factors and prevention strategies. *Nat Rev Gastroenterol Hepatol***16**, 713-732, doi:10.1038/s41575-019-0189-8 (2019).
- 3 Dekker, E., Tanis, P. J., Vleugels, J. L. A., Kasi, P. M. & Wallace, M. B. Colorectal cancer. *Lancet***394**, 1467-1480, doi:10.1016/s0140-6736(19)32319-0 (2019).
- 4 Deptała, A. Nowotwory dolnego odcinka przewodu pokarmowego (Cancers of lower digestive tract) in *Onkologia wydanie 2. Podręcznik dla studentów medycyny. Pomoc dydaktyczna dla lekarzy specjalizujących się w onkologii* (ed. Stec, R., Smoter, M., Deptała, A.) 171-183 (AsteriaMed, 2021).

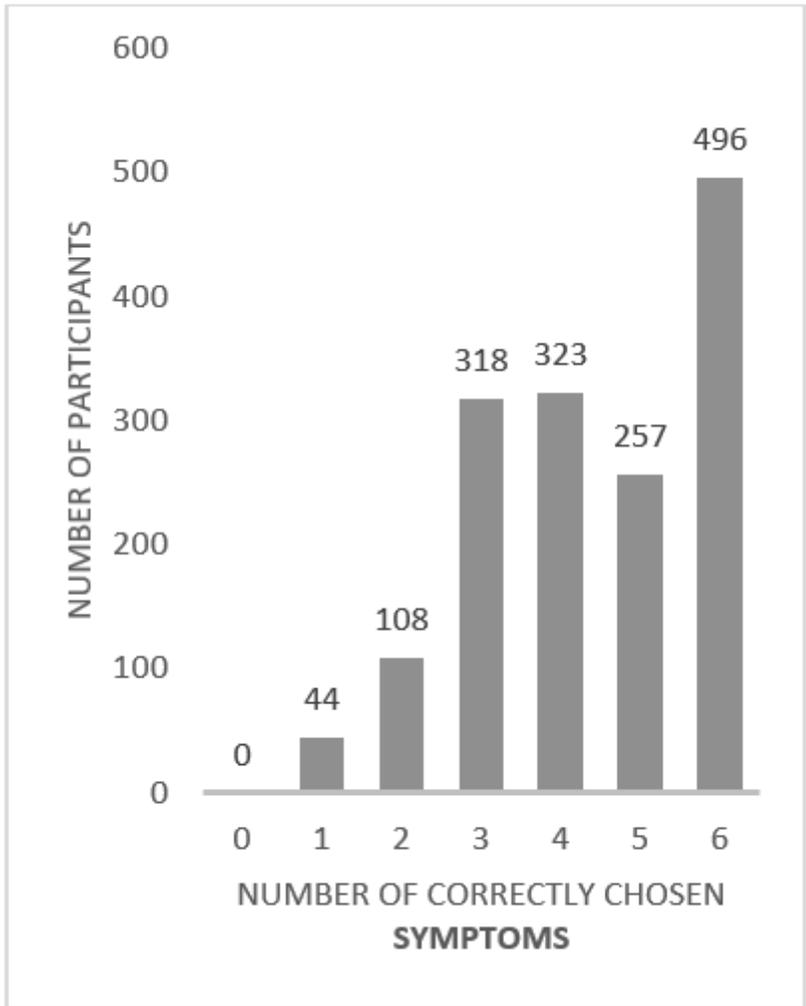
- 5 Biller, L. H., Syngal, S. & Yurgelun, M. B. Recent advances in Lynch syndrome. *Fam Cancer***18**, 211-219, doi:10.1007/s10689-018-00117-1 (2019).
- 6 Boland, P. M., Yurgelun, M. B. & Boland, C. R. Recent progress in Lynch syndrome and other familial colorectal cancer syndromes. *CA Cancer J Clin***68**, 217-231, doi:10.3322/caac.21448 (2018).
- 7 Half, E., Bercovich, D. & Rozen, P. Familial adenomatous polyposis. *Orphanet J Rare Dis***4**, 22, doi:10.1186/1750-1172-4-22 (2009).
- 8 Mauri, G. *et al.* Early-onset colorectal cancer in young individuals. *Mol Onco***13**, 109-131, doi:10.1002/1878-0261.12417 (2019).
- 9 Siegel, R. L., Jakubowski, C. D., Fedewa, S. A., Davis, A. & Azad, N. S. Colorectal Cancer in the Young: Epidemiology, Prevention, Management. *Am Soc Clin Oncol Educ Book***40**, 1-14, doi:10.1200/edbk\_279901 (2020).
- 10 Althobaiti, A. & Jradi, H. Knowledge, attitude, and perceived barriers regarding colorectal cancer screening practices and risk factors among medical students in Saudi Arabia. *BMC Med Educ***19**, 421, doi:10.1186/s12909-019-1857-7 (2019).
- 11 Young, G. P. *et al.* Recommendations for a step-wise comparative approach to the evaluation of new screening tests for colorectal cancer. *Cancer***122**, 826-839, doi:10.1002/cncr.29865 (2016).
- 12 Honein-AbouHaidar, G. N. *et al.* Systematic Review and Meta-study Synthesis of Qualitative Studies Evaluating Facilitators and Barriers to Participation in Colorectal Cancer Screening. *Cancer Epidemiol Biomarkers Prev***25**, 907-917, doi:10.1158/1055-9965.Epi-15-0990 (2016).
- 13 McLachlan, S. A., Clements, A. & Austoker, J. Patients' experiences and reported barriers to colonoscopy in the screening context—a systematic review of the literature. *Patient Educ Couns***86**, 137-146, doi:10.1016/j.pec.2011.04.010 (2012).
- 14 Bretthauer, M. *et al.* Population-Based Colonoscopy Screening for Colorectal Cancer: A Randomized Clinical Trial. *JAMA Intern Med***176**, 894-902, doi:10.1001/jamainternmed.2016.0960 (2016).
- 15 Koczkodaj, P., Kamiński, M., Ciuba, A. & Didkowska, J. Cancer screening coverage in Poland – from bad to better to the worst during the SARS-CoV-2 pandemic. *Archives of Medical Science***17**, 1132-1133, doi:10.5114/aoms/134239 (2021).
- 16 Czaderny, K. Increasing deaths from colorectal cancer in Poland – Insights for optimising colorectal cancer screening in society and space. *Annals of Agricultural and Environmental Medicine***26**, 125-132, doi:10.26444/aaem/99233 (2019).
- 17 Patel, S. G. & Ahnen, D. J. Colorectal Cancer in the Young. *Curr Gastroenterol Rep***20**, 15, doi:10.1007/s11894-018-0618-9 (2018).

- 18 Campos, F. G. Colorectal cancer in young adults: A difficult challenge. *World J Gastroenterol***23**, 5041-5044, doi:10.3748/wjg.v23.i28.5041 (2017).
- 19 Hubbard, J. M. & Grothey, A. Adolescent and young adult colorectal cancer. *J Natl Compr Canc Netw***11**, 1219-1225, doi:10.6004/jnccn.2013.0144 (2013).
- 20 Rocke, K. D. Colorectal Cancer Knowledge and Awareness Among University Students in a Caribbean Territory: a Cross-sectional Study. *J Cancer Educ***35**, 571-578, doi:10.1007/s13187-019-01499-1 (2020).
- 21 Hussain, I. *et al.* Knowledge, attitude, preventive practices and perceived barriers to screening about colorectal cancer among university students of newly merged district, Kpk, Pakistan - A cross-sectional study. *J Oncol Pharm Pract***27**, 359-367, doi:10.1177/1078155220922598 (2021).
- 22 Hauer, K. E., Wilkerson, L. & Teherani, A. The relationship between medical students' knowledge, confidence, experience, and skills related to colorectal cancer screening. *J Cancer Educ***23**, 209-213, doi:10.1080/08858190802188586 (2008).
- 23 Imran, M., Sayedalamin, Z., Alsulami, S. S., Atta, M. & Baig, M. Knowledge and Awareness of Colorectal Cancer among Undergraduate Students at King Abdulaziz University, Jeddah, Saudi Arabia: a Survey-Based Study. *Asian Pac J Cancer Prev***17**, 2479-2483 (2016).
- 24 Rucinska, M. *et al.* Polish High School Students' Knowledge about Cancer. *International Journal of Environmental Research and Public Health***18**, 4765 (2021).
- 25 Plackett, R. *et al.* Use of Social Media to Promote Cancer Screening and Early Diagnosis: Scoping Review. *J Med Internet Res***22**, e21582, doi:10.2196/21582 (2020).
- 26 Al-Naggar, R. A. & Bobryshev, Y. V. Knowledge of colorectal cancer screening among young Malaysians. *Asian Pac J Cancer Prev***14**, 1969-1974, doi:10.7314/apjcp.2013.14.3.1969 (2013).
- 27 Ruco, A. *et al.* Social Media and mHealth Technology for Cancer Screening: Systematic Review and Meta-analysis. *J Med Internet Res***23**, e26759, doi:10.2196/26759 (2021).
- 28 Noar, S. M., Willoughby, J. F., Myrick, J. G. & Brown, J. Public figure announcements about cancer and opportunities for cancer communication: a review and research agenda. *Health Commun***29**, 445-461, doi:10.1080/10410236.2013.764781 (2014).
- 29 Ayers, J. W., Althouse, B. M., Noar, S. M. & Cohen, J. E. Do celebrity cancer diagnoses promote primary cancer prevention? *Prev Med***58**, 81-84, doi:10.1016/j.ypmed.2013.11.007 (2014).
- 30 Wang, Y., McKee, M., Torbica, A. & Stuckler, D. Systematic Literature Review on the Spread of Health-related Misinformation on Social Media. *Soc Sci Med***240**, 112552, doi:10.1016/j.socscimed.2019.112552 (2019).

- 31 Boehler, M. *et al.* Knowledge and attitudes regarding colorectal cancer screening among medical students: a tale of two schools. *J Cancer Educ***26**, 147-152, doi:10.1007/s13187-010-0161-3 (2011).
- 32 Pietrzyk, Ł., Torres, A., Denisow-Pietrzyk, M. & Torres, K. What Do We Know About Education in Colorectal Cancer Prevention?-Survey Among 1130 Medical Students. *J Cancer Educ***32**, 406-412, doi:10.1007/s13187-015-0967-0 (2017).
- 33 Ustundag, H., Zengin, N., Andsoy, Il & Gul, A. Awareness of health sciences students about colorectal cancer risk factors. *Eur J Cancer Care (Engl)***28**, e13016, doi:10.1111/ecc.13016 (2019).
- 34 Hansen, I. O. & Jess, P. Possible better long-term survival in left versus right-sided colon cancer - a systematic review. *Dan Med J***59**, A4444 (2012).
- 35 Missiaglia, E. *et al.* Distal and proximal colon cancers differ in terms of molecular, pathological, and clinical features. *Ann Oncol***25**, 1995-2001, doi:10.1093/annonc/mdu275 (2014).
- 36 Newcomb, P. A. *et al.* Estrogen plus progestin use, microsatellite instability, and the risk of colorectal cancer in women. *Cancer Res***67**, 7534-7539, doi:10.1158/0008-5472.Can-06-4275 (2007).
- 37 Kim, S. E. *et al.* Sex- and gender-specific disparities in colorectal cancer risk. *World J Gastroenterol***21**, 5167-5175, doi:10.3748/wjg.v21.i17.5167 (2015).
- 38 Odukoya, O. & Fayemi, M. A Rural-Urban Comparison of Knowledge, Risk- Factors and Preventive Practices for Colorectal Cancer among Adults in Lagos State. *Asian Pac J Cancer Prev***20**, 1063-1071, doi:10.31557/apjcp.2019.20.4.1063 (2019).
- 39 Su, T. T. *et al.* Level of colorectal cancer awareness: a cross sectional exploratory study among multi-ethnic rural population in Malaysia. *BMC Cancer***13**, 376, doi:10.1186/1471-2407-13-376 (2013).
- 40 Sessa, A., Abbate, R., Di Giuseppe, G., Marinelli, P. & Angelillo, I. F. Knowledge, attitudes, and preventive practices about colorectal cancer among adults in an area of Southern Italy. *BMC Cancer***8**, 171, doi:10.1186/1471-2407-8-171 (2008).
- 41 Alyabsi, M., Alhumaid, A., Allah-Bakhsh, H., Alkelya, M. & Aziz, M. A. Colorectal cancer in Saudi Arabia as the proof-of-principle model for implementing strategies of predictive, preventive, and personalized medicine in healthcare. *Epma j***11**, 119-131, doi:10.1007/s13167-019-00186-x (2020).
- 42 Bergin, R. J. *et al.* Rural-Urban Disparities in Time to Diagnosis and Treatment for Colorectal and Breast Cancer. *Cancer Epidemiol Biomarkers Prev***27**, 1036-1046, doi:10.1158/1055-9965.Epi-18-0210 (2018).
- 43 Schlottmann, F., Gaber, C., Strassle, P. D., Charles, A. G. & Patti, M. G. Health care disparities in colorectal and esophageal cancer. *Am J Surg***220**, 415-420, doi:10.1016/j.amjsurg.2019.12.025 (2020).

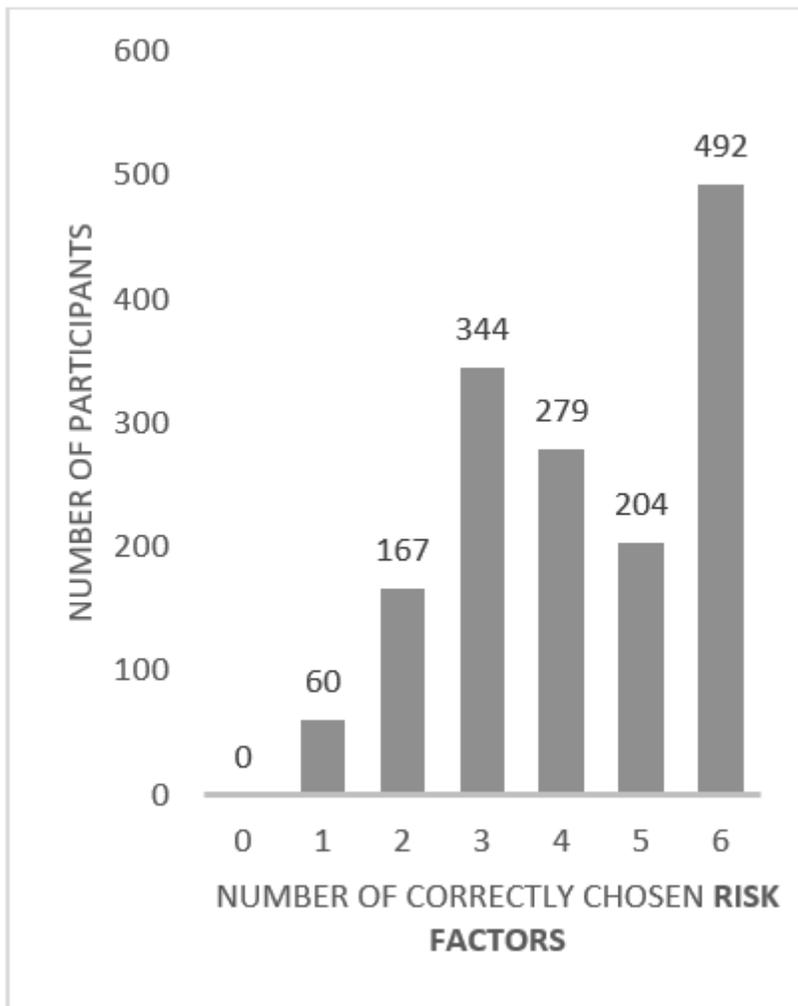
- 44 Enayatrad, M., Yavari, P., Etemad, K., Khodakarim, S. & Mahdavi, S. Association of Urbanization Levels and Colorectal Cancer Incidence in Iran. *Int J Cancer Manag***11**, e68476, doi:10.5812/ijcm.68476 (2018).
- 45 Wen, D. *et al.* Urban-rural disparity in colorectal cancer incidence and increasing trend in relation to socioeconomic development and urbanization in China. *J Int Med Res***46**, 4181-4196, doi:10.1177/0300060518791090 (2018).
- 46 Papanikolaou, I. S. *et al.* Awareness and attitudes of Greek medical students on colorectal cancer screening. *World J Gastrointest Endosc***4**, 513-517, doi:10.4253/wjge.v4.i11.513 (2012).
- 47 Kulkarni, V. *et al.* Colorectal Cancer: How Familiar Are Our Future Doctors with the Cancer of Tomorrow? *Biomed Res Int***2018**, 7462101, doi:10.1155/2018/7462101 (2018).
- 48 Aga, S. S. *et al.* Knowledge & Awareness regarding colorectal cancer among health and allied students of King Saud Bin Abdulaziz University for Health Sciences, Jeddah. *J Family Med Prim Care***10**, 2284-2292, doi:10.4103/jfmpc.jfmpc\_2427\_20 (2021).
- 49 Mhaidat, N. M. *et al.* Knowledge and Awareness of Colorectal Cancer Early Warning Signs and Risk Factors among University Students in Jordan. *J Cancer Educ***33**, 448-456, doi:10.1007/s13187-016-1142-y (2018).
- 50 Matkowski, R., Szelachowska, J., Szewczyk, K., Staszek-Szewczyk, U. & Kornafel, J. Improvements in undergraduate oncology education introduced at Polish medical universities between 2004 and 2010 under Poland's "National Program for Combating Neoplastic Diseases". *J Cancer Educ***29**, 428-433, doi:10.1007/s13187-014-0633-y (2014).
- 51 Wilkerson, L., Lee, M. & Hodgson, C. S. Evaluating curricular effects on medical students' knowledge and self-perceived skills in cancer prevention. *Acad Med***77**, S51-53, doi:10.1097/00001888-200210001-00017 (2002).
- 52 Geller, A. C. *et al.* Evaluation of a cancer prevention and detection curriculum for medical students. *Prev Med***35**, 78-86, doi:10.1006/pmed.2002.1044 (2002).
- 53 Dilly, C. K., Craven, H. J. & Molleston, J. P. Perspectives on Colon Cancer Screening-A Physician Panel Discussion for Preclinical Medical Students. *MedEdPORTAL***16**, 11019, doi:10.15766/mep\_2374-8265.11019 (2020).

## Figures



**Figure 1**

Distribution of correctly chosen CRC symptoms



**Figure 2**

Distribution of correctly chosen CRC risk factors