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# Cancer Risk Reduction Through Education of Adolescents: Development of a Tailored Cancer Risk-Reduction Educational Tool

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## Abstract

Growing evidence links adolescent exposures to cancer risk later in life, particularly for common cancers like breast. The adolescent time period is also important for cancer risk reduction as many individual lifestyle behaviors are initiated including smoking and alcohol use. We developed a cancer risk-reduction educational tool tailored for adolescents that focused on five modifiable cancer risk factors. To contextualize risk factors in adolescents' social and physical environments, the intervention also focused on structural barriers to individual- and community-level change, with an emphasis on environmental justice or the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The educational tool consisted of a 50-min module that included an introduction to cancer biology including genetic susceptibility and environmental interactions, cancer burden in the local community, and risk reduction strategies. The module also included an interactive activity in which adolescent students identify cancer risk factors and brainstorm strategies for risk reduction at both the individual and community level. We administered the module to 12 classes of over 280 high school and college students in New York City. Cancer risk reduction strategies identified by the students included family- or peer-level strategies such as team physical activity and community-level action including improving parks and taxing sugary foods. We developed a novel and interactive cancer risk-reduction education tool focused on multiple cancers that can be adopted by other communities and educational institutions.

**Keywords** Cancer risk reduction · Cancer prevention education

## Background

The global cancer burden continues to rise annually [1]. The increases in incidence are in part due to increasing prevalence of modifiable factors in some countries including tobacco and alcohol use, obesity and physical inactivity, and infection. As such, opportunities for reducing risk of cancer through effective and evidence-based cancer control programs including vaccination and tobacco control are paramount to addressing the increasing cancer burden. Nearly 40 years ago, Doll and Peto estimated that a substantial proportion of cancers can be prevented at a population-level through tobacco control and other lifestyle changes [2]; these estimates have largely been confirmed through recent modeling [3, 4]. Moreover, there is mounting evidence that cancer risk reduction efforts that begin in adolescence may have a greater impact by reducing the risk of early cancers and by shifting the long-term trajectory of risk accumulation [3]. For example, women who regularly engaged in physical activity during both adolescence and

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adulthood have lower risk for both premenopausal and postmenopausal breast cancer, than women who were active during only one period or inactive [5, 6]. Adolescence (ages 10–19 years) and early adulthood (ages 19–30 years) are critical periods for prevention and educational intervention as lifestyle behaviors beneficial to health including physical activity and healthy diet, as well as harmful lifestyle behaviors including alcohol consumption and tobacco use are being initiated and/or established [7]. It is also a critical time to discuss and administer the human papilloma virus (HPV) vaccine. HPV vaccination is currently recommended for adolescents ages 11 or 12 years, and is recommended through age 26 years for individuals that were not previously vaccinated. Adolescence is also an opportune time for intervention on other risk factors because adolescents are already being introduced to the concept of cancer risk reduction through the HPV vaccine for cervical, head and neck, and anal cancers. Therefore, incorporating information about lifestyle factors into cancer risk-reduction messages targeted for adolescence during this critical window of time for potential health behavior initiation and modification may have a lasting impact on cancer prevention in adulthood [3].

Low levels of knowledge in young adults about modifiable cancer risk factors such as obesity and alcohol consumption have been previously reported [8, 9]. For example, one study noted that while participants were frequently able to correctly identify the association between cancers and health risk behaviors that have received widespread media coverage or are relevant to their life stage (smoking and lung cancer: 99%; alcohol and liver: 86%; UV radiation and skin: 99%) they had low levels of knowledge about associations that were less publicized (alcohol and breast cancer: 3%) [9]. Previous studies have demonstrated that education interventions are effective strategies for increasing cancer knowledge in adolescents and young adults from different backgrounds, as well as increasing students' intentions to engage in healthy behaviors [10–12]. Targeting cancer education to adolescents and young adults may also improve knowledge and communication about cancer risk reduction across family and social networks. [11, 13–15]. However, with few exceptions, including school-based interventions in the UK [14] and Poland [16], and a culturally tailored large intervention targeting African American adolescents in four US states [17], most studies focus on sharing information about a single cancer (e.g., lung cancer) and on individual-level behavioral change (e.g., smoking cessation).

In contrast to developing cancer risk reduction curriculum based on a single cancer, we developed an educational intervention using an integrated approach, introducing cancer biology and genetics alongside environmental and lifestyle exposure information and structural (environmental and social) factors that affect health and healthy lifestyles. Here, we present the approach and module we developed for adolescents which focuses on five lifestyle risk factors that they can act on in adolescence to potentially reduce their risk of cancer later in life: the HPV vaccination, avoiding tobacco products including newer alternative tobacco products, increasing physical activity, avoiding or reducing alcohol consumption including avoiding binge drinking, and eating a balanced diet. We also discussed environmental carcinogens and ways to lower exposures to environmental carcinogens at an individual, household, and community level.

## Methods

### Community Partnership

The Columbia Center for Children's Environmental Health (CCCEH) Community Outreach and Translation Core (COTC) has long-standing engagement in the Northern Manhattan and South Bronx communities [18]. The CCCEH COTC has worked to translate research findings with the community on exposure to common urban pollutants for two decades. The COTC also has a strong collaboration with a community-based organization, WE ACT for Environmental Justice (WE ACT), which has previously educated youth in Northern Manhattan on environmental health issues through their Environmental Health and Justice Leadership Training program. This study builds on this partnership to extend the scope and focus on cancer prevention by developing an educational tool tailored for adolescents in these communities.

### Focus Groups

Prior to developing the education tool, we conducted a series of focus groups to explore current health priorities and concerns and better understand how to effectively communicate health information, particularly cancer prevention messages, with adolescents in the community. We recruited adolescents from the CCCEH cohort between the ages of 15 and 18. We held four focus groups that included 5–9 individuals each. We centered focus group discussions on current health priorities and motivations, preventive actions, how to effectively communicate with their age group, and how to engage a youth advisory board. We transcribed focus group discussions and utilizing NVIVO© 11, analyzed the data using thematic analysis and Colaizzi's method for phenomenological data analysis.

### Education Tool with Activity and Discussion Questions

We adopted a trans-disciplinary approach to develop this educational tool and involved several key stakeholders including local breast cancer advocates, community partners (WE ACT), local educators, and cancer and environmental

epidemiologists from the academic community. In focus groups we conducted with adolescents from the community, participants repeatedly mentioned that they would prefer to receive information on risk reduction messages through their schools. Based on this information, we developed a 50-min module on cancer risk reduction tailored to high school and college students, which consisted of a 15-min presentation and a 35-min activity with discussion questions. The module included information on the cancer burden nationally and in the community (Washington Heights and Inwood Neighborhoods in Manhattan), an introduction to cancer biology including information on cancer genes and types of mutations, major carcinogens, pedigrees, gene-environment interactions, and risk reduction strategies at the individual and community level.

Our education module included interactive ways to convey risk-reduction messages. Using a pedigree that highlighted both inherited cancer genes and shared environmental and lifestyle factors within families tied together several concepts from the module that transitions naturally into the interactive biography activity and group discussion. We also highlighted that some risk factors (e.g., environmental exposures) are areas of active research and more evidence is needed to determine the extent to which they raise a person's risk for developing cancer. In the character biography activity, we asked students to identify which risk factors are within the character's control and this question generated discussion around the multiple factors at the individual and community levels that can influence a person's ability to make healthy choices. This module was co-taught by the CCCEH COTC coordinator and WE ACT environmental health programs manager. Several investigators also participated in the sessions (NZ, MBT). Teachers provided feedback during the development of the module and following the implementation in their own classrooms.

Although we collected feedback from students and teachers to improve the curriculum, we were unable to formally evaluate the effectiveness of the educational tool due to the NYC Department of Education policy on research-related activities occurring during instructional time.

## Results

We administered this education intervention to more than 280 high school and college students from the following schools and programs: Washington Heights Expeditionary Leadership School in Northern Manhattan, University Prep Charter High School in the South Bronx, Summer Youth Employment Program in Staten Island, and Columbia University's Herbert Irving Cancer Center summer program high school students in a summer youth employment program on Staten Island.

### Focus Group Findings

Eighteen subthemes emerged during the coding process, with three overarching themes: facilitators of health, social pressures, and mental health issues. The following were perceived as fundamental for being a "healthy teen": active living, social support, staying positive, and eating habits. Social pressure, or physical and mental health factors influencing health behaviors, included bullying; peer influences in terms of body size and self-image/physical appearance; and adult influences, including negative behaviors. Environmental health was not explicitly mentioned as part of the adolescents' definition of "health." Additionally, when asked specifically about cancer prevention, many students mentioned that "you can't really prevent cancer." In terms of preferred methods of communication, the overarching theme was for health information to be communicated using interactive and dynamic methods, including using social media (Snapchat, Instagram) and video (YouTube) platforms. A sample quote regarding the most effective methods of communication from one of the focus groups illustrates this "I don't know. For me, like a visual is more like I'm very comfortable when it comes to videos. Reading, I mean I can read, but you know, it's kind of like, okay." Students also indicated that they preferred being able to have this information in a health or science class. Supplemental Table 1 presents overarching themes and subthemes with sample quotes extracted from the focus groups.

### Education Module Development and Delivery

The education module focused on five modifiable lifestyle factors that students can act upon in adolescence and young adulthood to reduce their risk of cancer later: (1) HPV vaccination, (2) avoiding tobacco products, (3) increasing physical activity, (4) avoiding alcohol consumption, and (5) eating a balanced diet. The specific messaging about each of these risk factors that was used in the module is highlighted in Fig. 1. To tie all of the concepts together, we constructed a pedigree example that incorporated an individual's family history and cancer genes, lifestyle behaviors, and exposures to carcinogens, illustrated in Fig. 2. The students were provided with a guided note sheet to complete throughout the presentation. We structured the module so that after the presentation, students apply what they have learned to analyze fictional scenarios and discuss methods of cancer prevention and risk reduction. The fictional scenarios were paragraph-long character biographies that were informed by the pedigree. We asked students to annotate the biographies for different types of risk factors (genetics, family history, environmental carcinogens, and lifestyle) and then answer discussion questions related to risk-reduction strategies at the individual and community level, and potential challenges in accomplishing or maintaining healthy behaviors. We encouraged students to reference their


**Fig. 1** Examples of five modifiable lifestyle factors highlighted in the education module that students can act on immediately to lower their long-term risk of cancer

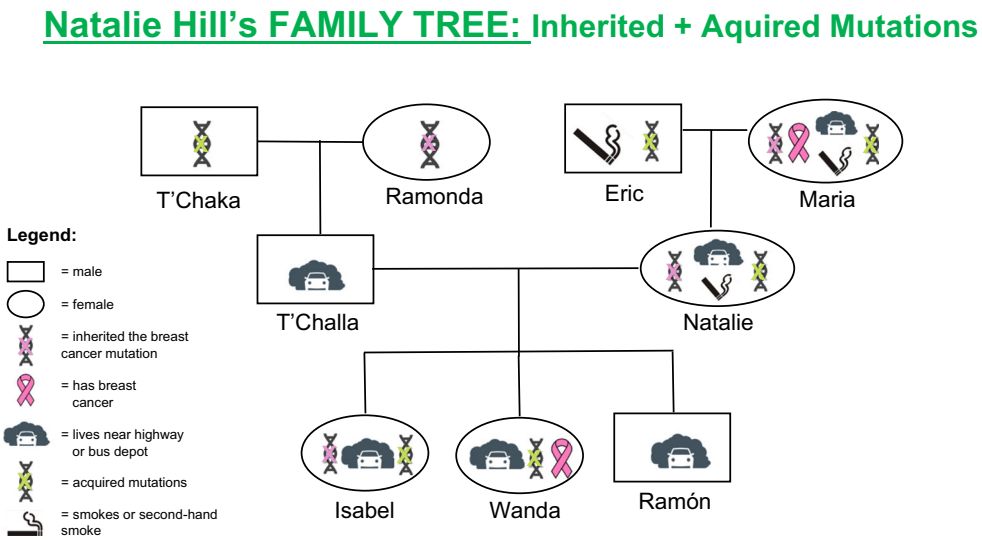


**Fig. 2** Example of a pedigree incorporating genes and the environment in the education module

note sheets during the activity and to work with a partner to discuss what biographical details may qualify as a risk factor and to what category or categories (genetics, family history, environmental carcinogens, and lifestyle) a risk factor could be classified into. Table 1 provides an example of student generated answers during class discussion that reflect three different levels of action for cancer risk reduction (individual, family or friends, and community). An example character biography and discussion questions are illustrated in Supplemental File 2.

## Discussion

This project sought to build on existing academic and community partnerships to develop innovative and tailored risk-reduction messages for adolescents. Despite mounting evidence that cancer risk-reduction efforts that begin earlier in life have a greater impact, cancer risk reduction messaging tailored to adolescents in the USA has largely only included HPV vaccination information, smoking, and sun protection. Each of these three areas is generally taught separately and within health education classes. Based on focus groups we conducted with adolescents in our cohort, we instead focused on educational methods that could be taught in either science or health classes with a focus on cancer biology, the ways multiple risk factors can affect cancer risk, and strategies for risk reduction. We also focused on creating a more dynamic and interactive education module, as that was one of the recurrent themes that emerged from the focus groups on the best way to communicate health information with adolescents.

We found that when the full-time classroom teacher was involved and integrated into the lesson, the module was more successful in terms of student engagement and overall smoother implementation based on the evaluator feedback from the three instructors who implemented the program. For example, the most successful sessions were the ones that were built off long-standing and established partnerships with both the teacher and the schools overall. In some instances, the teacher co-facilitated the session by reframing concepts (e.g., risk) to emphasize and highlight important messages. Additionally, student questions and participation enhanced the learning experience. Questions centered on familial risk, types of physical activity, pedigrees, cancer etiology, and risk reduction strategies. For example, questions about family tree and why a disease "skipped" a generation resulted in a class discussion that highlighted the fact that genes alone do not cause cancer, but rather carcinogenesis is a multifactorial and complex process that is more likely an interaction of genes, the environment, and lifestyle factors. Moreover, the class discussions highlighted structural- and community-level factors, such as local sources of air pollution in upper Manhattan, and how community-based organizations such as WEACT and individuals have worked together towards policy change.

We selected adolescents (ages 10–19) as our target age group as adolescence is a period of initiation and establishment of different lifestyle behaviors (both beneficial and harmful), as well as a window of susceptibility for environmental exposures. Health and risk behaviors adopted during adolescence form and shape the individual's health and risk behaviors in adulthood [7]. For example in breast cancer, growing data support that exposures (e.g., diet including animal versus plant proteins, lack of physical activity, and increased alcohol and tobacco use) in adolescence may be associated with increased breast cancer risk [3]. Higher adolescent physical activity and consumption of vegetable fat and protein and carotenoid intake has been associated with a reduced risk of benign breast disease and breast cancer risk [5, 19–24]. Physical activity during adolescence has also been shown to delay the onset of breast cancer even in women with *BRCA1* or *BRCA2* mutations [25].

Health care providers can play an important role in communication of these cancer prevention messages; however, most physician communication about cancer prevention is performed in adults, where many health behaviors are well established and more difficult to change, and even may be too late to reverse/offset the risk/damage conferred from exposures in earlier windows of susceptibility [26]. In addition, physician messages need to be augmented as a typical visit is

**Table 1** Class discussion—possible actions to reduce risk at three levels of action. An example of student generated answers during class discussion that reflect three different levels of action for cancer risk reduction (individual, family or friends, and community)

| Individual-level | Family- or friends-level "positive peer pressure" | Community-level (local, state, or national policy) |
|---|---|---|
| Tobacco use | Second-hand smoke | Ban smoking in building, smoking cessation programs, tax |
| Exercise | Team physical activities | Improve parks and sidewalks |
| Serving your plate or buying a meal | Grocery shopping or choosing a restaurant | Ban or tax sugary foods |
| Alcohol use | Alcohol use and education | Implement alcohol cessation programs, ban, tax |
| Vaccines (HPV) | Vaccine education | Make vaccines mandatory |

short and happens < 1 times year. Moreover, educating youth can be used to improve the awareness and behaviors of the family members, including parents. For example, prior studies have encouraged or measured student communication and transfer of acquired knowledge to parents [13–15] and guided students in conducting a family health history [27]. A study targeting female middle school students with a breast cancer curriculum showed significant knowledge transfer to the students themselves and to their relatives [11].

Most educational interventions target a single cancer or risk factor rather than tackle the intersectional nature of common risk factors like obesity, alcohol, exercise, and diet that can interact to increase risk for various cancer types. For example, HPV vaccination education interventions typically focus only on cervical cancer as an outcome, sun exposure education focuses solely on skin cancer, and smoking prevention education typically highlights lung cancer though most smoking prevention and cessation programs do not explicitly mention cancer. Exceptions include a water pipe smoking intervention that targeted multiple cancer types such as bladder, oral, and lung cancers [28] and an intervention that covered several lifestyle risk factors for cancer in addition to ultraviolet radiation and workplace exposure to carcinogens [29]. Given that the exposures of these lifestyle risk factors are interrelated and that they affect the risks of multiple cancer sites, the focus on a single risk factor and a single cancer may lead to a failure to understand the broader lifelong potential of cancer risk reduction through teaching students about the science of cancer.

Further, existing educational interventions typically only discuss individual-level lifestyle risk factors and ignore a broader discussion of societal level and environmental risk factors and the ways in which communities may address these factors. Addressing the structural factors (environmental and social) is important in terms of empowering individuals to advocate for policy and societal changes that can have a lasting impact on their communities in terms of cancer prevention and public health in general. We applied a novel and integrated approach that concentrated on five lifestyle modifiable factors that are associated with several cancers and other chronic diseases, and that integrated individual behavior/responsibility as well as structural (environmental and social) factors that affect health, which we linked back to the specific communities in which these students reside (e.g., policy related to environmental exposures near bus depots). During the class discussion, students identified avoiding tobacco use as the individual-level factor for risk reduction, but also cited exposure to second-hand smoke as family and friends level, and finally taxation of tobacco products, smoking bans, and smoking cessation programs as the community-level strategies to reduce risk.

Our module aligns with the New York State (NYS) and the New York City (NYC) educational standards for biology and health. More specifically, it aligns with the NYC health education standard by promoting self-management, advocacy, and decision-making skills, and reinforcing four identified areas of "functional knowledge" including (1) physical activity and nutrition, (2) tobacco, (3) alcohol and other drugs, and (4) sexual risk. Additionally it aligns with six "enduring understanding" topics highlighted by NYC health education standards: (1) how heredity, environment, and lifestyle shape health; (2) risk reduction strategies; (3) social, cultural, and media influences on health behavior; (4) personal responsibility and its challenges; (5) the supportive role of community organizations; and (6) care and respect for self and others. Finally, our module aligns with the NYS Comprehensive Cancer Control Plan 2018–2023 with strong overall of goals for health promotion and cancer prevention including to reduce adolescent alcohol use, tobacco use, and obesity; increase HPV vaccination in adolescents; and increase screening and genetic counseling [30].

In conclusion, we developed and used an integrative and trans-disciplinary approach to develop a novel and interactive cancer risk-reduction education tool focused on multiple risk factors and multiple cancers for adolescents young adults. With the growing burden of cancer, particularly in young adults under 40 years of age [1], adopting broader educational campaigns in adolescence will be essential for greater awareness and ultimately reducing in risk. We plan to continue working with public and private schools throughout New York City to more widely field and test our curriculum. We also plan to disseminate the finalized curriculum to other researchers and communities that may benefit from targeting our curriculum to their students. Curricula that increase adolescent knowledge of modifiable risk factors for cancer have the potential to reduce future cancer burden by potentially and shifting the long-term trajectory of risk accumulation.

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s13187-020-01943-7.

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**Data Availability** Not applicable.

## Compliance with Ethical Standards

**Conflict of Interest** The authors declare that they have no conflicts of interest.

**Code Availability** Not applicable.

## References


1. Kehm RD, Yang W, Tehranifar P, Terry MB (2019) 40 years of change in age- and stage-specific cancer incidence rates in US women and men. JNCI Cancer Spectr 3(3):pkz038. https://doi.org/10.1093/jncics/pkz038
2. Doll R, Peto R (1981) The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. J Natl Cancer Inst 66(6):1191–1308
3. Colditz GA, Bohlke K (2014) Priorities for the primary prevention of breast cancer. CA Cancer J Clin 64(3):186–194. https://doi.org/10.3322/caac.21225
4. Blot WJ, Tarone RE (2015) Doll and Peto's quantitative estimates of cancer risks: holding generally true for 35 years. J Natl Cancer Inst 107(4):djv044. https://doi.org/10.1093/jnci/djv044
5. Maruti SS, Willett WC, Feskanich D, Rosner B, Colditz GA (2008) A prospective study of age-specific physical activity and premenopausal breast cancer. J Natl Cancer Inst 100(10):728–737. https://doi.org/10.1093/jnci/djn135
6. Matthews CE, Shu XO, Jin F, Dai Q, Hebert JR, Ruan ZX, Gao YT, Zheng W (2001) Lifetime physical activity and breast cancer risk in the Shanghai Breast Cancer Study. Br J Cancer 84(7):994–1001. https://doi.org/10.1054/bjoc.2000.1671
7. Williams PG, Holmbeck GN, Greenley RN (2002) Adolescent health psychology. J Consult Clin Psychol 70(3):828–842
8. Kratzke C, Amatya A, Vilchis H (2015) Breast cancer prevention knowledge, beliefs, and information sources between non-Hispanic and Hispanic college women for risk reduction focus. J Community Health 40(1):124–130. https://doi.org/10.1007/s10900-014-9908-9
9. Merten JW, Parker A, Williams A, King JL, Largo-Wight E, Osmani M (2017) Cancer risk factor knowledge among young adults. J Cancer Educ 32(4):865–870. https://doi.org/10.1007/s13187-016-1093-3
10. Zeinomar N, Moslehi R (2013) The effectiveness of a community-based breast cancer education intervention in the New York State Capital Region. J Cancer Educ 28(3):466–473. https://doi.org/10.1007/s13187-013-0488-7
11. Soto-Perez-de-Celis E, Smith DD, Rojo-Castillo MP, Hurria A, Pavas-Vivas AM, Gitler-Weingarten R, Mohar A, Chavarri-Guerra Y (2017) Implementation of a school-based educational program to increase breast cancer awareness and promote intergenerational transmission of knowledge in a rural Mexican community. Oncologist 22(10):1249–1256. https://doi.org/10.1634/theoncologist.2017-0063
12. Stölzel F, Seidel N, Uhmann S, Baumann M, Berth H, Hoyer J, Ehninger G (2014) Be smart against cancer! A school-based program covering cancer-related risk behavior. BMC Public Health 14(1):392. https://doi.org/10.1186/1471-2458-14-392
13. Louis-Nance TR, Flournoy MW, Clinton KS, Hightower K, Sebastian N, Wilkinson LL, Glover SH (2012) The females against cancer educational series: a qualitative evaluation of mother/daughter knowledge and perceptions of human papillomavirus and its related cancers. J Natl Med Assoc 104(3–4):194–198. https://doi.org/10.1016/s0027-9684(15)30137-1
14. Kyle RG, Macmillan I, Rauchhaus P, O'Carroll R, Neal RD, Forbat L, Haw S, Hubbard G (2013) Adolescent Cancer Education (ACE) to increase adolescent and parent cancer awareness and communication: study protocol for a cluster randomised controlled trial. Trials 14:286. https://doi.org/10.1186/1745-6215-14-286
15. Cunningham-Sabo L, Davis SM (1999) Pathways to Health: a school-based cancer prevention project for Southwestern Native American youth. In: Weiner DE (ed) Preventing and controlling cancer in North America: a cross-cultural perspective. Greenwood Publishing Group
16. Adamowicz K, Zalewska M, Majkowicz M, Zaucha JM (2015) Evaluation of the impact of different types of health education on the adoption and preservation of prohealth attitudes in preventing cancer in juveniles younger than 18 years. J Cancer Educ 30(3):432–438. https://doi.org/10.1007/s13187-014-0730-y
17. Kerr JC, Valois RF, Farber NB, Vanable PA, Diclemente RJ, Salazar L, Brown LK et al (2013) Effects of promoting health among teens on dietary, physical activity and substance use knowledge and behaviors for African American adolescents. Am J Health Educ 44(4):191–202. https://doi.org/10.1080/19325037.2013.798218
18. Minkler M, Vásquez VB, Shepard P (2006) Promoting environmental health policy through community based participatory research: a case study from Harlem, New York. J Urban Health 83(1):101–110
19. Berkey CS, Tamimi RM, Willett WC, Rosner B, Lindsay Frazier A, Colditz GA (2014) Adolescent physical activity and inactivity: a prospective study of risk of benign breast disease in young women. Breast Cancer Res Treat 146(3):611–618. https://doi.org/10.1007/s10549-014-3055-y
20. Berkey CS, Willett WC, Tamimi RM, Rosner B, Frazier AL, Colditz GA (2013) Vegetable protein and vegetable fat intakes in pre-adolescent and adolescent girls, and risk for benign breast disease in young women. Breast Cancer Res Treat 141(2):299–306. https://doi.org/10.1007/s10549-013-2686-8
21. Lagerros YT, Hsieh SF, Hsieh CC (2004) Physical activity in adolescence and young adulthood and breast cancer risk: a quantitative review. Eur J Cancer Prev 13(1):5–12
22. Boeke CE, Eliassen AH, Oh H, Spiegelman D, Willett WC, Tamimi RM (2014) Adolescent physical activity in relation to breast cancer risk. Breast Cancer Res Treat 145(3):715–724. https://doi.org/10.1007/s10549-014-2919-5
23. Bernstein L, Henderson BE, Hanisch R, Sullivan-Halley J, Ross RK (1994) Physical exercise and reduced risk of breast cancer in young women. J Natl Cancer Inst 86(18):1403–1408
24. Fuemmeler BF, Pendzich MK, Tercyak KP (2009) Weight, dietary behavior, and physical activity in childhood and adolescence: implications for adult cancer risk. Obes Facts 2(3):179–186. https://doi.org/10.1159/000220605
25. King MC, Marks JH, Mandell JB (2003) Breast and ovarian cancer risks due to inherited mutations in BRCA1 and BRCA2. Science 302(5645):643–646. https://doi.org/10.1126/science.1088759
26. Terry MB, Forman MR (2016) Empowering pediatricians to prevent chronic disease across generations. Pediatrics 138(Suppl 1):S92–S94. https://doi.org/10.1542/peds.2015-4268M
27. Mays D, Peshkin BN, Sharff ME, Walker LR, Abraham AA, Hawkins KB, Tercyak KP (2012) Correlates of adherence to a telephone-based multiple health behavior change cancer preventive intervention for teens: the Healthy for Life Program (HELP). Health Educ Behav 39(1):18–26. https://doi.org/10.1177/1090198111404554
28. Nakkash R, Lotfi T, Bteddini D, Haddad P, Najm H, Jbara L, Alaouie H, al Aridi L, al Mulla A, Mahfoud Z, Afifi R (2018) A randomized controlled trial of a theory-informed school-based intervention to prevent waterpipe tobacco smoking: changes in knowledge, attitude, and behaviors in 6th and 7th graders in Lebanon. Int J Environ Res Public Health 15(9). https://doi.org/10.3390/ijerph15091839

29. Lana A, del Valle MO, López S, Faya-Ornia G, López ML (2013) Study protocol of a randomized controlled trial to improve cancer prevention behaviors in adolescents and adults using a web-based intervention supplemented with SMS. BMC Public Health 13(1): 357
30. Consortium, NYS Cancer (2018) New York State Comprehensive Cancer Control Plan 2018–2023. https://www.health.ny.gov/diseases/cancer/consortium/docs/2018-2023_comp_cancer_control_plan.pdf