



Development of a Measurement Tool to Assess Students' Knowledge and Perceptions About Cancer (SKPaC)

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Abstract

Cancer literacy is currently one of the most important dimensions of cancer continuum. Objective assessment of cancer knowledge in populations remains a challenging field to public health entities. Different evaluation tools are currently available; still, some groups remain disregarded due to the absence of validated instruments. Cancer literacy in adolescents and young adults has been clearly overlooked being a subject that requires new tools to be properly studied. To address this topic, we developed a new instrument and field tested it in a classroom environment for internal reliability, construct, and face validity. “Students Knowledge and Perceptions about Cancer questionnaire” was designed in Portuguese language and adapted to the Portuguese context by a multidisciplinary team. The final version of the questionnaire includes 35 items organized in three sections, encompassing knowledge and perceptions about cancer and socio-biographic data. Cancer experts ensured content validity, while tailoring of contents was refined with high school teachers. Test and retest of the instrument showed a good reliability of the scale and construct validity. Also, the clarity of the questionnaire and suitability to properly evaluate cancer knowledge was consistent between test and retest. The *Students' Knowledge and Perceptions About Cancer Questionnaire* (SKPaC) showed to be a valid tool to assess adolescents' knowledge and perceptions about cancer that can be used in the educational context.

Keywords Questionnaire SKPaC · Cancer knowledge · Cancer perceptions · Students · Health education

Background

Cancer is assuming a leading role in health literacy due to the increasing rates of incidence and mortality [1–4] and the

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extended social impact of this disease. Improvement of cancer literacy is a major focus of new public health policies based upon prevention education strategies that aim to reduce the burden of cancer for future generations [5].

Regarding cancer context, prevention is a determinant topic since it is known that half of the deaths attributed to cancer can be avoided [6] so it is vital to make people aware of risk factors and effective prevention routines. Increasing knowledge about cancer is a decisive point but does not guarantee the adoption of preventive behaviors. Action, in the way that skills are mobilized to translate knowledge, is also needed in order to raise cancer literacy [7–9]. Comprehensive information adapted to individual educational levels is required to improve cancer knowledge [10]. This can only be achieved with a closest collaboration between researchers and healthcare professionals refining communication tools to enhance cancer literacy [11, 12].

There are several available instruments to measure cancer literacy in different aspects of the cancer spectrum; among them, some of the most commonly used are the following: *the Communication and Attitudinal Self-Efficacy scale (CASE-Cancer)*, *the Cancer Literacy Score (CLS)*, *Cancer*

Message Literacy Test (CMLT), *Cancer Awareness Measure (CAM)*, and *Cancer Health Literacy Test (CHLT)*.

The CASE-Cancer—the Communication and Attitudinal Self-Efficacy scale—measures patients' self-efficacy in the context of productive communication and positive attitude towards cancer. This tool emphasizes the communication network established between patients and healthcare providers since both patients' attitudes and healthcare providers' expectations influence this interaction [13]. The CLS—the Cancer Literacy Score—was developed by European researchers and integrates an important attempt to define cancer literacy in the European context [14]. The CMLT—Cancer Message Literacy Test—is a pair of tools that contains the CMLT-listening (CMLT-L) and the CMLT-reading (CMLT-R). These tests use messages that simulate real situations of adults' everyday life and allow the establishment of a link between spoken/oral and written/print literacy and the influence of this link in healthcare decision-making and health behavior [15, 16]. Another tool is the Cancer Awareness Measure (CAM) which evaluates the awareness of early warning signs and risk factors and barriers to seeking medical advice in which concerns to cancer [17]. The last one is the Cancer Health Literacy Test (CHLT) with two versions conceived to measure patients' cancer health literacy along a continuum (CHLT-30) and to identify patients with limited cancer health literacy (CHLT-6) [18].

These tools cover a wide range of dimensions of cancer literacy, but none of them evaluates topics related to cancer prevention, especially concerning adolescents. According to Koay et al. [19], new tools are needed and new studies are required to improve the existing tools, particularly in what concerns to cancer prevention.

In this study, we developed and validated a new instrument to assess effective knowledge and perceptions about cancer topics (including risk factors and cancer prevention), in a population of adolescents.

We focused our research on this specific population, because adolescence is a stage of transition between childhood and adulthood. This stage is an elective target since it enfoldes the development of new cognitive skills, for the construction of an identity and the acquisition of psychological sense of control over live, actions, and attitudes [20, 21]. As a phase of transformation and active learning, it will be easier to induce a change in attitudes and behavior towards a healthier lifestyle that should be adopted to promote the prevention of diseases such as cancer. Additionally, young people have the capacity of mutual influence, when adopting particular lifestyles and social trends.

The aim of this study was to develop and validate a tool to assess adolescents' knowledge and perceptions about cancer that can be used in the educational context. This particular group has a great potential to develop skills and improve cancer literacy together with a dissemination potential (social networking) that might be critical to amplify the impact of future targeted educational campaigns.

Materials and Methods

The study was approved by the Portuguese Ministry of Education and Science. Enrollment in the study was voluntary, with the students having the option to decline participation. All the participants signed an informed consent to participate in the study before the application of the questionnaire. For students with ages between 12 and 17 years old, the consent was sought from their parents or tutors. Students 18 years old and older signed their own consent form.

In order to measure the students' knowledge and perceptions about cancer, we created the “Students Knowledge and Perceptions about Cancer” (SKPaC) questionnaire (see Additional File 1—Questionnaire “Students Knowledge and Perceptions about Cancer”), designed in Portuguese language and adapted to the Portuguese context by a multidisciplinary team, including high school teachers, cancer research specialists, a statistician, and a sociologist. The research team, using the expertise on the topic, ensured the content validity.

This instrument is structured upon cancer topics (cervical, breast, skin, and colorectal cancer, risk factors, and prevention), each one composed by a set of items.

We applied a preliminary version of the questionnaire on a group of ten students, to refine the instrument.

The final version of the questionnaire used for the pilot study, includes 35 items organized in three sections: (1) perceptions about cancer (14 items); (2) knowledge about cancer (18 items); and (3) students' socio-biographic characterization (3 items).

Questionnaires were applied in a classroom environment using a web-based format. Data from surveys were analyzed using IBM® SPSS® Statistics, version 25. Descriptive statistics were performed to characterize the sample. Parametric (e.g., Pearson's correlation) and non-parametric statistics (e.g., Kendall's tau, Spearman's rho) were used to analyze reliability and validity.

The sample used for the questionnaire validation is well balanced by gender, with 56.6% (98) girls and 43.4% (75) boys. The age ranged between 12 and 21 years old; 47.4% (82) were attending middle school (8th and 9th grade), while 52.6% (91) were attending high school (10th, 11th, and 12th grade). Detailed information is available as supplementary data (see Additional File 2—Students' sample characterization).

Results

Test-Retest and Internal Reliability

Internal reliability was assessed using Cronbach's alpha. In the first application of the questionnaire (*test*), the Cronbach's Alpha was 0.780 and in the second application (*retest*), it was 0.819, regarding 173 students that completed

both applications. Regarding the different sections of the questionnaire, students' self-perceptions had a Cronbach alpha of 0.905 for the *test* and 0.947 for the *retest*. In what concerns section 2, students' effective knowledge about cancer, the Cronbach alpha was 0.610 in the first application (*test*) and 0.757 in the second application (*retest*). Globally, the Cronbach alpha values presented an *acceptable* or *good* internal reliability of the scale.

Construct Validity

Regarding the questionnaire items that evaluate the students' perceived knowledge about cancer, the results showed that the Pearson correlation was significant for all the items. The items with stronger correlation between the two applications were colonoscopy, breast cancer, and mammography and the items with weaker correlation, but still significant, were colorectal cancer, cancer prevention, and UV radiation.

Students' global perceived knowledge about cancer (arithmetic mean of the 13 items presented in Table 1) had a mean value of 4.60 with a standard deviation of 1.90 in the first application (*test*) and a mean value of 5.07 with a standard deviation of 2.11 in the second application (*retest*). The Pearson correlation for global perceived knowledge was 0.846 ($p < 0.01$), indicating a strong positive correlation between *test* and *retest*.

In Table 2, we present the results for the open-ended question about the meaning/definition of the word cancer. The students' answers were grouped in different categories: (a) biomedical definition that groups the answers related to the

Table 1 The Pearson correlation on perceived knowledge about cancer items ($n = 173$)

Perceived knowledge	
Category	The Pearson correlation Test vs. retest
Colonoscopy	0.771*
Breast cancer	0.760*
Mammography	0.723*
HPV	0.712*
Hereditary cancer	0.711*
Pap smear test	0.705*
Skin self-exam	0.703*
Melanoma	0.689*
Cervix cancer	0.673*
Risk factors	0.662*
UV radiation	0.657*
Cancer prevention	0.605*
Colorectal cancer	0.521*

*Correlation is significant at the 0.01 level

Table 2 What does the word cancer mean to you... ($n = 173$)

Cancer meaning/definition	N (%)	
	Test	Retest
Biomedical definition	58 (33.5)	60 (34.7)
Psychosocial definition	69 (39.9)	58(33.5)
Mixed definition	10 (5.8)	16 (9.2)
Other definition	31 (17.9)	35 (20.2)
No definite answer	3 (1.7)	0 (0)
Do not know or no answer	2 (1.2)	4 (2.3)

biological aspects (technical and/or scientific) of cancer development, (b) psychosocial definition that groups the answers related to the emotional burden of cancer, (c) mixed definition that groups the answers with a merge of the two previous dimensions, (d) other definition that groups answers with other types of definitions, (e) no definite answer that groups the answers that do not express a clear definition, and (f) do not know or no answer category that groups "don't know" answers or the absence of an answer.

Overall, the results were similar when comparing the answers from the *test* with the *retest*. Chi-square tests for the two main categories of answers (biomedical and psychosocial definitions) showed a strong dependency between the *test* and *retest* ($p < 0.001$). Phi coefficient was 0.589 for the biomedical definition and 0.472 for the psychosocial definition, both statistically significant ($p < 0.001$).

In Table 3, we present phi coefficient of association for each item of students' effective knowledge about cancer, between *test* and *retest*.

In what concerns students' effective knowledge about cancer, chi-square tests showed strong dependency between *test* and *retest* for all the items presented in Table 3, with $p < 0.001$ for the majority of the items, $p = 0.0017$ for item 7, and $p = 0.007$ for item 13.

Students' global knowledge about cancer (arithmetic mean of the 18 items presented in Table 3) had a mean value of 0.49 with a standard deviation of 0.1 in the first application (*test*) and a mean value of 0.51 with a standard deviation of 0.18 in the second application (*retest*). The Pearson correlation for global knowledge is 0.722 ($p < 0.01$), indicating a strong positive correlation between the *test* and the *retest*.

Face Validity

When we asked the participants about the goal of the questionnaire, the majority considered that it intended to evaluate the knowledge about cancer. The results are presented in Table 4, according to the categories of the answers.

Chi-square tests for the three main categories of answers ("evaluate the knowledge about cancer", "learn more or look

Table 3 Effective knowledge about cancer—correct answer only (*n* = 173)

Effective knowledge about cancer	
Category	Phi coefficient Test vs. retest
1. What is the agent that causes cervical cancer?	0.474**
2. Which of the following behaviors increases the risk of infection by human papillomavirus (HPV)?	0.623**
3. Taking a vaccine can prevent what type of the following cancers?	0.722**
4. The Pap smear test detects...	0.699**
5. What is the main cause of the majority of skin cancer cases?	0.560**
6. Breast cancer is a disease that affects...	0.691**
7. Which of the following is a breast cancer screening test?	0.243**
8. What time of day is the most dangerous for sun exposure?	0.453**
9. Which of these groups can develop skin cancer?	0.641**
10. Which of the following cancer types is the most deadly for women worldwide?	0.546**
11. Which of the following measures decreases the risk of breast cancer for a woman?	0.408**
12. Which of the following is a colorectal cancer screening test?	0.330**
13. There is an increase of the probability to develop colorectal cancer...	0.221*
14. Which of the following measures decreases the risk of colorectal cancer?	0.348**
15. What is the most deadly cancer in Portugal for both sexes?	0.512**
16. What is the most deadly type of skin cancer?	0.439**
17. Do you know about your family history of cancer?	0.798**
18. Have you already tried to know about your family history of cancer?	0.639**

*Correlation is significant at the 0.01 level. **Correlation is significant at the 0.001 level

more information on the subject” and “alert, sensitize, prevent”) show a strong dependency between the test and the retest ($p < 0.001$). Phi coefficients are 0.578, 0.552, and 0.516, respectively, all statistically significant ($p < 0.001$).

We also asked the participants about “what they think that was being evaluated in this survey?” The majority wrote that the questionnaire intends to assess cancer knowledge of an individual, group, or population. In Table 5, we present the main categories of answers.

Chi-square tests for the two main categories of answers (“assess cancer knowledge of an individual, population or group” and “assess knowledge (without specifying the theme)”) show a strong dependency between the *test* and the *retest* ($p < 0.001$). Phi coefficients are 0.461 and 0.352, respectively, both statistical significant ($p < 0.001$).

The clarity of the questionnaire, asked in a five-point Likert scale (from 0 = *Unclear (I had doubts in all the questions)* to 4 = *Totally clear (I had no doubt)*) had a mean value of 2.46 with a standard deviation of 0.88 in the first application (*test*) and a mean value of 2.57 with a standard deviation of 0.86 in the second application (*retest*). Spearman’s rho coefficient of 0.629 indicates a strong positive correlation of questionnaire clarity between the *test* and the *retest* ($p < 0.001$).

The questionnaire suitability to proper evaluate cancer knowledge, asked in a scale from 0 “Don’t allow” to 10 “Completely allow,” had a mean value of 7.31 with a standard deviation of 2.18 in the first application (*test*) and a mean value of 6.93 with a standard deviation of 2.22 in the second application (*retest*). Pearson’s correlation coefficient of 0.538 indicates a moderately strong positive correlation between the

Table 4 Goal of the questionnaire (*n* = 181)

Goal	N (%)	
	Test	Retest
The goal is to evaluate the knowledge about cancer	107 (59.1)	127 (70.2)
The goal is to learn more or look for more information on the subject	31 (17.1)	15 (8.3)
The goal is to alert, sensitize, prevent	30 (16.6)	30 (16.6)
Do not know or no answer	6 (3.3)	6 (3.3)
Other type of answer	7 (3.9)	3 (1.7)

Table 5 What do you think that is being evaluated in this survey?

Category	What do you think that is being evaluated?	
	Test	Retest
Assess cancer knowledge of an individual, population or group	108 (61.0)	106 (61.6)
Assess knowledge (without specifying the theme)	35 (19.8)	29 (16.9)
Assess other issues, whether or not they are cancer related	20 (11.3)	20 (11.3)
Do not know or answer	14 (7.9)	17 (7.9)
Total	177 (100.0)	172 (100.0)

test and the *retest* ($p < 0.001$), on questionnaire suitability to properly evaluate cancer knowledge.

Discussion

Different evaluation tools are currently available to assess distinct dimensions of the cancer literacy continuum. Still, some topics remain disregarded due to the absence of validated instruments. Cancer prevention in adolescents is clearly a subject that requires new tools to be properly studied. To address this topic, we developed a new instrument and assessed it for internal reliability, construct, and face validity.

Globally, Cronbach's alpha values present an *acceptable* or *good* internal reliability of the scale with a total Cronbach's alpha of 0.78 in the *test* and 0.819 on the *retest*. Test-retest reliability was also good, when analyzing perceptions (0.905 vs. 0.947) and effective knowledge (0.610 vs. 0.757) in separate.

Construct validity was measured regarding the items for self-perceptions and effective knowledge. Globally, a strong positive correlation was found between the *test* and *retest*, with all self-perception items showing a significant Pearson correlation, which is a strong indicator of reliability of the items that were used for the questionnaire.

Regarding the question about what cancer means, the results revealed a strong dependency between the *test* and *retest* answers, especially in which concerns the biomedical and psychosocial definitions.

In what concerns students' effective knowledge about cancer, the Pearson correlation for global knowledge (0.722; $p < 0.01$) indicates a strong positive correlation between the *test* and the *retest*. Moreover, the phi coefficient of association and the chi-square tests showed a strong dependency between *test* and *retest* for all the items, which indicates the validity of construct.

Face validity was also measured regarding the different aspects of the questionnaire, with the majority of the respondents recognizing the objective of the instrument and considering it suitable to properly evaluate cancer knowledge. A strong

dependency between the *test* and the *retest* answers with chi-square tests and the phi coefficient being statistical significant ($p < 0.001$) further reinforces the validation of the questionnaire purpose.

Conclusion

The *Students Knowledge and Perceptions About Cancer* (SKPaC) instrument was developed to provide a validated measure of cancer knowledge, namely prevention and risk factors for different types of cancer (cervical cancer, skin cancer, breast cancer, and colorectal cancer) among the adolescent population. The field test indicated that this instrument is a valid and reliable instrument to measure adolescents' perceptions and effective knowledge about cancer in a larger scale.

Further developments of the instrument might include other cancer types and adaptations to other cultural contexts or populations.

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Author Contributions AB, LM, HS, NR, and FSS conceived and designed the study. AB, NR, and FSS performed the study. AB, LM, HS, and FSS analyzed the data. All authors helped to draft the manuscript, read, and approved the final manuscript.

Compliance with Ethical Standards

Competing Interests The authors declare that they have no competing interests.

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