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Original article

Tumor biology

Knowledge about the European Code Against Cancer, and adherence to the principles of a healthy lifestyle among students in Poland

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Introduction. The European Code Against Cancer (ECAC) was created to reduce the incidence and mortality of cancer. We conducted a study assessing students' knowledge of ECAC, and adherence to healthy lifestyle principles.

Material and methods. The study involved an anonymous validated online survey among the student community of 47 Polish universities. The questions pertained to knowledge about ECAC, awareness of cancer risk factors and health-related behaviours.

Results. A total of 1041 surveys were obtained (65% female). Knowledge of the term ECAC was seen in 9% of non-medical students (NMS) and 19% of medical students (MS). MS demonstrated higher awareness of cancer risk factors, such as smoking, obesity and sedentary lifestyle, and were more knowledgeable about screening tests compared to NMS ($p < 0.001$).

Conclusions. Knowledge about ECAC among Polish students, especially NMS, is insufficient. It is necessary to continue health-promoting initiatives to increase awareness of cancer risk factors, the importance of vaccinations and self-examinations.

Keywords: European Code Against Cancer, cancer, cancer awareness

Introduction

In 2021, the Polish National Cancer Registry recorded approximately 171,558 new cancer cases and 93,652 deaths due to cancer [1]. In 2022, there were approximately 20 million new cancer cases and 9.7 million deaths from cancer globally. Europe faces a disproportionately high burden of cancer, accounting for 22.4% of global cancer cases and 20.4% of cancer deaths, despite having only 9.6% of the world's population [2]. Poland belongs to countries with the highest cancer mortality rates [1]. The European Code Against Cancer (ECAC) was established to decrease cancer risk and cancer-related deaths by promoting prevention and healthy behaviour [3].

Epidemiological observations prove that 80–90% of cancer cases in Western countries are associated with environmental factors [4]. Through the recommendations included in ECAC, about 40% of cancer cases can be prevented by actions that individual citizens can take to help prevent cancer [5].

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Unfortunately, awareness of the ECAC is still uncommon across the general population. [6].

Our study assessed knowledge about the ECAC among Polish students, and examined their approach to healthy lifestyle principles. The aim was to evaluate the awareness and attitudes to cancer prevention and early detection recommendations covered in the ECAC.

Material and methods

The study was gathered on the initiative of the Immunooncology Student Club of The University of Warmia and Mazury in Olsztyn. The research data was based on a voluntary, anonymous online questionnaire sent out to 47 universities across Poland to respond to students studying various disciplines. The study was first sent out on March 14, 2022, and data gathering was concluded on May 21, 2022. The study was promoted through social media and by contacting university dean offices requesting that the survey be promoted. Upon inquiry, The Bioethics Committee confirmed that a formal opinion is unnecessary due to the voluntary nature of the questionnaire.

The questionnaire contained 59 questions. The questionnaire was divided into sections covering participant demographics, main sources of information and daily internet/social media usage. One section assessed awareness of the ECAC and sources of knowledge. Another tested respondents' knowledge of cancer screening tests available in Poland. A section for smokers inquired about tobacco use, while the lifestyle section included questions on diet, weight control, transportation, vaccinations and intentions to use screening programs. The ECAC section evaluated the understanding of cancer prevention and debunked common health misconceptions.

To measure the approach of the responders, the Likert scale was utilized in the construction of the answers as follows "Definitely yes", "Probably yes", "I have no opinion", "Probably not", "Definitely not". Questions were validated by distributing the questionnaire among 19 individuals collecting their responses. The results of validating individual questions are presented as a supplement.

The statistical significance of the relationship between the data gathered from the individual question was ascertained using the chi-square and the Fisher exact test.

Results

Study group characteristics

A total sample of 1041 students (average age: 22.4 years, median: 22.0 years) from 47 Polish universities responded to the survey. The characteristics of the study group is presented in Table I.

Table I. The characteristics of the study group

General information, n (%)		
Gender	Female	680 (65.3%)
	Male	342 (32.9%)
	Do not want to provide information	19 (1.8%)
Year of study	I	267 (25.6%)
	II	275 (26.4%)
	III	218 (20.9%)
	IV	116 (11.1%)
	V	134 (12.9%)
	VI	31 (3.0%)
Field of study	Humanities	267 (25.6%)
	Science	244 (23.4%)
	Medical	157 (15.1%)
	Technical	139 (13.4%)
	Natural Sciences	115 (11.0%)
	Arts	70 (6.7%)
	Finance	43 (4.1%)
	Physical culture	6 (0.6%)
Number of inhabitants	> 100 000	364 (35.0%)
	50 000–100 000	110 (10.6%)
	< 50 000	225 (21.6%)
	Countryside	342 (32.9%)
BMI	< 18.5 (underweight)	95 (9.1%)
	18.5–24.9 (normal)	705 (67.7%)
	25.0–29.9 (overweight)	176 (16.9%)
	> 30.0 (obese)	61 (5.9%)
Chronic disease	No	831 (79.8%)
	Yes	210 (20.2%)
Main source of information	Internet	508 (48.8%)
	Social media	353 (33.9%)
	Radio and TV	68 (6.5%)
	Family	60 (5.8%)
	Specialist literature	37 (3.6%)
	The press	15 (1.4%)

BMI — body mass index

Awareness of European Code Against Cancer

Only 10.7% (n = 111) of responders were familiar with the term of ECAC. Women were more familiar with the ECAC term (13.7%; n = 93) than men (5.0%; n = 17) ($p < 0.001$). The highest familiarity with the ECAC term was found among medical students (MS; medical students, nursing students, midwifery students, emergency medical services students; 19.1%; n = 30). Among non-medical students (NMS), 9.2%

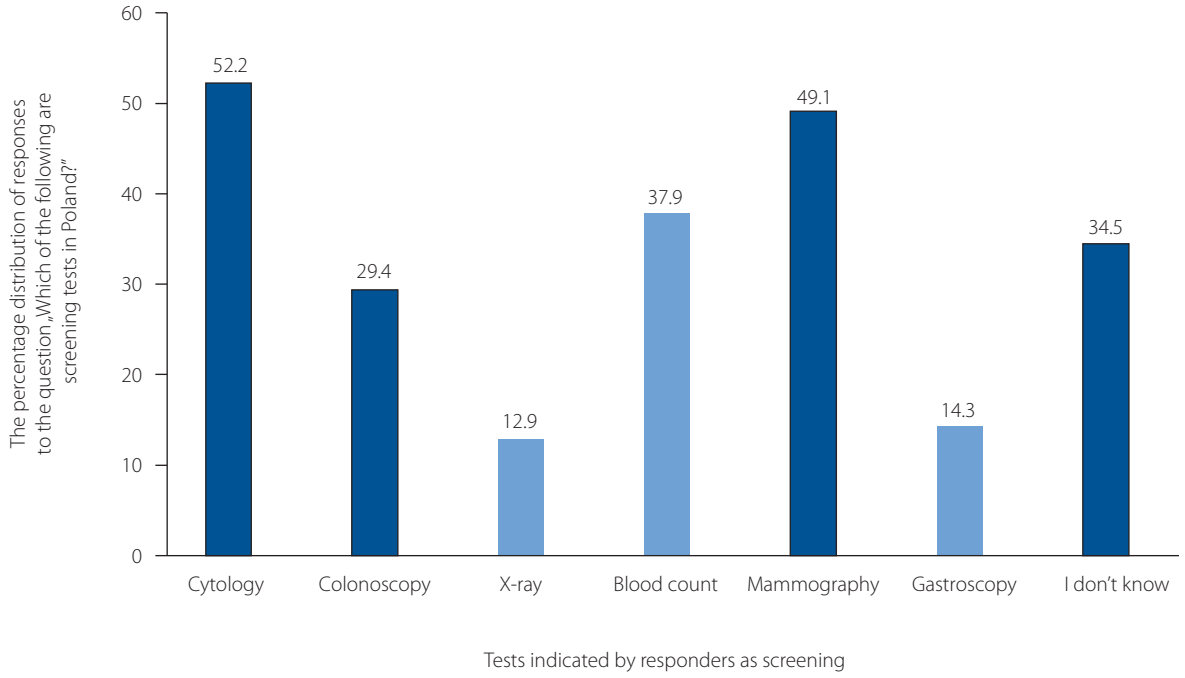

Figure 1. The ability to identify screening studies in Poland

Table II. The ability to correctly identify all screening tests in Poland and associate them with the cancers they detect depending on gender and field of study

	Screening programmes	Cancers	Both cancers and screening programmes
Men	24 (7.0%)	32 (9.4%)	20 (5.9%)
Women	64 (9.4%)	77 (11.3%)	51 (7.5%)
Chose not to disclose	2 (10.5%)	3 (15.8%)	1 (5.3%)
p	0.405	0.473	0.58
Medical	40 (25.5%)	47 (29.9%)	38 (24.2%)
Non-medical	50 (5.7%)	65 (7.4%)	34 (3.9%)
p	< 0.001	< 0.001	< 0.001

(n=81) were aware of the term ECAC ($p < 0.001$). Awareness varied significantly among the different student groups: 0% among physical culture students, 4.1% among science students and 5% among technology students ($p < 0.001$).

Screening test programmes

The majority of students (52.2%; n = 543) correctly chose cytology, mammography 49.1% (n = 511) and colonoscopy as a screening test 29.4% (n = 306). 37.9% of respondents incorrectly considered complete blood count a screening test. Medical students exhibited considerably better knowledge of screening tests than the NMS (Fig. 1). Most students identified breast and cervical cancers as cancers which may be diagnosed through screening tests (Fig. S1). Among MS, 82.8% (n = 130) chose breast and cervical cancers. Colon cancer was identified by 33.4% (n = 348) of the general population and 70.7% (n = 111) of MS. Over one-fourth of MS (25.5%; n = 40) can correctly identify all screening tests in Poland. Nearly the same percentage (24.2%; n = 38) can correctly associate them with the cancers they detect. NMS correctly identified the set of screening tests in only 5.7% (n = 50) and cancers in 7.4% (n = 65) ($p < 0.001$). However, only 3.9% (n = 34) can correctly name both screening tests and the cancers they allow to detect ($p < 0.001$) (Tab. II). Only 2 of first-year students were able to correctly select all screening programs and just 1 was able to select tested for cancers. For students of sixth year, it was 88.9% (n = 8) for both questions ($p < 0.001$) (Tab. SI).

The awareness of cancer risk factors among students

A. Recognition of cancer risk factors: smoking, lifestyle and misconceptions

Smoking was the most commonly recognized cancer risk factor, with 98.2% (n = 1023) indicating either "probably yes" or

Table III. Knowledge of cancer risk factors as listed by European Code Against Cancer (ECAC) among the general population of students

Factor	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Smoking	852 (81.8%)	171 (16.4%)	11 (1.1%)	1 (0.1%)	6 (0.6%)
Obesity	511 (49.1%)	383 (36.8%)	104 (10.0%)	39 (3.7%)	4 (0.4%)
Sedentary lifestyle	308 (29.6%)	393 (37.8%)	224 (21.5%)	109 (10.5%)	7 (0.7%)
Unhealthy eating habits	505 (48.5%)	406 (39.0%)	88 (8.5%)	36 (3.5%)	6 (0.6%)
Drinking alcohol	450 (43.2%)	388 (37.3%)	123 (11.8%)	74 (7.1%)	6 (0.6%)
Harmful substances in the workplace	716 (68.8%)	274 (26.3%)	44 (4.2%)	2 (0.2%)	5 (0.5%)
Radon radiation	333 (32.0%)	314 (30.2%)	302 (29.0%)	78 (7.5%)	14 (1.3%)
Not breastfeeding	55 (5.3%)	94 (9.0%)	417 (40.1%)	332 (31.9%)	143 (13.7%)
Hormone replacement therapy	74 (7.1%)	123 (11.8%)	682 (65.5%)	152 (14.6%)	10 (1.0%)
HPV infection	266 (25.6%)	259 (24.9%)	468 (45.0%)	44 (4.2%)	4 (0.4%)
HBV infection	197 (18.9%)	307 (29.5%)	478 (45.9%)	56 (5.4%)	3 (0.3%)

HBV — hepatitis B virus; HPV — human papilloma virus

"definitely yes" (Tab. III). Over half of the respondents recognized obesity (85.9%, n = 894), a sedentary lifestyle (67.4%, n = 701), unhealthy eating habits (87.5%, n = 911), alcohol consumption (80.5%, n = 838), harmful substances in the workplace (95.1%, n = 990), radon radiation (62.2%, n = 647) and HPV infection (50.5%, n = 525) as carcinogenic. Only 48.4% (n = 504) agreed that HBV infection is a cancer risk factor. Less than one-fifth of the responders agreed that lack of breastfeeding is a cancer risk factor (14.3%, n = 149). Nearly two-thirds (65.5%, n = 682) had no opinion on whether hormone replacement therapy (HRT) is a cancer risk. Furthermore, 34.2% (n = 356) incorrectly believed that consuming genetically modified organisms (GMOs) poses a cancer risk. Regarding remaining popular misconceptions about cancer risks, respondents most commonly agreed with energy drink consumption (56.6%, n = 589). Only 6.4% (n = 67) view 5G technology as a cancer risk, and a minority of students (14.1%, n = 147) agree that dietary supplements decrease the risk of cancer (Tab. SII).

B. Gender differences in perceptions of cancer risk factors

The majority of both men and women agree that smoking (99.1%, n = 339 and 98.0%, n = 666 respectively, p = 0.05), obesity (88.9%, n = 304 and 85.0%, n = 578 respectively, p = 0.009) and radon radiation (56.5%, n = 193 and 64.8%, n = 441, p = 0.021) are cancer risk factors (Tab. SIII). Only 12.2% of men and 15.6% of women agree that lack of breastfeeding increases cancer risk with over half of the men (57.9%, n = 198) marking the "I have no opinion" (p < 0.001). Over half of the women agree that HPV and HBV infections are a cancer risk (54.7%, n = 372 and 53.5%, n = 364) with less than half of men agreeing (42.1%, n = 144 for HPV and 38.3%, n = 131 for HBV) (p = 0.005 and p = 0.003). The minority of both men and women considered HRT as a cancer risk factor (16.6% men and 19.8% women, p < 0.001). Regarding common misconceptions, 27.7% of men and 37.7% of women consider GMO consumption a cancer risk factor (p < 0.001), more women than men think of 5G technology (7.6% and 3.5%, p < 0.001) or energy drink consumption (60.4% and 49.2%, p = 0.019) as cancer risk factors (Tab. SIV).

C. Medical students recognize cancer risk factors better than non-medical students

Medical students recognize cancer risk factors more accurately than NMS. Both groups largely agreed that smoking (MS 99.4%, n = 156; NMS 98.1%, n = 867, p < 0.001), obesity (MS 96.8%, n = 152; NMS 83.9%, n = 742, p < 0.001), unhealthy eating habits (MS 97.4%, n = 153; NMS 85.8%, n = 758, p < 0.001), alcohol consumption (MS 94.9%, n = 149; NMS 77.9%, n = 689, p < 0.001) and sedentary lifestyle (MS 87.3%, n = 137; NMS 63.8%, n = 564, p < 0.001) are cancer risk factors (Tab. SV). However, disparities emerged with other cancer risk factors. About 50% of NMS had no opinion on whether HPV infection (50.5%, n = 446) or HBV infection (50.1%, n = 443) are cancer risk factors. At the same time, 45.3% of NMS and 79.7% of MS recognized HPV infection as a risk factor. Similarly, 44.5% of NMS and 70.7% of MS considered HBV infection a risk factor. The difference in knowledge between both groups was proven to be statistically significant for both HBV and HPV (p < 0.001 for both). Hormone replacement therapy and not breastfeeding were less commonly recognized as risk factors, even among

MS. Only 9.8% of NMS and 39.5% of MS agreed that not breastfeeding is a risk factor ($p < 0.001$). Similarly, 13.9% (n = 123) of NMS and 47.2% (n = 74) of MS considered hormone replacement therapy a risk factor ($p < 0.001$).

Lifestyle habits

A. Lifestyle habits among responders

Smokers made up 18.6% (n = 194) of the respondents. Regarding diet and weight control, 50.4% (n = 525) monitored their body mass index (BMI), and 59.1% (n = 615) reported following healthy eating guidelines. Additionally, 69.3% (n = 721) either did not consume red meat or did so less than once per week, and 94.2% (n = 981) consumed fruits and vegetables daily or at least more than once per week. Over one-third (37.5%, n = 390) were physically active two to three times per week, while 57.5% (n = 599) exercised sporadically.

More than half of the respondents (64.2%, n = 668) abstain from alcohol consumption entirely. Additionally, over half of the respondents (55.2%, n = 575) use ultraviolet radiation (UV) filters and limit their time outdoors between 10 am and 4 pm during summer months. The majority of respondents (66.5%, n = 692) regularly check their skin lesions, but 64.6% (n = 672) do not undergo regular checks at the doctor's office, and 30% (n = 312) do so irregularly. Less than half (49.2%, n = 512) consider potential exposure to carcinogenic hazards when choosing their future careers. Over half of the respondents (51.5%, n = 536) claim they have not been vaccinated against HBV, and 61.6% (n = 641) against HPV, but 84.9% (n = 884) express willingness to vaccinate their children against both.

Among the responding women, 68.6% (n = 432) intend to breastfeed in the future; however, 33.3% (n = 230) do not perform breast self-examinations, and 35.3% (n = 244) do so less than once per month. Additionally, 46.4% (n = 163) of male respondents do not perform testicular self-examinations.

B. Gender differences in lifestyle habits

Over half of the women (54.1%, n = 368) control their BMI and attempt to maintain it within the healthy range, meanwhile, less than half of men do so (43.9%, n = 150; $p = 0.004$). Additionally, almost two-thirds of women and over half of male responders follow healthy eating guidelines (62.8%, n = 427, and 52.0%, n = 178 respectively; $p = 0.003$). Over 75 percent of women do not consume red meat or do so less than once per week (77.5%, n = 527) while more than half of men do so (51.8%, n = 177; $p < 0.001$). A similar difference was in reported daily consumption of fruit and vegetables (75.7%, n = 515 of women and 58.2%, n = 199 of men; $p < 0.001$). Over half of both men and women abstain from alcohol, but for women, it is a more common choice (68.4%, n = 465 for women and 55.8%, n = 191 for men; $p < 0.001$). Just under 66% (65.6%, n = 446) of women use UV light protection filters, with less than 35% (34,8%, n = 119) of men doing so ($p < 0.001$). Additionally, when it comes to checking their skin lesions, 72.1% (n = 490) of women and 55.6% (n = 190) of men do that ($p < 0.001$). However, none of the male responders (0,0%, n = 0) use solariums, while 3.2% (n = 22) of women do ($p = 0.014$) (Tab. IV).

Table IV. Habits or lifestyle choices of all responders

Lifestyle habits	Answer	n (%)	Gender			p	Field of study		p
			Female	Male	Indeterminate sex		Non-medical	Medical	
Smoking, n (%)	No	847 (81.4%)	555 (81.6%)	279 (81.6%)	13 (68.4%)	0.343	716 (81.0%)	131 (83.4%)	0.469
	Yes	194 (18.6%)	125 (18.4%)	63 (18.4%)	6 (31.6%)		168 (19.0%)	26 (16.6%)	
Controlling/ /examining BMI (to be 18.5–24.9 kg/ /m^2), n (%)	No	516 (49.6%)	312 (45.9%)	192 (56.1%)	12 (62.3%)	< 0.001	463 (52.4%)	53 (33.8%)	< 0.001
	Yes	525 (50.4%)	368 (54.1%)	150 (43.9%)	7 (36.8%)		421 (47.6%)	104 (66.2%)	
Healthy eating habits, n (%)	No	426 (40.9%)	253 (37.2%)	164 (48.0%)	9 (47.4%)	0.003	383 (43.3%)	43 (27.4%)	< 0.001
	Yes	615 (59.1%)	427 (62.8%)	178 (52.0%)	10 (52.6%)		501 (56.7%)	114 (72.6%)	
Red meat consumption, n (%)	None	256 (24.6%)	214 (31.5%)	32 (9.4%)	10 (52.6%)	< 0.001	213 (24.1%)	43 (27.4%)	0.027
	Less than 1/week	465 (44.7%)	313 (46.0%)	145 (42.4%)	7 (36.8%)		384 (43.4%)	81 (51.6%)	
	More than 1/week	247 (23.7%)	127 (18.7%)	119 (34.8%)	1 (5.3%)		219 (24.8%)	28 (17.8%)	
	Daily	73 (7.0%)	26 (3.8%)	46 (13.5%)	1 (5.3%)		68 (7.7%)	5 (3.2%)	

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Table IV cont. Habits or lifestyle choices of all responders

Lifestyle habits	Answer	n (%)	Gender			p	Field of study		p
			Female	Male	Indeterminate sex		Non-medical	Medical	
Fruit and vegetable consumption, n (%)	None	4 (0.4%)	0 (0.0%)	4 (1.2%)	0 (0.0%)	< 0.001	4 (0.5%)	0 (0.0%)	0.005
	Less than 1/week	56 (5.4%)	24 (3.5%)	30 (8.8%)	2 (10.5%)		55 (6.2%)	1 (0.6%)	
	More than 1/week	255 (24.5%)	141 (20.7%)	109 (31.9%)	5 (26.3%)		224 (25.3%)	31 (19.7%)	
	Daily	726 (69.7%)	515 (75.7%)	199 (58.2%)	12 (63.2%)		601 (68.0%)	125 (79.6%)	
Physical activity, n (%)	None	52 (5.0%)	33 (4.9%)	18 (5.3%)	1 (5.3%)	0.182	46 (5.2%)	6 (3.8%)	< 0.001
	Occasionally	599 (57.5%)	410 (60.3%)	179 (52.3%)	10 (52.6%)		531 (60.1%)	68 (43.3%)	
	More than 2 or 3/week	390 (37.5%)	237 (34.9%)	145 (42.4%)	8 (42.1%)		307 (34.7%)	83 (52.9%)	
Alcohol consumption, n (%)	None	668 (64.2%)	465 (68.4%)	191 (55.8%)	12 (63.2%)	0.002	557 (63.0%)	111 (70.7%)	0.411
	1–2 units per week	19 (1.8%)	8 (1.2%)	11 (3.2%)	0 (0.0%)		17 (1.9%)	2 (1.3%)	
	Less than 5 units per week	274 (26.3%)	173 (25.4%)	96 (28.1%)	5 (26.3%)		240 (27.1%)	34 (21.7%)	
	More than 5 units per week	58 (5.6%)	29 (4.3%)	28 (8.2%)	1 (5.3%)		49 (5.5%)	9 (5.7%)	
	More than 10 units per week	19 (1.8%)	3 (0.4%)	16 (4.7%)	0 (0.0%)		18 (2.0%)	1 (0.6%)	
	More than 3 units daily	3 (0.3%)	2 (0.03%)	0 (0.0%)	1 (5.3%)		3 (0.3%)	0 (0.0%)	
Using UV light protection filters, n (%)	No	466 (44.8%)	234 (34.4%)	223 (65.2%)	9 (47.4%)	< 0.001	405 (45.8%)	61 (38.9%)	0.106
	Yes	575 (55.2%)	446 (65.6%)	119 (34.8%)	10 (52.6%)		479 (54.2%)	96 (61.1%)	
Limiting sun exposure between 10am and 4pm during summer months, n (%)	No	511 (49.1%)	323 (47.5%)	182 (53.2%)	6 (31.6%)	0.069	423 (47.9%)	88 (56.1%)	0.058
	Yes	530 (50.9%)	357 (52.5%)	160 (46.8%)	13 (68.4%)		461 (52.1%)	69 (43.9%)	
Checking skin lesions, n (%)	No	349 (33.5%)	190 (27.9%)	152 (44.4%)	7 (36.8%)	< 0.001	321 (36.3%)	28 (17.8%)	< 0.001
	Yes	692 (66.5%)	490 (72.1%)	190 (55.6%)	12 (63.2%)		563 (63.7%)	129 (82.2%)	
Taking harmful substances in future workplace into consideration, n (%)	No	529 (50.8%)	358 (52.6%)	161 (47.1%)	10 (52.6%)	0.240	469 (53.1%)	60 (38.2%)	< 0.001
	Yes	512 (49.8%	322 (47.4%)	181 (52.9%)	9 (47.4%)		415 (46.9%)	97 (61.8%)	
HBV vaccinee, n (%)	No	536 (51.5%)	334 (49.1%)	191 (55.8%)	11 (57.9%)	0.108	505 (57.1%)	31 (19.7%)	< 0.001
	Yes	505 (48.5%)	346 (50.9%)	151 (44.2%)	8 (42.1%)		379 (42.9%)	126 (80.3%)	
HPV vaccinee, n (%)	No	641 (61.6%)	405 (59.6%)	224 (65.6%)	12 (63.2%)	0.182	555 (62.8%)	86 (54.8%)	0.057
	Yes	400 (38.4%)	275 (40.4%)	118 (34.5%)	7 (36.8%)		329 (37.2%)	71 (45.2%)	
Planning to vaccinate a child against HBV and HPV, n (%)	No	157 (15.1%)	104 (15.3%)	50 (14.6%)	3 (15.8%)	0.957	149 (16.9%)	8 (5.1%)	< 0.001
	Yes	884 (84.9%)	576 (84.7%)	292 (85.4%)	16 (84.2%)		735 (83.1%)	149 (94.9%)	

BMI — body mass index; HBV — hepatitis B virus; HPV — human papilloma virus; UV — ultraviolet radiation

C. Differences in lifestyle habits between MS and NMS

Smoking was reported by 16.6% (n = 26) of MS and 19.0% (n = 168) of NMS, with no statistically significant difference proven between those two groups. Almost two-thirds of MS (66.2%, n = 104) control their BMI to maintain it within the range of 18.5–24.9 kg/m^2. However, less than half of NMS (47.6%, n = 421) do so ($p < 0.001$). Most MS (52.9%, n = 83) are physically active 2 to 3 times a week, with an additional 43.3% (n = 68) reporting sporadic activity. For NMS, the reported numbers were 34.7% (n = 307) and 60.1% (n = 531), respectively ($p < 0.001$). Nearly three-quarters (72.6%, n = 114) of MS and 56.7% (n = 501) of NMS report having healthy eating habits ($p < 0.001$).

The majority of responders consume fresh fruits and vegetables daily — 79.6% (n = 125) for MS and 68.0% (n = 601) for NMS ($p < 0.001$). Additionally, 19.7% (n = 31) of MS and 25.3% (n = 224) of NMS consume them more than once per week. The majority of both MS (82.2%, n = 129) and NMS (63.7%, n = 563) check their skin lesions ($p < 0.001$). However, most respondents do not have regular skin lesion checks at a doctor's office — 51.6% (n = 81) for MS and 66.9% (n = 591) for NMS, or they do so irregularly – 42.0% (n = 81) and 27.8% (n = 246) respectively ($p < 0.001$ for comparison of the groups in both of these regards). Over half of MS (61.8%, n = 97) consider the risk of exposure to hazards such as asbestos, benzene, arsenic, or engine exhaust fumes when choosing future career paths, while less than half of NMS do so (46.9%, n = 415) ($p < 0.001$). A minority of NMS report being vaccinated against HBV — 42.9% (n = 379), with 80.3% (n = 126) MS doing so ($p < 0.001$) (Tab. IV).

Testicular self-examinations are performed once per month by 26.9% (n = 84) of NMS compared to 46.2% (n = 18) MS, less than once a month by 23.4% (n = 73) of NMS and 33.3% (n = 13) of MS and never by 49.7% (n = 155) of NMS and 20.5% (n = 8) of MS ($p = 0.002$). Regarding breast self-examination, 10.3% (n = 59) of NMS and 17.9% (n = 21) of MS perform it correctly, which means once a month, 2–3 days after their period. Some of them perform it regardless of the period timing — 19.7% (n = 113) of NMS and 20.5% (n = 24) of MS or less than once a month — 34.8% (n = 200) of NMS and 37.6% (n = 44) of MS. On the other hand, 35.2% (n = 202) of NMS and 23.9% (n = 28) do not perform breast self-examination at all ($p = 0.031$).

Embracing screening tests programs and future decisions

Regarding declarations of participating in screening programs, 86.0% (n = 592) of all responding women already participate or are planning to participate in the cytology screening program, and for mammography, 93.9% (n = 644) are willing to join the program. For the colonoscopy program, it was 66.3% (n = 690) of all students. Willingness to in the future vaccinate their children against HPV and HBV was declared by 84.9% (n = 884) of all participants.

When declaring participating in a screening colonoscopy, 67.1% (n = 456) of women and 64.6% (n = 221) of men are willing to do so. Over 80% of both men (85.4%, n = 292) and women (84.7%, n = 576) would be willing to vaccinate their children against HBV and HPV ($p = 0.957$).

In the mammography screening program, 93.0% (n = 528) of NMS and 98.3% (n = 116) of MS plan to participate ($p = 0.027$). In the cytology program, 85.1% (n = 485) of NMS and 90.7% (n = 107) of MS are participating or intend to participate ($p = 0.111$). In the colorectal cancer screening program, which involves both women and men, 63.9% of NMS and 79.6% of MS plan to participate in the future ($p < 0.001$) (Supp. Tab. VII). The majority of both MS (94.9%) and NMS (83.1%) declare willingness to vaccinate their children against HPV or HBV ($p < 0.001$) (Tab. IV).

Discussion

This study aimed to assess the awareness of these recommendations among Polish students, and determine what actions should be taken to increase this awareness, disseminate the code and encourage adherence to its guidelines.

It showed that the general awareness of the ECAC was limited. In the study, only 10.7% of responders were familiar with ECAC. We achieved similar results regarding familiarity with the term ECAC compared to the study by D. Ritchie et al., which collected data from eight European countries (Finland, France, The Republic of Ireland, The United Kingdom, Hungary, Poland, Portugal, Spain) [5, 7].

Awareness of the impact of lifestyle on the risk of developing cancer is higher in the population of MS compared to NMS. For almost all factors, a higher percentage of MS indicated more substantial agreement with the statements compared to NMS. Factors like smoking, obesity, sedentary lifestyle, unhealthy eating habits, drinking alcohol, harmful substances in the workplace, not breastfeeding, hormone replacement therapy, HPV and HBV infection show significant differences in agreement between MS and NMS ($p < 0.001$).

Medical students have greater knowledge about biological threats like HBV and HPV infection, which may influence the results obtained in this group regarding the willingness to be vaccinated against HBV and HPV.

Nearly two-thirds of students had no opinion about hormone replacement therapy (HRT) as a cancer risk factor. The young age and lack of need for HRT translate into low knowledge and awareness on this topic.

More than a quarter of MS are able to identify screening tests and the corresponding cancers. Among NMS students awareness is dramatically low. This may be primarily due to the relatively young age of the respondents and insufficient education. That is also related to the availability of screening programs for people older than the student population. In our

study, due to the insufficient age for participation in screening tests, we could only examine the aspiration of embracing them, and the vast majority of both MS and NMS expressed a desire to participate in the future. This means that although awareness of the available tests is low, young people wish to undergo screening to prevent and detect cancer early. After the 4th year of medical studies, awareness is significantly higher. This is likely due to the start of clinical courses in oncology and other subjects that address public health and cancer prevention topics.

A serious and urgent problem appears to be the lack of awareness about self-examinations. According to our study, 33.3% of female responders do not perform breast self-examinations which is consistent with the literature [8]. Among male respondents, almost half do not perform testicular self-examinations. Gutema et al. [9] asked students whether they had performed a testicular self-examination within the past year, receiving a negative response from nearly 90%. According to the authors, this is due to a lack of proper preparation, information and communication with students, and most importantly, a lack of know-how tailored to the students' behaviour model [9].

The respondents, students are a group of young people who is the most subject to all of confusing, misleading and even contradictory information about disease prevention and healthy life rules being presented nowadays in multiple social media and other media streams. In the face of lack of consistency, a professional source of reliable information, based on scientific evidence is priceless [10].

Medical students constitute a specific target group, as research says that the lack of encouragement by family members and physicians is one of the factors that strongly affects patients' will to participate in cancer screening programs [10]. Future physicians, nurses and other health professionals should know the terms of ECAC, and acquire the relevant skills to interest patients in healthy lifestyle.

The benefit of our study lies in providing evidence regarding the awareness of the participants about a healthy lifestyle, as well as their knowledge of risk factors for cancer development. This information can contribute to the promotion and advocacy of measures that enable a reduction in the incidence of cancer, as well as early detection of tumours, among both participants and their families.

Limitations

Due to the voluntary nature of participation, we gathered a very heterogeneous group consisting of students from various fields and cities.

Conclusions

Knowledge about the European Code Against Cancer (ECAC) within the Polish student community is insufficient. Despite a weak understanding of risk factors, a significant portion of students either utilize or intend to undergo preventive screening tests. This indicates that awareness and knowledge about cancer comes from sources other than ECAC, justifying the need to increase resources for promoting ECAC, and modifying its principles based on ongoing research.

Article information and declarations

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

Ethics statement

The research was conducted in accordance with the principles embodied in the Declaration of Helsinki and the Bioethics Committee has confirmed that a formal opinion is unnecessary due to the voluntary nature of the questionnaire.

Authors contributions

M.L., B.A.P.: conceptualization, data curation, investigation, project administration, resources, visualization, writing — original draft preparation, writing — review & editing.
A.Cz.: conceptualization, data curation, formal analysis, methodology, validation, writing — original draft preparation.
D.S.: conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, supervision, validation, visualization, writing — original draft preparation, writing — review & editing.
P.S.: formal analysis, methodology, validation, writing — review & editing; S.N.: supervision, writing — review & editing.

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Conflict of interest

The authors declare no conflict of interest.

Supplementary material

The supplementary materials, including tables and figures, are available online.

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