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Commentary: eight ways to prevent cancer: a framework for effective prevention messages for the public

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Abstract Research over the past 40 years has convincingly shown that lifestyle factors play a huge role in cancer incidence and mortality. The public, though, can often discount the preventability of cancer. That health information on the Internet is a vast and often scientifically suspect commodity makes promoting important and sound cancer prevention messages to the public even more difficult. To help address these issues and improve the public's knowledge of, and attitudes toward, cancer prevention, there need to be concerted efforts to create evidence-based, user-friendly information about behaviors that could greatly reduce overall cancer risk. Toward this end, we condensed the current scientific evidence on the topic into eight key behaviors. While not an end in themselves, "Eight Ways to Stay Healthy and Prevent Cancer" forms an evidence-based and targeted framework that supports broader cancer prevention efforts.

Keywords Cancer prevention · Risk factors · Lifestyle modification · Health communication · Policy

Introduction

Research over the past 40 years has convincingly shown that lifestyle factors play a large role in cancer incidence and mortality. Doll and Peto's groundbreaking analyses in the 1980s and the cascade of research they inspired estimate that over half of all cancers—and up to three quarters of some specific cancers—could be avoided by a combination of healthy lifestyle and regular screening (Table 1) [1–12].

Despite this large weight of evidence and the important role it plays in public health activities and policies, it also seems to be one that is evading much of the public [13, 14]. Cancer remains one of the public's primary health fears, yet a quarter to nearly half the public discounts the preventability of cancer [13, 15].

To help address this and improve the public's knowledge of, and attitudes toward, cancer prevention, there need to be concerted efforts to create evidence-based, user-friendly information for the public about behaviors that could greatly reduce overall cancer risk. Toward this end, we developed eight key messages, collected under the name "Eight Ways to Stay Healthy and Prevent Cancer" and linked it with our validated risk assessment website, "Your Disease Risk" (http://www.yourdiseaserisk.wustl.edu) [16].

While the full "Eight Ways" document includes supporting text and tips for individuals as well as parents and grandparents, one-line summaries of the messages are as follows:

1. Don't smoke
2. Maintain a healthy weight
3. Exercise regularly
4. Eat a healthy diet
5. Drink alcohol only in moderation, if at all
6. Protect yourself from the sun
7. Protect yourself from infections
8. Get screening tests regularly

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Table 1 Estimated percentage of total cancers avoidable through established non-genetic causes of cancer

Risk factor	Percentage of cancers (%)
Tobacco	29
Adult diet/obesity	25
Viruses/other biologic agents	8
Sedentary lifestyle	5
Family history of cancer	5
Reproductive factors	5
Prescription drugs/medical procedures	5
Alcohol	4
Environmental pollution	4
Ionizing/ultraviolet radiation	2

Adapted from: Figure 2—Wolin, Carson, and Colditz, 2010 [12]

(Full print version online: http://tinyurl.com/8waysPDF)

There are additional steps beyond these eight that could reduce the risk of some individual cancers, yet these eight provide the greatest benefit for the most cancers and can also substantially reduce the risk of other serious chronic diseases (e.g., cardiovascular disease, type 2 diabetes, osteoporosis, and chronic obstructive pulmonary disease) adding even more force to their messages.

Below we summarize the rationale behind each of the eight messages.

Don't smoke

In the United States, smoking causes approximately 30 percent of all cancers and 90 percent of lung cancers. About half of all smokers will die from a smoking-related disease, like cancer, heart disease, and chronic obstructive lung disease. Globally, tobacco is estimated to cause just under five million deaths a year—a number that will likely rise dramatically over the next two generations [17].

Linked primarily in the public's mind with lung cancer, smoking, and use of smokeless tobacco, cause or greatly increase the risk of many other cancers, including cancers of the head and neck, bladder, kidney, cervix, esophagus, pancreas, stomach, colon, and rectum, as well as myeloid leukemia [18, 19].

The single best way to prevent cancer and other chronic diseases is not to smoke. In the United States alone, over 150,000 cancer deaths could be avoided each year if tobacco use were eliminated completely [20]. Globally, it is estimated that if half of smoking adults stopped by 2020, 150–180 million smoking-related deaths could be avoided over the next three decades [21].

Preventing teens and young adults from taking up smoking provides the biggest health benefits, yet despite stepped up efforts to prevent tobacco use, over 20 percent of the U.S. population still smokes [22]. Cessation has large, demonstrated benefits and should be a key part of any prevention recommendations. Within 2 years of quitting, the risk of many smoking-related diseases begin to drop, and after 10–20 years, the risk of lung cancer and most other tobacco-related diseases nearly equals that of non-smokers [8, 23].

Maintain a healthy weight

Although weight is one of the most important risk factors for cancer, an American Cancer Society commissioned survey found that less than 10 percent of the public were aware that being overweight could increase the risk of cancer [24]. Yet convincing evidence shows that about 90,000 deaths from cancer could be avoided each year in the United States if everyone maintained a healthy weight throughout life [25].

Carrying extra weight, particularly being obese (BMI $\geq$ 30), has been strongly linked in prospective data from over 2 million women and men to an increased risk of developing cancers of the breast (after menopause), colon, kidney, pancreas, endometrium, and esophagus (adenocarcinoma) [26]. There is growing evidence that obesity also increases the risk of leukemia, lymphoma, multiple myeloma, and cancers of the liver and gallbladder [26] (Table 2).

Evidence showing that weight loss can lead to a demonstrated lower cancer risk is still developing [12]. This is likely due in large part to the general difficultly of losing weight and then maintaining the loss over time. Most research studies have not had enough subjects with large enough weight differences maintained over a long enough follow-up period to reveal any possible benefits for direct cancer endpoints.

However, there is substantial evidence that weight loss has beneficial effects on biomarkers that serve as intermediate endpoints in the pathway to cancer. Lowering BMI has been shown, for example, to improve insulin levels and also to lower circulating estrogen levels [27].

For direct evidence, a 28-year follow-up in the Nurses' Health Study found that sustained weight loss could cut the risk of postmenopausal breast cancer by over half, with weight loss of as little as five pounds significantly decreasing risk [7].

The well-documented trends in the rising prevalence of overweight and obesity in the United States predict a growing burden of not only weight-related cancers but also heart disease, stroke, and diabetes. The latest data show that a full two-thirds of the population is either overweight (BMI 25–29.9) or obese [28]. Over the last two decades, rates of obesity have significantly increased across the nation, with over a third of the population now considered

Table 2 Risk of cancer with increased body mass index (BMI)[a]

Cancer	Sample size (millions)	Follow-up (years)	RR Men	RR Women
Breast (premenopausal)	2.5	8.4	–	0.92**
Breast (postmenopausal)	2.5	8.4	–	1.12*
Colon	4.8	11	1.24*	1.09*
Endometrium	3.0	10.6	–	1.59*
Gallbladder	3.3	12.7	1.09	1.59***
Gastric	4.7	10.8	0.97	1.04
Leukemia	4.7	13.7	1.08**	1.17***
Liver	3.3	12.7	1.24	1.07
Lung	2.6	11.9	0.76*	0.80***
Malignant melanoma	4.0	10.6	1.17**	0.96
Multiple myeloma	5.2	14.6	1.11*	1.11*
Non-Hodgkin lymphoma	5.0	12.4	1.06*	1.07
Esophageal adenocarcinoma	4.7	10.8	1.52*	1.51*
Esophageal squamous	4.7	10.8	0.71*	0.57*
Ovarian	2.7	12.2	–	1.03
Pancreas	3.3	9.4	1.07	1.12***
Prostate	3.0	10.6	1.03	–
Rectum	4.8	11	1.09*	1.02
Renal	5.5	10.6	1.24*	1.34*
Thyroid	3.3	14.4	1.33***	1.14**

Data source: Renehan et al. 2008 [26]

* $p < 0.0001$; ** $p < 0.01$; *** $p < 0.05$

[a] Relative risk for a 5-point increase in BMI

obese [28, 29]. Such trends, while most pronounced in the United States, are being expressed worldwide as well, pointing to a huge future global burden from weight-related diseases [30].

Exercise regularly

Overall, in the United States, it is estimated that 5 percent of cancers are linked to lack of regular exercise, which is largely accounted for through two common cancers, breast cancer and colon cancer [2]. Regular physical activity lowers the risk of colon adenomas and colon cancer by about 15–20 percent [31, 32]. For breast cancer, the benefits of regular exercise seem largest for premenopausal women, but postmenopausal women see lower risks from regular physical activity as well [33–35]. Though data are still developing, some evidence supports the theory that adolescent activity level may be even more important to breast cancer risk than adult activity level, as it can lower lifetime estrogen exposure through increased leanness and delayed menarche [35].

Despite its demonstrated health benefits, over 50 percent of the U.S. population does not get the recommended amount of activity each week—either 30 min of moderate activity (like brisk walking) 5 or more days per week, or 20 min of vigorous activity (like running) 3 or more days per week [36]. About a third of the U.S. population gets no leisure-time activity [37], and in some counties, the rate of inactivity crests 40 percent [38]. Two-thirds of people do not know how much physical activity they should be getting [14].

Eat a healthy diet

A healthy diet is key to overall health and can help lower the risk of numerous cancers. The most important aspect of diet for cancer prevention is overnutrition [39]. Overconsumption of calories, and the weight gain it causes, contributes greatly to cancer burden. Keeping calories in check, so weight stays in check, is therefore a key part of any healthy diet recommendation and is reflected in the 2010 Dietary Guidelines for Americans and the American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention [40, 41].

Outside of overnutrition, good evidence shows that a cancer risk reducing diet is as follows: largely plant based (with a lot of fruits, vegetables, and whole grains); low in animal products (like animal fat, red meat, and processed meat); low in sodium; and, for men, not too high in calcium (less than 1,500 mg/day) [42] .

A daily multivitamin can provide added protection against certain cancers and other chronic diseases [43, 44]. Although some recent trials have had null results when looking at supplement use and cancer risk, there is a growing body of evidence that calcium and vitamin D (found in increasing levels in most multivitamins) protect against colon cancer [45–54]. Long-term folate intake has also been shown to lower the risk of colon cancer, as well as breast cancer in women who regularly drink alcohol [55–59].

Cancers with a link to diet include: breast cancer, colon cancer, esophageal cancer, lung cancer, oral cancer, pancreatic cancer, prostate cancer, pharyngeal cancer, laryngeal cancer, and stomach cancer, as well as kidney and uterine cancer, which are linked through weight gain [3, 5, 42].

Drink alcohol in moderation, if at all

The dual health effects of alcohol give it a complex role in public health. While studies consistently show that moderate alcohol consumption can significantly lower the risk

of cardiovascular disease, drinking even a small amount of alcohol (less than one drink/day) can raise the risk of numerous cancers, including two of the most common—breast and colon [42, 60]. For both breast cancer and colon cancer, alcohol likely increases risk by acting as a folate antagonist and therefore lowering serum levels of folate, among other possible causal mechanisms. Good evidence, though, suggests that taking a folate supplement can help eliminate some of the cancer risk linked to alcohol [61–63].

Balancing these risks and benefits is key to the pubic health messages about alcohol intake. Although the benefits of moderate intake are well established, the cancer risk and potential for alcohol dependence means that non-drinkers should not be encouraged to start drinking. Most of those who already drink moderately, though, do not need to be encouraged to stop. While cancer risk may be increased slightly in this group, the cardiovascular benefits are significant as well. All heavy drinkers, though, should be encouraged to cut back to moderate levels, or stop altogether.

Protect yourself from the sun

With melanoma rates rising steadily from year to year both in the United States and worldwide, proper sun protection is a key public health message [64]. Yet in the United States, the percent of the population reporting a sun burn over the past year is rising, with a third reporting at least one sunburn, and about 20 percent reporting four or more [65].

Severe sunburns and unprotected sun exposure can greatly increase the risk of melanoma, particularly in susceptible groups, such as those with fair skin and hair [66–68]. Over exposure in youth seems especially linked to increased risk later in life.

Yet, it is estimated that about 50 percent of the adult population rarely uses sunscreen, and 50–80 percent do not wear sun-protective clothing when outside on sunny days [69].

There is some evidence promoting unprotected "safe sun" exposure, which could help elevate serum vitamin D (25(OH)D) levels, which in turn could lower risk of osteoporosis and certain cancers [54, 70, 71]. One recent study found that whites who stayed out of the sun or wore long sleeve shirts increased their risk of vitamin D deficiency [72].

Currently, though, population rates of sun-protection practices are so low, that for now the public should be encouraged to properly protect themselves (and their children) from the sun whenever possible, which includes: avoiding the sun as much as possible during peak burning hours (10 am–4 pm); wearing long-sleeve shirts, long pants, and wide-brimmed hats, and; properly applying broad-spectrum sun screen.

Protect yourself from infections

Infections play an important role in the development of certain cancers. Worldwide, approximately 15 percent of all cancers have been linked to infections. In developing countries marked by poor living conditions and inadequate health care, this number reaches almost 25 percent [73].

At least ten infectious agents are known to increase the risk of cancer (Table 3), several of which are quite common. Of particular importance are human papillomavirus (HPV), hepatitis B and C viruses, and Helicobacter pylori. HPV is a sexually transmitted virus that is linked to numerous cancers, with cervical cancer being the most important. Hepatitis B and C infect the liver and together account for the large majority of liver cancer. Finally, *Helicobacter pylori* has been estimated to cause upward of 75 percent of all stomach cancers, the second leading cancer worldwide [74].

Concrete steps like avoiding blood exposure (e.g., by not sharing needles), practicing safer sex and, for women, getting regular Pap tests and possibly HPV tests can help lower risk. There is also very strong evidence that vaccinating girls (around age 11 or 12) effectively protects against major types of HPV that can cause cervical cancer later in life [75, 76]. Vaccinating boys against HPV is also likely to lower risk of anal cancer and further protect girls by lowering the overall presence and transmission rates of cancer-associated HPV [77]. The hepatitis B vaccine reduces liver cancer risk, and its growing use worldwide is expected to result in similar benefits to those expected with the HPV vaccine [11, 78]. Advances on vaccines for other agents also offer much promise.

Table 3 Infectious agents associated with cancer

Agent	Type of cancer
Human papillomavirus (HPV)	Cervix, vulva, anus, penis, head and neck
Hepatitis B virus (HBV)	Liver
Hepatitis C virus (HCV)	Liver
Helicobacter pylori	Stomach
Epstein-Barr virus (EBV)	Nasopharynx, Hodgkin's disease, non-Hodgkin's lymphoma
Human herpesvirus type 8 (HHV-8)	Kaposi's sarcoma
Human immunodeficiency virus type 1 (HIV-1)	Kaposi's sarcoma, lymphoma
Human T-cell lymphotrophic virus type I (HTLV-I)	Leukemia/lymphoma
Schistosomes	Bladder
Liver flukes	Bile duct

Get screening tests regularly

Cancer screening at regular intervals with effective tests is established to protect against some specific cancers. Regular screening with sigmoidoscopy, for example, has been shown in a large randomized controlled trial to cut the risk of colorectal cancer by about 25 percent, and the risk of dying of the disease by nearly a third [79]. Fecal occult blood test cuts colorectal cancer mortality by up to a quarter [80, 81]. Modeling data estimate that modest compliance to recommendations for colonoscopy every 10 years can reduce colorectal cancer incidence by 58 percent [82].

Pap tests, along with the addition of the newer human papillomavirus (HPV) test, help assess future cancer risk and allow treatment of identified precursor lesions. With widespread use of the Pap test, incidence and mortality rates of invasive cervical cancer have dropped by over 40 percent in the United States since 1973 [83].

Though clinical breast examination and mammography are not preventive, they are keys to early detection and successful, less aggressive treatment of breast cancer, conferring significant survival benefit [84].

Despite its common use, the benefits of prostate-specific antigen (PSA) screening for prostate cancer are not as clear as those of other recommended screening tests and should be offered to men only in concert with a clear discussion of its limitations and potential risks and benefits [85].

Recently, the large National Lung Screening Trial has shown significant lung cancer and all-cause mortality benefits with low-dose-computed tomographic scans in current and former heavy smokers [86]. Open questions remain, though, on exactly how to translate these findings to effective population-wide screening recommendations [87].

Statistics show a clear need for improvement in rates and implementation of cancer screening, with half of all colorectal and cervical cancers, and a third of all breast cancers, still diagnosed in late stages [88].

Importance of policy

As various social science models show, individuals do not often act in a vacuum [89]. So, while the "Eight Ways" are intended to help guide and promote healthy behaviors in individuals, their messages must be broadly reflected across the environmental and social influences that surround people if they are going to result in successful and sustained behavior change in people and populations.

Policies—whether those of workplaces, insurers, schools, or governments—can help create environments that promote and support a healthy, cancer-preventing lifestyle [90]. Momentum for positive policy changes has been slowly gaining in some areas [91]. Awareness of the need to stem the tide of childhood obesity is spurring action by many groups, and restrictions on tobacco use continue to grow, even across Europe, which once seemed impervious to such policies [92–95].

Still much more needs to be done at both the local, state, and federal levels to help individual make healthier choices that will realize the huge potential of cancer prevention.

Conclusion

Approximately eighty percent of all Internet users search online for health information [96]. With much of this information scientifically suspect, there is benefit in developing sound, evidence-based messages the public can both trust and find useful. That should be a major goal for any health communication program and is the genesis behind the "Eight Ways to Stay Healthy and Prevent Cancer." While such messages are not an end in themselves, they form an evidence-based and targeted framework that supports broader cancer prevention efforts. They can be readily used by cancer center outreach programs and community groups to focus priority on prevention efforts in local communities and to guide policy strategies that will make our population healthier, save health care expenditures, and avoid future pain and suffering.

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