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Evaluation of cancer awareness, cancer education, and prevention intervention techniques among university-level students in the United States and India

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Abstract:

BACKGROUND: Cancer is one of the leading causes of death globally. A considerable number of different cancer types may be preventable, using primary intervention techniques, such as health education, cancer awareness, behaviors and lifestyle modifications. The present study conducted a comparative assessment of cancer awareness among undergraduate students of the United States and India.

MATERIALS AND METHODS: Students from an Institution in India (KC) (55 females, 33 males), and an Institution in the United States of America (SHU) (226 female, 58 male) during 2019–2020 participated in this study. Participants (n = 372) across all majors and all years (first through fourth year) completed an online questionnaire and answered the questions on their demographic characteristics (e.g., gender, age, and location), academic status (e.g., year of study, major), multiple-choice questions about cancer knowledge, and opinion questions (e.g., "where would you find info," "should therapies be free"). Student responses were collected using Qualtrics Survey Software. Excel was used to analyze responses. We conducted statistical X^2 tests for independence to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table, with a significance of $\alpha = 0.01$. While small sizes due to the small institutions and the response pool, we note that we achieved the necessary "n" for all tests reported.

RESULTS: Our research shows a few important statistically significant differences, including knowledge of cancer and breast lumps is dependent on location, ranking of global cancer deaths is dependent on location, and that cancer knowledge is dependent on the information source. All for X^2 tests with $P < 0.001$.

CONCLUSIONS: Further encouragement of education for young people in various aspects of cancer and cancer prevention, as well as information facility and sources of reliable data, could be helpful for improving the overall health and primary prevention. A thorough assessment is needed to understand the responsible factors for the observed cancer knowledge variations among students of two different places.

Keywords:

Cancer education, lifestyle modification, online survey, primary prevention, risk factors

Introduction

Cancer is a leading cause of death and a major growing public health burden in the United States. Cancer etiology is both multifactorial and complex, differing from mechanisms of onset to diverse options for palliative measures in disease management. The focus of scientific research on cancer is extensive due to the burden cancer places

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on public health systems. Although a large focus of our health-care system is on tertiary care, it is becoming more apparent that primary prevention is a critical focus point for scientific research, being that a large percentage of cancer types are preventable.[1] Cancer prevention has conventionally focused on older adults, aged 40 and over, who tend to be eligible for most cancer screenings, while less attention has been placed on younger age groups.[2,3] It has been well established that prevention strategies should be targeted toward a younger age demographic, aged 18–29 years, to promote the early implementation of positive behavioral changes including physical activity, weight maintenance, reduction in alcohol consumption, smoking cessation, and vaccination.[4]

Being that many risk factors fall under the umbrella of primary prevention, it is critical to foster positive health behaviors during this critical age period to not only shape future health habits and lifestyles but also to reduce the future burden of cancer on our healthcare system.[5,6] Though cancers that are commonly diagnosed around middle age or afterward, such as cancers of the lung, breast, colon, and prostate are not commonly remarkable in younger demographics, the limited technical developments and modern methods of pharmaceutical research do not solely prevent the increasing cancer problem. This is why primary prevention is extremely important and focus needs to be placed on cancer prevention strategies before disease development occurs. Primary prevention aims at a decrease of cancer incidence and mortality by eliminating or reducing exposure to risk factors and the promotion of protective factors.[7] It was found that more than 80% of tumors are connected to lifestyle, which is why health behaviors are extremely important in primary prevention measures. Pro-health behaviors should also be of utmost importance for women at child-bearing age, pregnant women, and parents of children both with and without anomalies, so that measures can be planned and executed efficiently.[8] Preventative measures should be planned for these demographic groups decades in advance to optimize patient outcomes while facilitating a societal movement to promote early positive health behaviors.

Numerous researches across the globe have shown that a reduction in tumor risk is mostly effective by adopting a healthy lifestyle, avoiding exposure to carcinogenic factors, and regularly performing screening tests.[9-11] The foundation for preventative action should be based on scientifically reliable information, which includes and is not limited to, pathological mechanisms and pro-social campaigns to increase knowledge in the area of neoplastic disease prevention.[12-14] To formulate strategies based on the research findings and to include them in healthy lifestyle programs, assessment of the level of knowledge in younger age demographics should be taken into account. This link between lifestyle and cancer development makes a compelling case to investigate if young adults are aware of this intricate relationship in the hopes to promote action in positive health behavior. This knowledge of cancer prevention is particularly important as young adults establish their health behaviors and thus it is critical to prioritize the fostering of positive health behaviors in our young adults to reduce the future burden of cancer.

Materials and Methods

Between October 2019 and April 2020, we surveyed a total of 480 respondents agreeing to participate in our research, while 4 respondents opted out (ethical approval # SU19-00/8.04a). We administered the questionnaire using Qualtrics Survey Software, which was distributed to all students at SHU in the United States of America and all students at KC, India. All participants were between the ages of 18 and 65+ (which included nontraditional undergraduates). Of these participants, 37 neglected to complete the education level question (which included the option of "other"); an additional 8 students neglected to complete the question identifying university/college; 1 additional student neglected to complete the age question; an additional 2 participants didn't complete the biological gender self-identification question; an additional 11 participants were not current undergraduates; finally an additional 5 participants did not complete at least one question related to cancer knowledge. Any participants who did not complete one of these categories were eliminated from the study by the researchers to clean the data pool. This resulted in 398 participants total, with 299 identifying as female, and 99 identifying as male. We then eliminated all ambiguous and irrelevant answers to reduce participants to either 1st-year, 2nd-year, 3rd-year, or 4th-year undergraduate studies. This produced a final sample of 88 students from KC (55 female, 33 male), and 284 students from SHU (226 female, 58 male) – for a final total of 372 students. The samples between schools are unequal, which does not influence the X^2 test of expected frequency. Furthermore, it may be worth mentioning that this varying sample size is resultant of varying pandemic effecting factors contributing to online learning, lack of participation in on-campus learning opportunities (i.e., lack of direct access/approach), and an overall difference in admission rates between the two institutions.

The remaining participants in the study completed questions on demographic categorization, university status and major, followed by a series of questions related to cancer divided into informative questions and a series of questions that formed an assessment that would point towards knowledge on cancer, which had objectively measurable correct answers. The informative questions

included the following: Do you personally know of someone who had or has cancer; During your education, have you studied the topic of cancer; Where would you look to find information on cancer; Do you believe new cancer therapies should be free to all patients regardless of their economic status.

The assessment portion was the following multiple-choice questions: What percentage of cancer is inherited/familial; Most breast lumps are cancerous; If you eat healthy foods and make lifestyle choices, does this minimize your chance of developing cancer; Deaths related to cancer are second only to which disease globally; Which of the following viruses is most commonly associated with cancer; Which of the following risk factors is most commonly linked with cancer; Is pain a common symptom experienced by most cancer patients; Which of the following is the most common type of cancer among females; Which of the following is the most common type of cancer globally among males.

Due to the size of the sample pool, and the ability to share data among the researchers, this aggregate data was analyzed using Microsoft Excel. Aside from summary statistics, the primary analysis of the data was conducted using the X^2 test. To test our hypotheses, we used an $\alpha = 0.01$ across all testing between the expected frequency of the mutually exclusive classifications. We selected the X^2 test to test whether there was a statistically significant relationship between categories, such as performance of an assessment question and year in university. We note that we are assuming simple random sampling.

Results

The goal of our study was to demonstrate a relationship between the level of education and cancer awareness while analyzing various angles of understanding of cancer. Our sample size consisted of a total of 372 participants identified themselves with age-range categories ranging from 18 to 54+ years old (y. o.) with a median age of 18–20 y.o.: Two hundred and seventy two students within 18–20 y.o., 88 students within 21–24 y. o., 9 students within 25–34 y.o., 1 student within 35–44 y. o., and 2 students within 45–54 y. o. [Figure 1]. A cohort of 284 students participated from the SHU, while 88 participated from the KC. The sample that participated in this voluntary study was 75.5% female and 24.5% male with concentrations of study ranging from the sciences to arts. The highest concentration of participants fell in the category of the basic sciences and health science-related concentrations (69.7% natural or health science, and 30.3% nonscience majors). Students were analyzed via a 19 response questionnaire that delved into various topics that surround cancer including general cancer pathology,

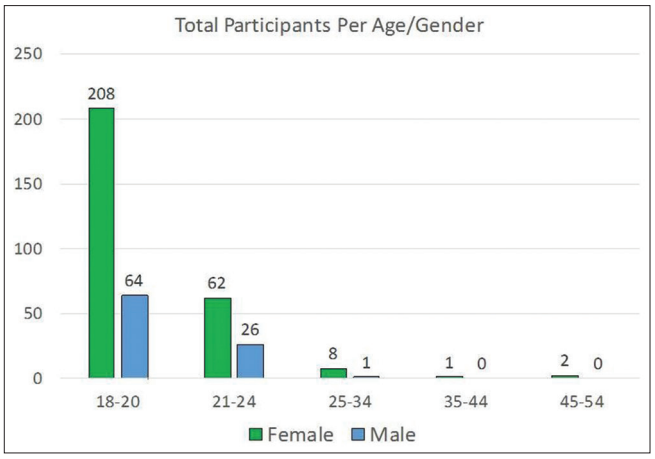

Figure 1: Age categorization of the overall eligible participants

epidemiology, treatment costs, and information sources that students gain their information.

Delving into general findings, it was noted that respondents catered toward online forms of data sources to gain their cancer-related information. Google searches trended the highest overall followed by scientific journals with other resources such as television and textbooks falling severely short. This stratification can be observed among the top sources of information in each performance group (grouped as high, middle, and low scores) on the 9 multiple choice questions asked regarding cancer [Figure 2]. We found that grouping scores into High (7/9–9/9 pts), Mid (4/9–6/9 pts), and Low (0/9–3/9 pts), we can say there is a dependency between performance on the multiple-choice questionnaire and information source for $P < 0.001$ for a X^2, with "Scientific Journal" having the highest percentage of usage among "High" scoring students (33%) and "Newspaper" second (25%), followed by "Google" (17%).

From a general economic perspective, the highest percentage of participants documented that cancer therapies should be free (approx. 61%), while the next highest percentage documented that they neither supported nor refuted the idea that cancer therapies should be free (approx. 35%). Some participants did note that cancer therapies should not be free (approx. 4%), which indicated that further questioning needed to be provided to participants to fully understand what they think is the average cost of cancer treatment in the respective regions of study [Figure 3]. This question tied directly to the question that was placed in the questionnaire to analyze overall cancer knowledge via close personal relationships. Astonishing, it was noted that 60 participants (roughly 16%) stated that they did not know someone with cancer [Figure 4]. While the meantime it took participants to answer was 41.2 min with a standard error of 13.4, the 38.5th percentile was a

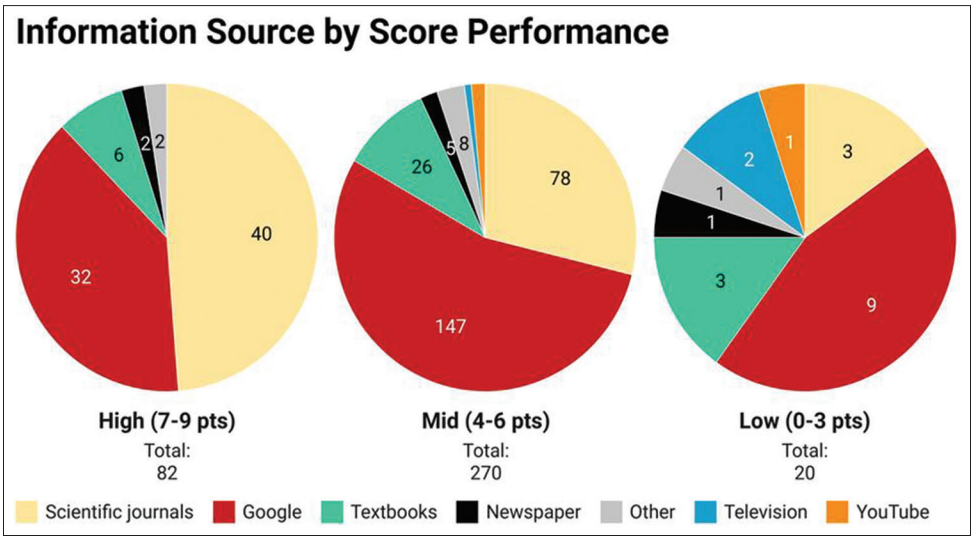

Figure 2: Participants' primary source of cancer-related knowledge. Footnote — pts: Points, which are in reference to the 9 cancer knowledge questions asked in the questionnaire, and ranges from 0 (all incorrect answers) to 9 (correct response to all questions)

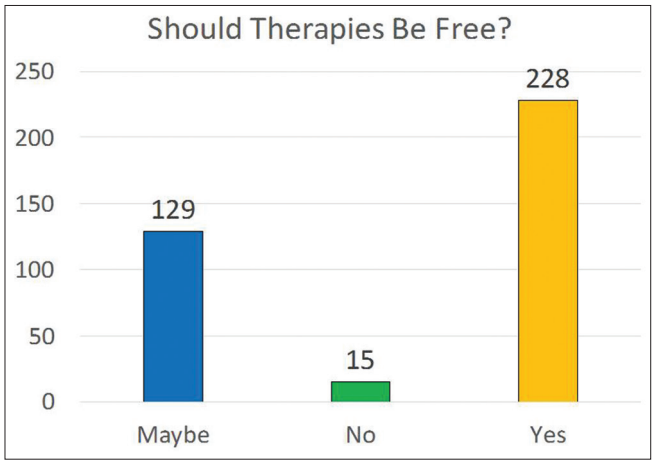

Figure 3: Opinion regarding the cost and affordability of cancer treatment

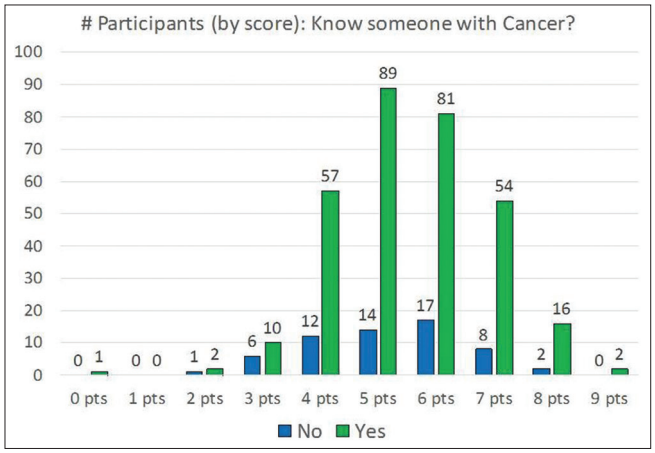

Figure 4: Information about participant's personal familiarity with cancer cases. Footnote — pts: Points are associated with 9 cancer-related knowledge questions – "1" and "0" and "9" scores were not present for all groups; i.e., nobody scored a 1, and the only person who scored a zero knew somebody with cancer

questionnaire completion time of under 3 min. This does not seem indicative of random clicking as a confounding factor in the study [Table 1], yet does seem to indicate an almost binary sense of knowledge that would require further study.

Further investigation took us to comparing overall scores of those who did know someone with cancer versus those who did not know someone with cancer. It was determined that there is independence in questionnaire score to whether or not the participant knew someone with cancer [Figure 4]. This then showed that further investigation into the school curriculum is needed to fully understand if the students who did not know someone with cancer know this information by obtaining it from various resources instead of through direct experience [Table 2]. It must be noted that more females did record that they did know people with cancer versus male participants. The proximity of these people with cancer to the participant was not investigated.

A strange result in this study was independence between years of study and questionnaire scores [Figure 5]. Even grouping scores into the classification of Top (7/9–9/9 pts) and Bottom (0/9–6/9 pts) (to maintain an expected frequency of 5 or more in 80% of cells in the contingency table) we compared against scores of Medical/Healthcare students who knew someone with cancer within first, second, third and fourth years; also indicating independence. However, we did find that among all students (biomedical or nonbiomedical) who knew someone with cancer, grouping scores into High (7/9–9/9 pts), Mid (4/9–6/9 pts), and Low (0/9–3/9 pts) (combined in this general way to maintain the assumptions of the X^2 test for expected frequency count in the contingency table) and comparing these

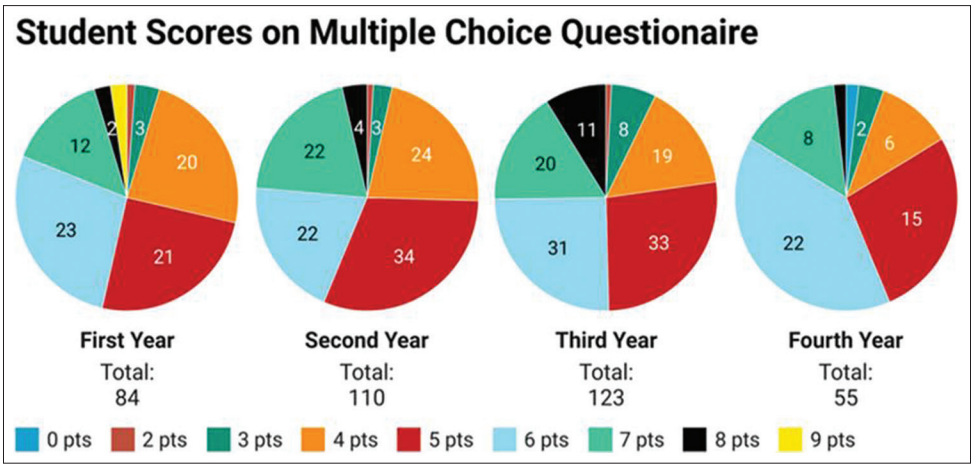

Figure 5: Number of participants by scores and level of education. Footnote — pts: Points have the same meaning throughout– i.e., 0 (all answers were incorrect) to 9 (correct response to all cancer knowledge questions)

Table 1: Assessment of the necessary time durations that were taken by the participants

Participant completion duration stats	Time (min)
Mean	41.2302867
SE	13.4860186
Median	3.48333333
Mode	3.65
SD	260.108907
Minimum	0.61666667
Maximum	3073.51667
25th percentile	2.55
38.5th percentile	2.98
90th percentile	10.9

SE=Standard error, SD=Standard deviation

Table 2: Learning about cancer at any time of the participants' life

Question: During your education, have you studied the topic of cancer?	
Major (number in major)	**Approximately percentage yes within major**
Medical (*n*=125)	77.6
Science/tech (*n*=155)	70.9
Other (*n*=27)	29.6
Arts/humanities (*n*=60)	28.3
Education (*n*=19)	26.3
Business/commerce/ administration (*n*=22)	18.1

35 students identified as having two or more majors

scores against the result of being having studied cancer (for any major), we reached a $P = 0.0050$; thus indicating that studying cancer influences score. The same was not true when including those who didn't know someone with cancer. This seems to indicate a confounding factor alongside education in knowledge of cancer. Additionally, using the same High (7/9–9/9 pts), Mid (4/9–6/9 pts), and Low (0/9–3/9 pts) and comparing student scores against the result of being a Medical/Healthcare major or Non-Medical/Healthcare major, we reached $P = 0.026$. As we are holding to a stronger significance level of 0.01, we will indicate that this suggests further study is needed for a statement that performance is dependent on this general major classification.

Looking at performance divided into "high" performing (7/9–9/9 correct responses) and "low" performing (below 7/9 correct responses) – with a $P = 0.05970$ for a X^2 test, we retain our null hypothesis that overall performance is independent of location for KC versus SHU. Similar results were reached for individual total correct questionnaire responses taken as correct versus incorrect, indicating independence of location for our sample, except four questions. The following were shown to be dependent on location of KC versus SHU against correct versus incorrect response: ("Most common cancer among males," $P < 0.00001$, KC = 50% >SHU 10% correct); ("Most breast lumps are cancerous," $P < 0.00001$, KC = 51% <SHU 83% correct); ("Most common risk factors", $P = 0.0029$, KC = 70% <SHU = 83% correct); ("Deaths related to cancer are second only to which disease globally," $P < 0.0001$, KC = 48% <SHU = 86% correct). This indicates possible disparities among knowledge between nations as it relates to these individual topics.

We retained our null hypothesis of independence of gender both overall and on individual questions, except one. Gender of self-identified biological male and female against correct versus incorrect responses for "Deaths related to cancer are second only to which disease globally" with $P = 0.0003$, female = 81% and male = 61% correct. This is the only individual question where responses were dependent on gender.

Discussion

Overall, potential confounding bias is found, based on a lack of investigation into the exact curriculum associated

with the field of study of the participants, particularly as it was self-identified. Further investigation is required into the respective curriculums of high-scoring participants to further analyze the hypothesized trend that as years of education increase, overall knowledge of the subject being studied should also increase linearly [Figure 5]. Increased participant size would potentially allow for more analysis. Question simplicity could also be a confounding factor in this trend.

We recognize our error in not asking more detailed questions on the questionnaire (although our survey time was limited as per the official instructions) and suggest that this change may have yielded more comprehensive results. The internet, Google, was the preferred choice of all students for identifying information about health care issues. This is not surprising, since Google has become a primary resource for students in higher education, replacing textbooks. It was surprising that YouTube was not as popular as either scientific journals or television for accessing information. This medium is a favorite among students and the general population for seeking information on repairing items, operating machinery and equipment, and educational tutorials. Our questionnaire may have been more specific as to what types of journals students preferred to locate information about cancer. Additional questions regarding search times to locate credible information and online journals would have also provided information pertinent to our study.

Female students represented the highest percentage of respondents and individuals enrolled in health-related majors at the schools surveyed. This result was not surprising since women's enrollment in pre-professional programs and in higher education has increased over the past 20 years. Our data also demonstrate that the majority of students in our questionnaire responders were in the age group between 18 and 20. This is significant because this segment of the population, typically college freshmen and sophomores have not taken upper-level science courses and are generally in good health. Their opinions and understanding of medical issues may have been shaped by family, social media, or high school experiences and not scientific curricula.

Our data also suggest that in at least one tested area, women are more knowledgeable and conscientious about topics relevant to cancer. We believe one reason for this outcome may be women are targeted more on social media, television and receive regular wellness visits. Statistics from the literature suggest men do not receive regular wellness visits, are historically more resistant to seek medical treatments, and seek medical intervention later in the disease than women.[15-17] Our questionnaire may have also asked about our participant's dietary habits, exercise regimen, and work environments. These factors are known contributors to cancer and overall good health. Unlike the COVID-19 pandemic or similar infectious diseases, cancers tend to be more genetic, environment, and dietary related. The majority of our responders in the 18–24 age bracket are most likely in relatively good health and have yet to personally experience a medical crisis.

It is impossible to determine from our questionnaire if a general lack of understanding about cancer was present among respondents due to the vagueness/generality of the survey questions. We would like further investigation into whether students in upper-level science courses may have responded differently than 1st-and 2nd-year students due to academic exposure to disease processes and epidemiology studies in the literature. We do believe health care cost is a global issue to people, regardless of their age, ethnicity, or geographic location. In the 2020 U. S. Presidential Elections, health-care costs were a central topic of discussion. The idea of socialized medicine versus private pay is a key point of discussion, mainly due to the cost associated with cancer treatments, research, and testing. In future investigations, the sample size should be maintained but participant selection should occur to limit participants to those studying medicine or science to further analyze the trend between years of education and cancer knowledge. Overall, this study provides a framework for those interested in cancer education and the lack thereof in our world. In order to cure the disease, we must first educate about it to provide people with primary prevention techniques to reduce the incidence and prevalence of cancer in our world.

Conclusions

According to the report of the World Health Organization, the primary organization for data for health policymakers, cancer was responsible for an estimated 9.6 million deaths in 2018 globally; and approximately 70% of deaths from cancer occur in low- and middle-income countries. Cancer in India is emerging as a major cause of morbidity and mortality, with some key features such as disease prevalence among young people (compared to the western population), advanced disease, poor performance status, and possibly more aggressive phenotype.[18] While different countries are indisputably distinguishable in terms of health-care system, as noted in our research, there were specific topics where students from India correctly answered, and students from the United States. correctly answered. Paired with our finding that education and knowing someone with cancer leads to a better performance on our cancer knowledge questionnaire, as well as our finding about sources of information leading to better performance, this indicates that further work is both needed and should make a difference. It may be worth

mentioning that a large number of cancers are thought be associated with environmental and lifestyle factors, and perhaps these neoplastic pathologies are preventable. So, further encouragement of education for young people in various aspects of cancer and cancer prevention, as well as information fluency and sources of reliable data is thus of critical importance. In particular, specifics about individual types of cancer, and their risk globally and regionally. Consequently, timely lifestyle modifications may influence disease occurrence as well as morbidities and mortality in later life. Certainly, improvement of cancer awareness and education denotes both effective strategy and key challenges in preventive oncology.

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Conflicts of interest

There are no conflicts of interest.

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