

German High School Students' Attitudes and Interest in Cancer and Factors Influencing Proactive Behaviour for Cancer Prevention

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Abstract Cancer diseases are pertinent topics to young people, who are confronted with the issue through media or family members that suffer from these diseases. Based on a paper-and-pencil questionnaire, we investigated German high school students' ($N=369$, 16–18 years old) interest in and their attitudes towards cancer. Attitude was assessed measuring multiple dimensions that included scales to measure several components: the cognitive (beliefs about the controllability of cancer), the affective (emotional responses towards cancer) and the behavioural (intention for proactive behaviour towards cancer) components. A student assessment of carcinogenic risk factor was executed. Our results suggest that students' willingness to deal with the topic cancer (e.g. to communicate about cancer or to reconsider their lifestyle) is highly dependent on their interest, their emotional responses and their beliefs about the controllability of cancer. Their assessment of carcinogenic risk factors does not have a direct influence on their intentions to behave proactively against cancer but might have an indirect influence on their beliefs about the controllability of cancer. Based on these results, we have drawn teaching implications and discussed which factors should be included in teaching processes in order to stimulate proactive behaviour related to cancer prevention.

Keywords Risk factors · Scientific literacy · Educational implications, Tri-partite model of attitudes

Introduction

In *The Emperor of all Maladies*, Siddhartha Mukherjee underlines the importance of cancer in 4,000 years of (human) history and its enormous impact on individuals, families and societies [1]. Cancer poses a main challenge to science and technology and is a “major public health problem” [2].

From the perspective of teaching cell biology, cancer provides an opportunity to learn about the impact of genetic mutations on the regulation of cell growth and cell division, as well as the importance of DNA repair and apoptosis. Furthermore, cancer should not be taught from the perspective of just being abnormal growth of cells but also consider the range of characteristics of cancer cells, which Hanahan and Weinberg summarized as “hallmarks of cancer”, with tissue invasion and metastasis or sustained angiogenesis among others [3, 4].

From a societal perspective, cancer diseases are epidemiologically relevant. Following cardiovascular diseases, cancer is the second most common disease in Germany [5] and other countries (e.g. USA or Asian countries), which is why cancer is called a “global burden” [6]. One out of 500 children is diagnosed with a malignant neoplasm before his/her 15th birthday, often in the form of leukaemia or tumours of the central nervous system [5]. For that reason, cancer diseases are pertinent topics also to young people, who are confronted with the issue via media or family members that suffer from the disease.

Understanding the relevance of cancer requires “scientific competencies”, e.g. the ability to explain phenomena like metastasis and to be able to assess different risk factors of carcinogenesis [7]. Thus, cancer is related to central issues currently discussed in relation to scientific literacy. According to Bybee et al. [7], “scientific literacy includes the ability to apply scientific understanding to life situations involving science.”

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During the last 10 to 15 years, cancer has become an optional content of curricula in Germany as well as in other countries. This implies that teachers can choose to teach the topic, which directly leads to the question “how” the topic should be dealt with in the classroom. A majority of teachers in a British study are willing to practise cancer education in schools [8]. However, Carey describes that teachers “do not feel confident enough to attempt [teaching] cancer because of their own lack of knowledge” [9]. Moreover, Cribb revealed an “attitudinal resistance” and an emotional barrier when thinking about teaching cancer due to personal emotional attitudes towards the topic [8]. Other critical voices have expressed concerns and argued that dealing with cancer can frighten pupils [8, 10].

The cancer topic carries indeed negative connotations as shown by Oakley et al. who examined knowledge and beliefs of British learners aged 9 to 16 through analysis of drawings and interviews [11]. Predominantly negative aspects (“cancer is bad for you”, “cancer is an illness which can kill you”) were found. On the other hand, cancer education material is designed in order to decrease this fear [12] which can also help to demystify the issues around cancer [9]. In the words of Nichols et al., it should be a “key goal of cancer education to encourage primary prevention and health-promoting decisions” [13].

Research Questions

Our research approach is based on the educational potential of cancer diseases for biology instruction as mentioned above. Several studies indicate that teaching about cancer can improve behaviour related to knowledge (e.g. risk factors) and prevention of cancer and can further change attitudes in a more protective direction [14–16]. In answering the question of what the key predictors that influence successful handling of this topic in school are, one is intuitively apt to say that the knowledge of carcinogenic risk factors plays an important role. A majority of all cancers could be prevented if people would integrate their knowledge of cancer risk factors into their lifestyle [17]. Given that reflecting on risk factors implies making adequate decisions early in life and repeatedly throughout life [16], we examined whether students saw a relation between cancer and particular carcinogenic and non-carcinogenic risk factors, e.g. smoking cigarettes or contact with cancer patients. We define the term “carcinogenic risk factor” as a factor that benefits carcinogenesis or has been shown to raise the risk of carcinogenesis.

Research in science education suggests that besides this cognitive component, the affective domain is likewise meaningful for teaching, learning and information processing [18, 19]. Regarding cancer, this implies that responsible decision-making is influenced by the knowledge as well as by the feelings about cancer [16]. Attitudes, which are classified in

the affective domain, can be characterized as a *certain entity* being evaluated with some degree of favour or disfavour as described in the model of Eagly and Chaiken [20]. The authors argue that attitudes can be understood as a product of cognitive, affective and behavioural processes and manifest themselves as cognitive, affective and behavioural responses [20]. For that reason, we examined how students rate statements towards cancer with relation to the cognitive, affective and behavioural dimension of attitudes. The cognitive component subsumes beliefs, thoughts and attributes towards an object [19]. An example for the cognitive dimension of attitude is the statement “I think suffering from cancer is one’s own fault”. It should be considered that the investigation of the cognitive component of attitudes towards cancer and the assessment of risk factors differ. Speaking in other words, both constructs are based on knowledge, but the cognitive dimension of attitudes is measured with a rating scale (because attitudes can neither be right nor wrong) from “fully agree” to “disagree”, whereas risk factors are rated with “yes” or “no” (because they can be clearly divided in these categories). The affective dimension represents feelings and emotions towards an issue (e.g. “thinking about getting cancer makes me feel anxious”). The behavioural dimension encompasses actions with respect to the attitude object and likewise intentions to act, not necessarily expressed in overt behaviour [20]. An example is the statement “Thinking about cancer motivates me to live a healthier life”.

Interest as part of the affective dimension is known to have a strong influence on learning and is understood as an enduring person-object relationship within science education [21]. Research has proven that interest is person specific and that it depends on a context and is often associated with positive emotions and curiosity, respectively, which fits better to the context of diseases [21]. Studies dealing with student interest in science, technology and science education are mentioned in the international Relevance of Science Education (ROSE) project. For Germany and Austria, Elster showed that the topic “cancer what we know and how we can treat it” is rated as the second most interesting topic by female students. In contrast, male students rated one cancer-related topic (“how radioactivity affects the human body”) in their top 15 list only [22]. Given these results, our study examines which aspects of cancer triggers most interest and whether interest is gender specific. To summarize, we address the following research questions:

RQ1: Do students see a relation between cancer and particular carcinogenic and non-carcinogenic risk factors?

RQ2: How do students rate statements towards cancer in relation to the cognitive, affective and behavioural dimension of attitudes?

RQ3: Which aspects of cancer trigger most interest and is this interest gender specific?

Correlations (Spearman's rho) were performed in order to identify relationships between the three dimensions of attitude, student interest and the assessment of risk factors. By linear regression, we examine which of these factors (independent variables: "interest in cancer", "beliefs about the controllability of cancer" and "negative emotional responses") are the best predictors for influencing the behavioural dimension of attitudes (dependent variable: "intention for proactive behaviour towards cancer").

Methodology

Our study is based on a paper-and-pencil questionnaire, which was administered in biology classes of eight randomly chosen secondary schools in urban and suburban areas of North Rhine-Westphalia (Germany, $N=369$ students; 54.7 % female, 43.9 % male), aged 16–18 years old. Biology teachers managed the procedure, and students were not able to confer during processing. The students aim for the Abitur [diploma from German secondary school], which qualifies for university admission or matriculation. More than 76 % of our participants did not handle cancer as topic in biology class before the date of study. Furthermore, 70 % of all students indicate that they know at least one person within family diagnosed with cancer. With the exception of gender and age, no personal data was gained in order to assure anonymity. Study participation and indication of data was voluntary such that ethical clearance was kept in mind. In preparation of the study, the questionnaire was appraised by the principals of the participating schools in order to check their approval with the questions asked.

Data about ethnicity and socioeconomic status were not raised. For data analysis, the software SPSS 20 was used.

To examine if students see a connection between cancer and a particular risk factor, a preliminary dichotomous scale (1=yes, 0=no) with 24 risk factors (10 carcinogenic, 14 non-carcinogenic) was construed. The internal consistency of this scale was $\alpha=.71$ (Cronbach's alpha). In order to assure the correctness of the risk factors, the list of 24 risk factors was reviewed by five medical experts. Their opinions towards carcinogenicity differ, e.g. if "electromagnetic pollution" or "being stressed" is carcinogenic or not. Due to this, we chose only the risk factors that were clearly assigned by all the medical experts to be included as carcinogenic in our study.

As shown in Table 1, we used adverbs ("often" and "excessively") in the questionnaire of the risk factors twice. We are aware of the fact that using the adverbs may be ambiguous and/or leading (e.g. "going to the solarium often" and "going to the solarium sometimes" have a different meaning). On the one hand, there are factors such as alcohol, smoking or exposure to X-ray radiation which are definitely known to be carcinogenic risk factors and do not need any strengthening; health education in school addresses these

factors as well. On the other hand, visiting the solarium moderately and exposure to sunlight are not per se risk factors; thus, we decided to use the adverbs to give the respective risk factor more emphasis.

In line with the tripartite model of attitudes [20], we developed items that represent the three different attitudinal dimensions (cognitive, affective and behavioural). Using a four-point rating scale (1=disagree to 4=agree), a mean value below 2.5 indicates that the students decline the statement, whereas a mean value over 2.5 shows that the students agree with the statement.

The cognitive dimension includes five items and can be summarized as "beliefs about the controllability of cancer" (see Table 2). The internal consistency of this scale, calculated using Cronbach's alpha, was $\alpha=.62$. In regard to the affective dimension of attitude, a scale characterized as "negative emotional responses towards cancer" with seven items was construed ($\alpha=.89$). The behavioural dimension of attitude included eight items ($\alpha=.78$) and can be described as "intentions for proactive behaviour towards cancer". This scale can be subdivided, and confirmatory factor analyses (rotation method: Varimax with Kaiser normalization, rotation converged in five iterations) lead to the subdivision of three different subscales: (1) "communicating" (four items, $\alpha=.78$), (2) "social engagement" (two items, $\alpha=.83$) and (3) "lifestyle choices" (two items, $\alpha=.73$).

Student interest towards cancer was examined with a four-point rating scale (1=not interesting to 4=very interesting). Using 25 items, we investigated student interest in cancer: in general, epidemiologically, importance of cancer types (e.g. skin cancer or lung cancer), symptoms of cancer and cancer therapy. The internal consistency of the interest scale, calculated using Cronbach's alpha, was $\alpha=.95$.

Results

The majority of students identified most of the carcinogenic risk factors correctly (Table 1) e.g. "going to the solarium often" (rated as carcinogenic by 95.4 %), "excessively exposed to sunlight" (92.4 %), "smoking cigarettes" (92.1 %), "radioactive radiation" (90.0 %), "ultraviolet radiation" (86.7 %) and "X-ray radiation" (85.1 %). Students correctly identified non-carcinogenic factors as well, e.g. "contact with cancer patients" (1.4 %), "frequent common cold" (1.6 %) and "hypertension" (6.0 %). However, there was a range of uncertainty by students about certain carcinogenic risk factors which are known to increase the risk of contracting cancer: "smoking the hookah" (70.2 %), "drinking alcohol" (55.8 %) and "overweight" (18.7 %).

Attitudes towards cancer, divided by the three subscales, revealed the following picture. The scale "beliefs about the controllability of cancer" (cognitive dimension of attitudes)

Table 1 Do students see a relationship between cancer and this particular risk factor?

Risk factor	Percentage	Risk factor	Percentage
Going to the solarium often ^a	95.4	Numerous birthmarks ^b	62.3
Excessively exposed to sunlight ^a	92.4	Drinking alcohol ^a	55.8
Smoking cigarettes, cigars or cigarillos ^a	92.1	Consuming drugs ^b	51.8
Radioactive radiation ^a	90.0	Overweight ^a	18.7
Ultraviolet radiation ^a	86.7	Hypertension ^b	6.0
X-ray radiation ^a	85.1	Frequent common cold ^b	1.6
Smoking the hookah ^a	70.2	Contact with cancer patients ^b	1.4

Selected items, dichotomous scale (0=no, 1=yes) converted in percentage values, $N=369$

^a carcinogenic risk factor

^b non-carcinogenic risk factor

showed a mean value of $M=2.10$ ($SD=.55$) (see Table 2) suggesting that students do not think that they have a great influence on contracting cancer. Nevertheless, students tended to agree with the statement “I think, suffering from cancer is a

result of lifestyle” ($M=2.77$; $SD=.87$), which indicated that students felt empowered to confront cancer through lifestyle choices up to a certain point. No gender differences were found. The scale “negative emotional responses towards

Table 2 How do students evaluate statements towards cancer?

Scales with items	Total	SD	Male	SD	Female	SD	Item-total-correlation
Beliefs about the controllability of cancer (cognitive dimension of attitudes)	2.10	.55	2.16	.61	2.06	.50	U test $p=.273$
I think, suffering from cancer is one's own fault	2.16	.88	2.31	.93	2.04	.82	.343
I think, suffering from cancer is a question of proper nutrition	2.17	.84	2.19	.90	2.15	.79	.478
I think, suffering from cancer is a result of lifestyle	2.77	.87	2.85	.92	2.71	.82	.455
I think, suffering from cancer is a question of mental attitude	1.87	.89	1.81	.95	1.91	.85	.348
I think, suffering from cancer is a question of personality	1.51	.76	1.56	.86	1.48	.67	.233
Negative emotional responses towards cancer (affective dimension of attitudes)	2.91	.73	2.61	.74	3.15	.62	U test $p=.000***$
Faced with the idea of getting cancer I feel depressed	2.95	.97	2.73	1.04	3.13	.88	.681
Thinking about cancer I have negative thoughts	3.47	.79	3.30	.93	3.61	.63	.617
Thinking about getting cancer makes me feel anxious	2.64	.97	2.27	.96	2.94	.88	.783
Faced with the idea of getting cancer I feel uncertain	2.77	.97	2.48	1.00	3.00	.87	.787
Thinking about cancer, I feel worried	2.85	.93	2.52	.94	3.12	.83	.765
Thinking about cancer, I feel sad	2.52	1.00	2.12	.90	2.85	.95	.648
Cancer diseases make me feel scared	3.13	.91	2.84	.93	3.37	.83	.523
Intentions for proactive behaviour towards cancer (behavioural dimension of attitudes)	2.40	.55	2.23	.56	2.55	.50	U test $p=.000***$
The idea of getting cancer motivates me to talk about it with my parents [1]	2.17	.91	1.97	.87	2.34	.91	.373
The idea of getting cancer motivates me to gather information about the issue [1]	2.67	.86	2.49	.86	2.81	.84	.579
The idea of getting cancer motivates me to speak with my friends about my anxieties [1]	2.09	.80	1.93	.81	2.21	.78	.561
The idea of getting cancer motivates me to talk with affected persons [1]	2.32	.91	2.15	.90	2.45	.89	.505
The idea of getting cancer motivates me to live a healthier life [2]	2.77	.87	2.68	.93	2.84	.81	.546
The idea of getting cancer motivates me to change my way of life [2]	2.28	.87	2.15	.91	2.39	.82	.438
The idea of getting cancer motivates me to donate for German Cancer Aid [3]	2.28	.84	2.06	.82	2.47	.80	.402
The idea of getting cancer motivates me to participate for children with cancer [3]	2.63	.93	2.34	.89	2.87	.88	.487

Four-point rating scale, 1=disagree to 4=agree; $N=369$; Mann-Whitney U , values are mean value; SD Standard Deviation; boundary level of item-total-correlation coefficient ≥ 0.20

[1] subscale “communication”, [2] subscale “lifestyle choices”, [3] subscale “social engagement”

*** $p \leq .001$ level is highly significant

cancer” (affective dimension of attitude) showed a mean value of $M=2.91$ ($SD=.73$) providing support that students rated cancer with negative emotions (Table 2). Female students rated cancer as having a significantly stronger connection to negative emotional responses ($M_{female}=3.15$; $SD=.62$, $p\leq.001$) than male students ($M_{male}=2.61$; $SD=.74$). The mean value of the scale “intentions for proactive behaviour towards cancer” was $M=2.40$ ($SD=.55$). Students rather declined intentions for proactive behaviour towards cancer (Table 2). Having a closer look at the mean values of the three subscales “communication”, “lifestyle choices” and “social engagement” (see methodology) and distinguishing them by gender, it was obvious that male students were more likely to decline communication about cancer ($p\leq.001$), social engagement towards cancer ($p\leq.001$) and lifestyle choices for proactive behaviour ($p\leq.05$) than female students.

We found a rather high interest towards the topic cancer ($M=2.75$; $SD=.53$). There were significant ($p\leq.001$) differences between female and male students, with female students showing higher interest ($M_{female}=2.88$; $SD=.45$) than male students ($M_{male}=2.57$; $SD=.57$).

The three types of cancer that trigger the most interest in our sample are brain tumours ($M=3.31$; $SD=.75$), leukaemia ($M=3.15$; $SD=.85$) and skin cancer ($M=3.05$; $SD=.81$) (see

Table 3). Similarly, a high interest in symptoms of cancer disease ($M=3.34$; $SD=.76$) and in cancer genesis ($M=3.28$; $SD=.74$) is found. Cancer therapy ($M=3.05$; $SD=.77$) and its different types trigger interest as well.

Correlation analysis showed that interest is positively correlated with all three subscales of the scale “intentions for proactive behaviour towards cancer” (“communication” $.348^{**}$, “lifestyle choices” $.187^{**}$, “social engagement” $.255^{**}$, Table 4). Thus, students with a higher interest in cancer are more willing to speak about cancer, to change their lifestyle to some extent and to engage socially. The “beliefs about the controllability of cancer” show a positive correlation with the subscale “lifestyle choices” ($.348^{**}$, Table 4). Thus, students’ beliefs are an important predictor in terms of the lifestyle they choose. The “negative emotional responses towards cancer” show low positive correlations with all three subscales of the behavioural component. Stronger negative emotions lead to more readiness to talk about cancer ($.282^{**}$), to reconsider lifestyle choices ($.258^{**}$) and to engage socially ($.239^{**}$) (Table 4). Interestingly, the assessment of risk factors correlates with none of the three subscales. Thus, the knowledge of risk factors is not a predictor for proactive behaviour.

To determine the key factors influencing proactive behaviour, we calculated a regression model to test which predictor

Table 3 Which aspects of cancer trigger most interest and is this interest gender specific?

Type of cancer	Total			Male			Female			U test
	Mean	SD	Number of samples	Mean	SD	Number of samples	Mean	SD	Number of samples	
Brain tumours	3.31	.75	361	3.19	.77	160	3.41	.72	201	.004*
Leukaemia (blood cancer)	3.15	.85	359	2.84	.91	158	3.39	.70	201	.000***
Skin cancer	3.05	.81	361	2.84	.87	159	3.22	.72	202	.000***
Breast cancer	2.87	.94	360	2.28	.88	160	3.33	.70	200	.000***
Lung cancer	2.84	.74	361	2.64	.77	160	2.99	.69	201	.000***
Cervical cancer	2.68	1.04	360	1.96	.88	160	3.24	.77	200	.000***
Stomach cancer	2.44	.76	360	2.35	.77	159	2.51	.74	201	.051
Liver cancer	2.44	.74	361	2.38	.82	160	2.49	.67	201	.128
Testicular cancer	2.44	.93	358	2.83	.90	159	2.13	.82	199	.000***
Kidney cancer	2.42	.74	358	2.30	.80	159	2.52	.67	199	.006**
Esophageal cancer	2.41	.77	359	2.24	.75	160	2.55	.76	199	.000***
Colorectal cancer	2.40	.77	359	2.31	.78	158	2.47	.76	201	.059
Cancer of the oral cavity and pharynx	2.39	.80	362	2.23	.83	160	2.51	.75	202	.001***
Laryngeal cancer	2.34	.78	361	2.25	.81	159	2.41	.74	202	.058
Bladder cancer	2.26	.75	360	2.19	.82	160	2.33	.69	200	.080
Prostate cancer	2.24	.76	360	2.35	.84	159	2.15	.68	201	.017*
Gallbladder cancer	2.13	.70	359	2.03	.77	157	2.21	.64	202	.007**

Interests in different cancer types; ranked by total mean value; SD Standard Deviation; four-point rating scale, 1=not interesting to 4=very interesting; Mann-Whitney U

* $p\leq.05$ level is significant; ** $p\leq.01$ level is significant; *** $p\leq.001$ level is highly significant

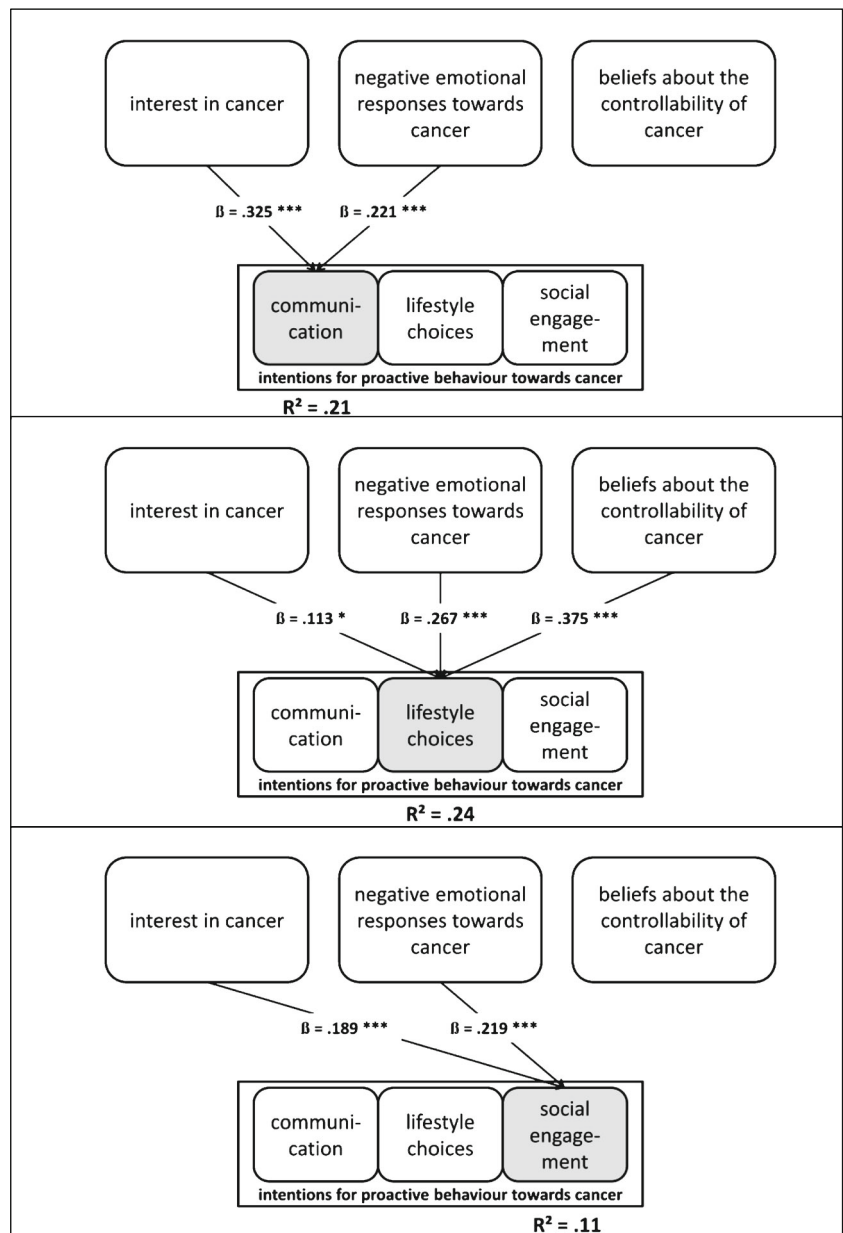
Table 4 Correlations between interest, attitude scales and assessment of risk factors

	Correlations coefficient	“Interest in cancer”	“Assessment of carcinogenic risk factors”	“Beliefs about the controllability of cancer”	“Negative emotional responses towards cancer”	Intentions for proactive behaviour towards cancer		
						Subscale “communication”	Subscale “lifestyle choices”	Subscale “social engagement”
“Interest in cancer”		1.000	.025	.036	.290**	.384**	.187**	.255**
	Sig. (two-tailed)		.631	.490	.000	.000	.000	.000
	N	368	368	367	366	367	368	367
“Assessment of carcinogenic risk factors”			1.000	.198**	.014	.091	.062	.000
	Sig. (two-tailed)			.000	.785	.081	.232	.995
	N		369	368	367	368	369	368
“Beliefs about the controllability of cancer”				1.000	-.059	.062	.348**	.045
	Sig. (two-tailed)				.260	.233	.000	.389
	N			368	367	367	368	367
“Negative emotional responses towards cancer”					1.000	.282**	.258**	.239**
	Sig. (two-tailed)					.000	.000	.000
	N				367	367	367	367

Bivariate correlation analysis, correlations coefficient Spearman's rho

** correlations coefficient is significant at $\leq .01$ level

Fig. 1 What are predictors of “intentions for proactive behaviour towards cancer”? (Linear regression analysis; dependent variable highlighted; coefficients significant at *** $p \leq .001$ and * $p \leq .05$ levels)



accounts most for proactive behaviour against cancer (Fig. 1). The results of the regression analysis point out that “interest in cancer” ($\beta=.325$) and “negative emotional responses” ($\beta=.221$) are the best predictors of students’ motivation to communicate about cancer (subscale “communication”) (see Fig. 1). Likewise, “interest in cancer” ($\beta=.189$) and “negative emotional responses” ($\beta=.219$) are the best predictors of students’ motivation to engage socially (subscale “social engagement”) as well. Regarding students’ motivation to face cancer through lifestyle choices, “beliefs about the controllability of cancer” ($\beta=.375$), “interest in cancer” ($\beta=.113$) and “negative emotional responses” ($\beta=.267$) were identified as the predictors.

Discussion

Based on our findings, we discuss possible implications for teaching the topic cancer. In our study, the two subscales “communication” and “lifestyle choices” are of major importance for primary prevention. Communicating about cancer might reduce misunderstandings about cancer and might decrease retentions or fear towards the topic. Furthermore, students should be enabled to make informed health-related decisions regarding lifestyle choices.

Data analysis shows that “interest in cancer” and “negative emotional responses” are predictors for “communication”. In our sample, stronger negative emotions (e.g. fear) and higher

interest in cancer led to higher willingness to communicate about cancer.

Our findings regarding negative emotional responses are in line with previous findings of Carey [9] showing that cancer is connoted with emotive terms (e.g. “tragic”) and of Oakley et al. [11] suggesting that these connotations are predominantly negative. Because of this, teachers should first elicit predominant emotions in the class and then discuss what these emotions depend on. With respect to Ranmal et al. who outlined that communication may help to better understand, prepare for and cope with the illness, we implicate that teaching processes need to consider emotions to trigger students’ communication [23]. However, teachers are often not trained to handle emotions and sensitive issues; hence, this is a delicate issue. The solution could be a reorientation of cancer towards a modern health education as already claimed by Cribb in 1990 [8]. In the field of modern health education, a holistic perspective is applied that integrates affective-emotional, social and cognitive personality traits in didactics of health education [24]. Therefore, a transfer towards a holistic cancer education comes along with further education for biology teachers and the implementation of appropriate teaching materials. It is our intention to develop and evaluate such teaching materials based on our findings and further research. Hence, we evaluate teachers’ attitudes towards cancer and their attitude towards teaching cancer in school at the present (Thesker, Heuckmann and Asshoff, unpublished data), in order to understand which needs teachers have and what kind of support they need.

Our study confirms the findings of both Elster and Busch, who processed data on more than 2,000 students from Japan, England and Denmark in another ROSE study showing that female students have a higher interest in cancer than male students [22, 25]. Cancer education can take advantage of the given interest in cancer and use it to trigger students’ communication about cancer. For example, students should have the opportunity to choose between different cancer types which should be taught in the classroom due to the fact that interest in cancer types and interest in genders cannot be unified. Analogously, teaching processes should focus on the types of cancer that trigger the most interest to both male and female students (brain tumours, leukaemia and skin cancer).

“Interest in cancer” and “negative emotional responses” are predictors for “lifestyle choices”. However, “beliefs about the controllability of cancer” is the strongest predictor in relation to lifestyle (see Fig. 1). The more the students believe that they have influence on contracting cancer, the stronger the students’ feeling of empowerment to confront cancer through lifestyle choices. However, our data shows that students think they have less influence on contracting cancer in general (see Table 2). This result is in line with the study of Murray and McMillan, who asked 700 adults about their perceived susceptibility to cancer [12]. The authors found that women in

particular attribute the causes more to heredity and less to behaviour. Educational programmes like Cancer 101 have shown that it is possible to change attitudes to a less fatalistic perspective [14]. Therefore, cancer education in school has to illustrate on the one hand that the risk of contracting cancer can be minimized and on the other hand that students can influence the risk of contracting cancer. This leads to question to what extent the knowledge of risk factors is relevant for proactive behaviour. Marteau and Lerman and Schernhammer et al. showed that the knowledge of risk factors does not influence behaviour directly [26, 27]. Our results of correlation and regression analysis confirm this picture. However, the “assessment of risk factors” correlates with “beliefs about the controllability of cancer” in our sample. For us, this means that the assessment of carcinogenic risk factors influences students’ beliefs about the controllability of contracting cancer and in this way influences intentions for proactive behaviour indirectly. Thus, to modify students’ beliefs about the controllability of contracting cancer as described above, it is important to include the knowledge about carcinogenic risk factors as well.

In line with Cribb, we suggest that objectives of cancer education, e.g. removing misconceptions or stigma to improve coping, can only be met with a multi-perspective education, teaching about biological, social and emotional aspects of cancer [8].

Overall our data explains 11–24 % of variance (see Fig. 1) indicating the role of other potential factors regarding intentions of proactive behaviour against cancer. Possible factors may be found in other models regarding the attitude-behaviour relation, e.g. the theory of planned behaviour [27]. In the theory of planned behaviour, intentions to act are influenced by different factors like attitudes towards the behaviour, subjective norms or perceived behavioural control.

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