



## PRIMARY PREVENTION OF CANCER AND FINANCIAL SAVINGS ACHIEVABLE THANKS TO HEALTHIER POPULATIONS: ONLINE EDUCATIONAL AND INFORMATIVE RESOURCES<sup>i</sup>

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### Abstract:

This article presents online documents downloadable for free on the primary prevention of cancer, and on the financial savings achievable thanks to healthier populations. Among the main cancer risk factors are: tobacco and alcohol use, suboptimal diet, infections, and sedentary lifestyle. Many lower-income countries are transitioning toward the western lifestyle, thus converging toward the western cancer risk profile. Incidence rates differ impressively by country; for instance, the values for prostate cancer vary in a range between 6.3 and 83.4 cases per 100,000 men, with higher values observed in the transitioned countries. In people that drink and smoke heavily, a risk of larynx cancer 289.4 times higher than in the lowest consumers of both alcohol and tobacco has been observed. This combined exposure also results in a disproportionately increased risk for oral cavity, oropharynx, larynx and esophagus. Particulate matter, classified as carcinogenic, is generated, e.g. by traffic, industries, livestock operations and crop residue burning. Some documents deal with existing mitigation techniques that only require policies to make them attractive. Physical inactivity is a risk factor for many cancers. Worldwide, the annual cost of diseases attributable to physical inactivity is US\$27 billion. In cycling commuters, the observed hazard ratios of cancer and cardiovascular disease incidence are respectively 0.55 and 0.54, which suggests the importance of policies favouring, e.g. cycle commuting to improve public health. The disabilities consequent to suboptimal diets are estimated to cost in healthcare more than \$1200/year for every American, whereas a healthy diet implies annually a \$550 higher cost per person. According to the authors, lowering the price of healthier foods should be a goal of policy efforts. Heavy taxes on tobacco products are the most effective strategy to discourage smoking. Some countries use the revenues generated from tobacco taxation to, e.g. improve healthcare for the poor, and promote sport activities for young people. The best results are achieved when healthy choices do not rely only on individuals, but

<sup>i</sup> RISORSE EDUCATIVE ED INFORMATIVE IN RETE SULLA PREVENZIONE PRIMARIA DEI TUMORI E SUI RISPARMI CHE NE DERIVANO PER LA SANITÀ PUBBLICA

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are supported by the whole society: schools, mass media, food industry, healthcare providers and governments working together.

**Keywords:** online educational resources, cancer prevention, tobacco taxation, subsidise healthy food, physical activity, particulate matter

**Riassunto:**

L'articolo presenta documenti scaricabili gratuitamente da internet sulla prevenzione dei tumori e sui benefici economici che ne derivano per il sistema sanitario. Tra i principali fattori di rischio troviamo: tabacco, alcool, dieta malsana, infezioni e sedentarietà. Molti paesi a basso reddito, passando allo stile di vita occidentale si assumono anche il profilo di rischio di tumori occidentale. I tassi di incidenza variano in maniera impressionante da un paese all'altro; ad esempio per il cancro della prostata variano tra 6,3 ed 83,4 casi su 100.000 uomini, con i valori più alti osservati nei paesi più ricchi. Nelle persone che consumano molto alcool e tabacco, era stato osservato un rischio di cancro alla laringe 289,4 volte più alto che in soggetti facenti poco uso di alcool e tabacco. Questa doppia esposizione porta anche uno sproporzionato aumento di rischio per: cavità orale, orofaringe, laringe ed esofago. Il particolato atmosferico, classificato come carcinogeno, è generato ad esempio da: traffico, industrie, attività zootecniche e combustione di residui agricoli. Alcuni documenti descrivono tecniche volte a mitigare questi problemi, che hanno solo bisogno di un supporto istituzionale che ne renda possibile l'attuazione. L'inattività fisica è un fattore di rischio per molti tumori. Nel mondo, il costo annuale delle malattie attribuibili alla sedentarietà è di 27 miliardi di dollari. Nei pendolari ciclisti, i tassi di rischio osservati per tumori e malattie cardiovascolari sono rispettivamente 0,55 e 0,54. Ciò suggerisce quanto sia importante per la salute pubblica una pianificazione che favorisca, ad esempio, gli spostamenti in bicicletta. Si stima che le disabilità conseguenti ad una dieta malsana costino in spese sanitarie più di 1.200 dollari l'anno per ogni americano. Seguire una dieta sana implica un costo maggiorato di 550 dollari. Secondo gli autori, eliminare gli ostacoli economici per una alimentazione più sana sarebbe utile. Alzare la tassazione sul tabacco è la strategia più efficace per scoraggiarne l'uso. Alcuni paesi usano i redditi generati da queste tasse per, ad esempio, migliorare l'assistenza sanitaria ai poveri e promuovere attività sportive per i giovani. I migliori risultati vengono raggiunti quando le scelte salutari dei cittadini sono supportate da tutta la società con scuola, mezzi di informazione, industria alimentare, operatori sanitari e governi che lavorano insieme.

**Parole chiave:** risorse educative in rete, prevenzione dei tumori, tasse sul tabacco, sovvenzioni per alimenti sani, attività fisica, particolato atmosferico

## 1. Aims of the teaching unit

This article is aimed at increasing knowledge and awareness on how a healthy lifestyle may reduce the risk of cancer and other diseases, which results in important savings for sanitary systems.

## 2. Material and methods

The article presents informative and educational resources downloadable for free from the internet. They consist of text, graphs, images and videos. This paper is exclusively based on the quoted documents, which teachers can use with the method felt as most appropriate.

## 3. Introduction

The Institute for Work & Health provides some examples of primary, secondary and tertiary prevention, with the first aimed at avoiding an unwanted event, for instance, a disease, before it ever occurs ([1](#)).

More than 100 types of cancer (C) exist; they are usually named according to the organs or tissues where they start developing ([2](#)). The document of the National Cancer Institute provides basic information on this genetic disease.

From a page of the National Cancer Institute, we can find much information about *causes and prevention of many types of C*, treatments, screening and the latest research ([66](#)).

“Agents Classified by the IARC Monographs, Volumes 1–135” is a document of the International Agency for Research on Cancer. The document classifies several agents according to carcinogenicity ([70](#)> List of Classifications / [70](#)> List of Classifications by Cancer Site).

An interactive atlas of the International Agency for Research on Cancer provides information on the incidence rates of C in the different parts of the body, by country, age and sex ([5](#)> Heatmap).

“Global Cancer Statistics 2020: Globocan Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries” provides general information on C that, in 2020 caused 19.3 million new cases and 10 million deaths. People are most commonly diagnosed with: female breast, lung, colon/rectum, prostate, liver and stomach Cs ([3](#)).

Figures from 8 to 23 ([3](#)) show graphs on incidence and mortality rates from different Cs by country. The document explains the reasons of the *impressive differences between countries*, and where and why the incidence rates are changing. C incidence rates in specific parts of the body may vary up to 50 times between different geographic areas ([4](#) fig 16.1). Much of the difference can be consequent to different lifestyle, environment, and levels of implementation of C control measures, which supports the importance of prevention in reducing the burden of C. According to the atlas, *two-fifths of diagnosed cases are potentially avoidable*.

Considering only population growth and aging, the new cases are expected to grow from 17 to 27.5 million per year between 2018 and 2040. A graph shows the projections of the C burden ([4](#) page 15).

Tobacco use is the first preventable cause of C deaths on a global scale. Figure 11.2 ([4](#)) shows the trends in the US, where increased cigarette consumption was followed by increased mortality rates a few decades later. In 2017, smoking was responsible for 24% of all C deaths globally. Quitting smoking at any age may substantially reduce the risk of death from lung C; clearly, the earlier we quit the better, as shown in Figure 26.2. Thanks to recent tobacco control laws, in 55 countries, 1.5 billion people benefit from smoke-free legislation.

According to “Health Risks of Smoking Tobacco” ([7](#)), the increased C risk is not only for the lung but also for: mouth, larynx, pharynx, esophagus, kidney, cervix, liver, bladder, pancreas, stomach, colon/rectum. Smoking tobacco also implies an increased cardiovascular risk, and may affect sex life and the reproductive system. Figure 5.2 ([4](#)) shows the percentage of C deaths attributable to alcohol by site, which includes the pharynx, oral cavity, esophagus and breast ([10](#)).

Infections are a major cause of Cs, this is particularly true in sub-Saharan Africa and other economically transitioning countries. Figure 2.1 ([4](#)) shows what Cs are caused by infectious agents, such as *H. pylori*, HPV, and hepatitis B and C viruses. In sub-Saharan Africa, the infections are responsible of 30-50% of C cases, Conversely, in North America and Europe this proportion is 3-5%. Figure 7.3 ([4](#)) shows the associations between the ten most common Cs and the reproductive and hormonal risk factors in women, worldwide.

The human carcinogens identified by the International Agency for Research on Cancer are discussed on pages 31-32 ([4](#)). “American Cancer Society Guideline for Diet and Physical Activity” is a document whose content is summarised by the title ([10](#)).

A document of the International Agency for Research on Cancer contains questions and related answers about foods and nutrients that influence C risk ([58](#)). From the website of the American Cancer Society, we can access information on many Cs, including causes, risk factors, prevention, symptoms and treatments ([6](#)> Select a Cancer Type). Figure 5.1 shows 10 recommendations aimed at C prevention. *Each of them protects from C; by following all of them together we can get the greatest benefit* ([4](#)).

#### 4. Bladder Cancer

In smokers, the risk is at least 3 times higher than in non-smokers. Tests may help us to find the C early, when the treatment is more likely to be effective ([6](#)> Select a Cancer Type> Bladder Cancer> Causes, Risk Factors, and Prevention). Among the risk factors of bladder C, we find: workplace exposures, arsenic in drinking water, certain medicines and some herbal supplements. *Drinking enough fluids may lower our risk since the more often we empty our bladder the less chemicals are lingering in it.*

According to several studies, but not all, fruits and vegetables have a protective effect for the bladder. According to a study, a high cruciferous intake is associated with a relative risk of 0.49 ([60](#)).

#### 4. Breast Cancer

The incidence rates of breast C are generally much higher in transitioned than in transitioning countries. This is related to hormonal risk factors, e.g. later age at first birth, less breastfeeding, oral contraceptive use and lifestyle risk factors, e.g. physical inactivity, alcohol intake and excess body weight. In Northern America, Oceania and Europe, the widespread availability of mammographic screening increased the detection between the 1980s and 1990s, while treatments for the disease have improved ([3](#)).

*In transitioning countries, the incidence rates of breast C are growing quickly, thus converging toward the risk profile of western countries.* In women living in Sub-Saharan countries the survival rates are low as a consequence of late diagnosis, which reflects weak health infrastructures ([3](#) / [4](#) Figure 12.2). Early diagnosis and adequate treatment may also contribute to a significant reduction in deaths ([3](#)).

According to “Migration History, Acculturation, and Breast Cancer Risk in Hispanic Women”, *breast C risk is increased in populations that move from countries where incidence rates are low to countries where rates are high.* For instance, the risk is 50% lower in Hispanic women born abroad than in those born in the US and, the longer they stay in the US the higher the risk ([64](#) / [3](#)).

One drink of alcohol a day may increase the risk by 7-10%. Age over 55 and being overweight or obese, especially if the weight has been gained at adult age, implies a higher risk after menopause ([6](#)> Select a Cancer Type> Breast Cancer> Causes, Risk Factors, and Prevention).

According to “Physical activity and breast cancer: a systematic review”, in physically active postmenopausal women the risk can be reduced by 20-80%. This protective effect is consequent to a lower exposure to sex steroid hormones, insulin and insulin-like growth factors, and a lower body weight ([12](#)).

#### 5. Colorectal Cancer

The risk factors include: overweight/obesity, physical inactivity, smoking, consumption of red meat, especially if cooked at very high temperatures, and processed meat. A low blood level of D vitamin and even a light-to-moderate alcohol use may increase the risk. People who drink alcohol would benefit from having no more than 2 drinks a day for men, and 1 drink for women ([6](#)> Select a Cancer Type> Colorectal Cancer> Causes, Risk Factors, and Prevention).

The document also provides information on unmodifiable risk factors for colorectal C, which include racial and ethnic background. People with inflammatory bowel disease have an increased risk; they might have to start screening earlier and more

frequently than other people do. The risk is higher in people with a first-degree relative diagnosed with colorectal C or adenomatous polyps; the risk is even higher if the relative was diagnosed before the age of 50, or if more than one first-degree relative is affected. In this case, our doctor might recommend starting screening earlier than other people. *For this reason, if we are diagnosed with one of these diseases, it is important to pass the information to our relatives* ([6](#)> Select a Cancer Type> Colorectal Cancer> Causes, Risk Factors, and Prevention).

Other factors influence our risk of colorectal C, for instance, type 2 diabetes. According to some studies, night shift work might increase our risk as a consequence of changes in the level of melatonin, but more research is needed in this field. Again, more research is necessary to understand if previous treatment for other Cs may result in increased colorectal C risk ([6](#)> Select a Cancer Type> Colorectal Cancer> Causes, Risk Factors, and Prevention).

“A meta-analysis of the association of physical activity with reduced risk of colorectal cancer” found risk ratios of 0.78 and 0.71, respectively in males and females practicing high levels of recreational activities. The analysis, however, did not show a protective effect against rectal C ([14](#)).

In contrast, “Physical Activity and Colorectal Cancer” has found a risk reduction of rectal C in both males and females with odd ratios, respectively 0.60 and 0.44 ([13](#)). According to the study, in men, vigorous activity confers greater protection than moderate activity.

According to “Food groups and risk of colorectal cancer”, a high intake of whole grains, fruit, vegetables and dairy products is associated to a lower risk of colorectal C. High fibre content is associated with a quick transit of faeces in the intestine, while minerals and antioxidants contained in fruit and vegetables might play a protective role. On the contrary, red and processed meat contains several carcinogenic chemicals, whose amount depends on processing and preparation ([15](#)).

## 6. Lung Cancer

A graph shows the sales of cigarettes per adult per day, from 1875 to 2015 ([65](#)). In the US, smoking is by far the 1<sup>st</sup> risk factor of lung C, radon exposure the 2<sup>nd</sup>, and second-hand smoke the 3<sup>rd</sup>. Radon is found in buildings, especially in the basements ([6](#)> Select a Cancer Type> Lung Cancer> Causes, Risk Factors, and Prevention). Radon enters homes from the soil. Heavy exposures may also occur in underground mines ([4](#)).

We may test our home to know the level of this radioactive gas, that may enter the home through small cracks or holes. The document, which also deals with *how to reduce radon levels*, contains a short video ([11](#)).

Professional exposure to asbestos increases the risk of lung C and malignant mesothelioma. Several carcinogens, including diesel exhaust, are found in workplaces. Other risk factors exist; for instance, in geographic areas where drinking water has a high



arsenic level, people suffer a higher risk of lung C ([6](#)> Select a Cancer Type> Lung Cancer> Causes, Risk Factors, and Prevention / [4](#)).

## 7. Prostate Cancer

In 2020, this disease was the 2<sup>nd</sup> most frequent C. The incidence rates vary in a range between 6.3 and 83.4 cases per 100,000 men in the different geographic areas, with higher values observed in transitioned than in transitioning countries. Among the modifiable risk factors, probably, tobacco use, excess body weight and some nutritional factors have a role in determining the risk ([3](#)).

Prostate C is more frequent in Afro-American and in Caribbean men of African ancestry than in other races. The risk is higher in White Americans than in Asian Americans. In these latter, the risk is higher than in Asians sharing similar ethnic backgrounds and living in Asia. Having a father and even more so having a brother with prostate C more than doubles our risk. Having several affected relatives increases the risk, *especially if they have been diagnosed when young* ([6](#)> Select a Cancer Type> Prostate Cancer> Causes, Risk Factors, and Prevention).

According to “Physical activity in relation to risk of prostate cancer: a systematic review and meta-analysis”, links between physical activity and prostate C remain difficult to understand ([17](#)). According to the meta-analysis, however, long-term occupational physical activity provides some protection against the disease, including reduced mortality among survivors.

## 8. Melanoma skin Cancer

It is important to detect it early when it is easier to treat. Exposure to UV rays is the first risk factor. Lighter skin, red or blond hair, blue or green eyes and a skin that freckles or burns easily imply higher risk. If a 1<sup>st</sup> degree relative has had melanoma, the risk is higher as a consequence of a shared family lifestyle including frequent sun exposure, or lighter skin tone, or for genetic reasons running in the family or these factors combined. *In parts of the body that are not constantly exposed to the sun, such as the trunk, the development of melanoma is typically associated to sunburns occurring during childhood* ([6](#)> Select a Cancer Type> Melanoma Skin Cancer> Causes, Risk Factors, and Prevention).

*In many countries, skin Cs cause a significant economic burden* ([4](#) Figure 6.1), and 90% of them are preventable thanks to sun protection. Tanning devices are classified as human carcinogens, their UV radiations are often stronger than the summer sun. Differently from many European countries, Australia has implemented UV protection campaigns; here, melanoma rates are decreasing in young people. This can be seen in a graph that compares the Australian and English incidence rates ([4](#) Figure 6.3).

Two maps of Europe ([39](#)) show the new cases of skin melanoma and deaths per 100,000 people.

A graph shows the incidence of melanoma by race in the United States of America, 2004-2008 ([40](#) figure 1).

*The immune system helps the body in the fight against Cs in the skin as well as in other parts of the body. C risk is higher if the immune system is weakened; this can be consequent to, e.g. HIV infection or medical treatments including organ transplants ([6](#)> Select a Cancer Type> Melanoma Skin Cancer> Causes, Risk Factors, and Prevention).*

## 9. Stomach Cancer

The consumption of food preserved by salting, and of processed or grilled or charcoaled meat, as well as infection with *Helicobacter pylori* are associated with a higher risk. Being overweight and obese increases the risk of C in the upper part of the stomach. The consumption of raw vegetables or fresh fruit, especially citrus fruits, exhibits a protective effect ([6](#)> Select a Cancer Type> Stomach Cancer> Causes, Risk Factors, and Prevention). In smokers, the risk is about doubled. Alcohol use probably increases the risk; this is more evident in people having more than 3 drinks per day. Among the factors that may increase the risk, there are, e.g. previous stomach surgery, having a 1<sup>st</sup> degree relative that has had this disease, and working in coal or rubber or metal industries ([6](#)> Select a Cancer Type> Stomach Cancer> Causes, Risk Factors, and Prevention).

Several studies have found an association between dietary salt intake with increased risk of stomach C. According to the studies reviewed, the pooled odds ratio is 1.55 for high versus low salt intake ([18](#) Figure 2). Several mechanisms may explain this association; for instance, a high salt concentration may damage the gastric mucosa, which can lead to hyperplasia and increased potential for mutations. In addition, high salt intake may promote the colonisation of *Helicobacter pylori* in the stomach, known for being a risk factor for gastric C.

## 10. Esophagus cancer

Aging and male sex are unmodifiable risk factors for this C. The more and the longer a person uses tobacco, the higher the risk. Drinking alcohol, gastroesophageal reflux, obesity, physical inactivity, and drinking frequently very hot liquids may increase the risk. Accidental drinking of a lye-based cleaner also may increase the risk, with C occurring many years or decades later ([6](#)> Select a Cancer Type> esophagus Cancer). Achalasia is a condition where the lower esophageal sphincter does not allow food and liquids to pass easily into the stomach, which irritates the lining of the lower part of the esophagus exposed to foods for a longer time than normally should happen. In people with this condition, the risk of C is many times higher, with C found about 15-20 years after achalasia began.



## 11. Cancer risk in those who smoke and drink alcohol heavily

“Independent and joint effects of tobacco smoking and alcohol drinking on the risk of esophageal cancer in men and women” deals with the strong synergistic interaction observed between the two habits. This implies a disproportionate increase of C risk, with odds ratio of 107 in those who drank and smoked heavily (33).

“A study of the interaction of alcohol drinking and tobacco smoking among French cases of laryngeal cancer” has found that *in those who drank and smoked heavily, the risk observed was 289.4 times higher than in the lightest consumers of both alcohol and tobacco* (34 Table 2). Interestingly, among the C cases observed in the study, none were both non-smoker and non-drinker.

According to a document of the World Health Organisation, being a smoker and alcohol drinker results in a 5 times higher risk of developing Cs in: oral cavity, oropharynx, larynx and esophagus, than in people using either alcohol or tobacco alone. Whereas, in heavy users, the risk is 30 times higher (35). A document by the American Cancer Society comes to similar conclusions (10).

## 12. Occupational cancer risk

“Occupation and cancer – follow-up of 15 million people in five Nordic countries” presents data on C incidence by occupational category (9). Tables 80 and 81 show the observed number and standardised incidence ratios of all malignant neoplasms, respectively for men and women.

Tables 10 and 11 show the standardised incidence ratios of C in the oral cavity, by country and occupational category, with average values ranging between 0.55 in farmers and 5.05 in waiters. The text provides a comment on it: alcohol and tobacco are the main aetiological agents, consequently, professional categories that have easy access and/or liberal attitudes towards drinking or smoking are more exposed (9).

Certain professions do not allow smoking during working hours; in contrast, tobacco workers had an increased smoking likelihood consequent to a former tradition of quotas of free cigarettes (9). Figure 8.2 (4) deals with occupational carcinogens and associated C sites.

## 13. Medications and cancer risk

The content of “Medical Treatments that Might Affect Cancer Risk” and of “Diabetes medications and cancer risk associations: a systematic review and meta-analysis of evidence over the past 10 years” are summarised by the titles (67 / 68).

“Antibiotic therapy is associated with an increased incidence of cancer” has found that the use of certain antibiotics, and not others, is associated with higher C risk. The authors also discuss the limitations of the study (69).

## 14. Air pollution and particulate matter

Annually, outdoor air pollution causes 6-8 million deaths from lung C and other diseases. In low- and middle-income countries the use of solid fuels results in indoor air pollution which, in turn, causes an estimated 3.8 million deaths per year ([4](#)).

The International Agency for Cancer Research has classified outdoor air pollution as carcinogenic to humans (Group 1). The exposure, besides causing lung C, is associated with an increased risk of bladder C. Main anthropogenic sources of outdoor air pollution are traffic, power plants, industry, agriculture, residential heating and cooking. Particulate matter, also classified as carcinogenic (Group 1), is an important component of outdoor air pollution. The director Dr. Christopher Wild says *“There are effective ways to reduce air pollution and, given the scale of the exposure affecting people worldwide, this report should send a strong signal to the international community to take action without further delay”* ([19](#)).

*“Outdoor Air Pollution - Volume 109 - IARC Monographs On The Evaluation Of Carcinogenic Risks To Humans”* provides much information on the subject ([20](#)).

A Swiss study has found a 1.43 times higher risk of leukemia in children living within 100 metres than in children living 500 metres or more from a highway. A particularly higher risk was observed in children younger than 5 years ([23](#)).

## 15. Particulate matter emissions from agriculture, and their mitigation

An Italian study deals with the generation of secondary inorganic particulate matter (PM<sub>2.5</sub>) in the atmosphere. Here, ammonia emitted from livestock waste reacts with atmospheric nitric and sulphuric acids, which results in the formation of ammonium nitrate and ammonium sulphate which constitute the major part of secondary particulate matter. This latter can penetrate deeply into the lung and translocate to blood circulation, which implies adverse health effects ([21](#)).

PM<sub>2.5</sub> largely originated in a similar way is estimated to cause 2,000 deaths per year in the Paris megacity ([22](#)).

According to a document of the United Nations Economic Commission for Europe, *the damage for public health and ecosystems from each kg of ammonia emitted is estimated to be 10-25 Euro* ([27](#)). More than 70% of the ammonia emitted in Europe originates from livestock operations.

Interestingly, thanks to anaerobic digestion, livestock waste can be used to produce biogas, which is an important energy source ([25](#)). *The process, aimed at reducing odour and emissions, generates two end products from organic waste: biogas and a nutrient-rich digestate which farmers can use to fertilise croplands.* A video shows the functioning of an anaerobic digester at Michigan State University ([24](#)).

*“Recovery of ammonia from digestate as fertilizer”* deals with a chemical process, that removes ammonia from digestate. Ammonia is recovered as ammonium sulphate, which can be used as fertiliser ([26](#)).

Biogas plants have not been widely adopted in the US because the management cost exceeds the benefits for the operators. *A link deals with policies that incentivise producers to adopt a methane digester, thus reducing emissions* ([25](#)> Climate Change Policy and the Adoption of Methane Digesters on Livestock Operations).

According to “European Framework for the Diffusion of Biogas Uses: Emerging Technologies, Acceptance, Incentive Strategies, and Institutional-Regulatory Support”, *in Europe policies are necessary to make biogas production attractive* ([28](#)).

“Toxic blaze: the true cost of crop burning” discusses what in many countries is known as the season of smog; here crop residues are burned, thus generating black carbon, a component of PM2.5. Black carbon, besides causing diseases has environmental consequences, including a faster melting of Himalayan glaciers. In India, according to the document, no-burn alternatives could provide economic and environmental benefits ([32](#)). “Anaerobic digestion of crop residues: Technological developments and environmental impact in the Indian context” discusses the technologies aimed at transforming such crop residues into methane and a nutrient-rich digestate that can be used in agriculture ([30](#)).

Collection and transportation of such residues for being processed is challenging, but it *could become practically possible thanks to state policies that favour their utilisation* ([30](#)). According to “PM2.5 in Thailand Explained | The role of pre-harvest sugarcane burning in air pollution”, burning the leaves in sugarcane fields, and subsequently carry away the sugarcane stalks is a quick and cheap harvesting technique. To prevent the consequent pollution, the government issued regulations, that subsequently were discontinued. *Financial assistance to farmers might support a different harvesting method and provide better access to machinery* ([71](#) Video).

According to World Health Organisation documents, in low- and middle-income countries, household air pollution consequent to inefficient combustion of solid fuels and kerosene is an important risk factor for a wide range of diseases, including Cs ([31](#)). Figure 3 shows the level of PM10 in a hut with open fire, which is typically much higher than levels observed in big cities. Boxes 3 and 6 suggest some possible solutions to the problem ([63](#)).

“How to use your wood heater the right way” shows how to reduce wood smoke pollution ([46](#) video).

## **16. A lifestyle aimed at cancer prevention may also prevent other problems**

According to “Economic burden of physical inactivity: healthcare costs associated with cardiovascular disease”, *physical inactivity is not only a risk factor for colon and breast Cs, but also for coronary heart disease, hypertension, type 2 diabetes and osteoporosis* ([49](#)).

According to “Walking School Bus Programs: Implementation Factors, Implementation Outcomes, and Student Outcomes, 2017–2018”, active travel to school, provides health-related and classroom behavioural benefits, including *reduced bullying and tardiness* ([43](#)). In a deprived area of Santiago, a study has found reduced bullying thanks to a before-school physical activity program ([41](#) Table 3).

## 17. Cost of healthy and unhealthy diet

A document from the Harvard Chan School of Public Health deals with C prevention; a table summarises 10 recommendations aimed at a healthy diet, physical activity and weight management. *Such recommendations taken together, besides helping to reduce C risk, may also contribute to preventing obesity and other chronic medical conditions such as cardiovascular disease and type 2 diabetes.* A link provides more detailed information on healthy food ([55](#)) using this visual guide as a blueprint).

“Fruits and vegetables in the prevention of cancer and cardiovascular disease” concludes that increasing the consumption of fruits and vegetables, from about 250 g/day to the recommended 400 g/day is associated with large public health benefits. According to the authors of the review, if the Dutch population adheres to the national dietary guidelines, besides a 6-28% reduction in C incidence, a 6-22% reduction in cardiovascular disease deaths is expected. *Potatoes are not included among the vegetables* ([56](#)).

According to a World Health Organisation document, heavy alcohol drinking is a major contributor to the global burden of chronic diseases ([59](#) page 49). Whereas, a very low alcohol consumption exhibits protective effects against the development of cardiovascular diseases, which is beneficial for middle-aged and older people whose cardiovascular risk is high. In young people, the adverse effects outweigh the benefits. According to studies reviewed in “The High Cost and Unequal Cancer Burden of Poor Diet in the United States”, poor diet is linked to increased C risk and mortality; this is a consequence of certain foods and/or of obesity ([50](#)). Among US adults, a *suboptimal diet accounted for 7.7% of C deaths and an estimated 7.8% of direct medical costs.*

According to “Estimated economic burden of cancer associated with suboptimal diet in the United States”, \$7.44 billion of 5-year medical costs for new C cases are attributable to diet, with colorectal C being the costliest (\$5.32 billion). Insufficient whole grain intake and high intake of processed meat accounted for the highest medical costs of diet-attributable Cs estimated, respectively \$2.76 and \$1.5 billion. The complete estimates are reported in Table 3 ([52](#)).

The disabilities consequent to suboptimal diets are estimated to cost in healthcare more than \$1200/year for every American, whereas a healthy diet implies annually a \$550 higher cost per person. According to the authors, lowering the price of healthier foods should be a goal of policy efforts ([53](#)).

“Strategies for Eating Well on a Budget” is a document of the Harvard Chan School of Public Health that provides many tips for saving money in the supermarket. For instance, *plant-based proteins are generally highly nutritious while being even cheaper than meat* ([57](#)).

Health inequalities between racial and ethnic groups and differences by socioeconomic status are well documented. For instance, death rates from colorectal C among black males are about 44% higher than among white males. According to the document, marginalised and lower-income populations suffer limited access to healthy food consequent, e.g. to financial and transportation difficulties; conversely, unhealthy

foods are more easily accessed (50). As a consequence of disparities in diet quality, this situation and the economic costs attributable to C will continue or worsen.

According to “Sugar-Sweetened Beverage Reduction Policies: Progress and Promise”, the consumption of sugar-sweetened beverages is linked to several chronic diseases, obesity and excess mortality. Several strategies have been developed to reduce this unhealthy exposure, such as increasing the price of sugar-sweetened beverages and incentivising the purchase of healthier options (51 figure 1 / 4). In some cases, the *industry has reformulated the beverages reducing sugars*. Information policies aimed at increasing awareness on health risks associated with sugar-sweetened beverages included *no advertising during children’s television programming*. Reductions in portion size constitute another strategy. *In the US cities where taxes are imposed on sugar-sweetened beverages, this revenue is invested in programmes aimed at benefiting marginalised people* (51).

The economic cost of the global C burden suggests the importance of adopting healthy behaviours aimed at reducing the risk of this disease. *But this cannot rely only on individuals; encouraging healthy behaviours is more likely to be successful if health promotion includes efforts to address environmental, economic and social factors*. For instance, the easy availability of fresh fruits and vegetables, facilitates healthy eating habits (4).

## 18. Sanitary expenditure and primary prevention

According to a World Health Organisation document, between 2020 and 2030, the cost of diseases attributable to physical inactivity is US\$27 billion annually, *unless governments do not take urgent action aimed at encouraging more physical activity among their populations* (45).

According to a UK governmental document, health care for most C patients costs as average £570 per month and the cost to the economy is £7.6 billion a year as a consequence of premature deaths and working hours lost (42).

Smoking and alcohol prevention, and physical activity are generally highly cost-effective. Seriously tackling the obesity epidemic is important for the next generations, and not investing now in prevention is a ticking time bomb for the sanitary system (42> cost-effectiveness of prevention).

*In UK, 54% of colorectal C cases are associated with the consumption of large amounts of red meat and processed meat. According to the International Agency for Research on Cancer, the first probably causes C, the second causes C*. Dietary fibre is probably protective against colorectal C, and about 12% of UK cases are associated with the consumption of less than 23 g of fibre a day (42> Health matters: improving the prevention and diagnosis of bowel cancer). Public Health England has produced advice consisting of reducing smoking, harmful drinking, obesity and improving diet.

Early detection of C is not a focus of this article. However, it seems interesting to observe that offering the population a specific screening test resulted in a 16% reduction in colorectal C mortality. The possibility of treating C at an earlier stage proves



significantly less expensive ([42](#)> Health matters: improving the prevention and diagnosis of bowel cancer).

“Physical Activity Promotion: Experiences and Evaluation of the Agita São Paulo Program Using the Ecological Mobile Mode” is a Brazilian programme that involved, inter alia, school children and their families, the elderly, workers, physicians and patients of health units ([47](#) / [59](#) page 99). The mass media contributed to public awareness of the programme.

A key element contributing to the success of the initiative is the possibility for the participants to choose the preferred type of physical activity. The pleasure is considered a key factor for long-term continuing of the activity. The programme also lead to interventions in the physical environment, such as the creation of sidewalks and a cycle walkway ([47](#)). Subsequently, many other physical activity promotion programmes have been launched in Latin America.

In low- and middle-income countries the incidence of major non-communicable diseases, including certain Cs, is quickly growing. Figure 2 shows the growing incidence of breast C in India and Thailand, driven by changes in lifestyle, often exacerbated by changes in the built environment that may encourage a sedentary lifestyle. Figure 6 shows that the use of asbestos, while declining in high-income countries, is growing in low- and middle-income countries; *the consequences of the exposure to this material are observed even decades after* ([48](#)).

C therapies are very expensive, the situation is exacerbated in low- and middle-income countries where the population is quickly growing and aging. *C prevention is an economic investment because much less expensive than the management of the disease* ([48](#)).

## **19. Healthy choices can be difficult, importance of the support of authorities**

A US document discusses other reasons why, for some decades, many people eat more than necessary. Highly processed foods, such as sodas, chips, chocolate and candies are now sold in many no-food establishments, e.g. office buildings, gas stations, and clothing stores ([62](#)). Furthermore, the portion sizes have been largely increased; this applies to beverages, packaging sizes, and restaurant portions, which results in increased food availability. The document also discusses the mechanisms that, sometimes without our conscious awareness, influence our consumption level. At the same time, the energy expenditure necessary for living, over time, has greatly declined and is still continuing to decline.

“Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake” showed that people allowed to eat as much as desired and exposed to ultra-processed foods, ate more calories than when exposed to an unprocessed diet. The results are shown in the graphical abstract: the people ate 500 kcal/day more, and their body weight increased when exposed to ultra-processed foods versus an unprocessed diet. According to the



document, softer food, and easier to chew and swallow may have contributed to the greater intake ([44](#)).

Figures 1 and 3 of “The Role of Race and Poverty in Access to Foods That Enable Individuals to Adhere to Dietary Guidelines” show the location of supermarkets and restaurants in St Louis ([54](#)). In the maps, supermarkets and restaurants are assigned a rating according to their potential to meet the dietary recommendations of the US Department of Agriculture. The maps also show the racial distribution and poverty rates observed in the different areas of the city. According to the document, African American and lower-income people have less access than others to healthy food.

According to “Association between active commuting and incident cardiovascular disease, cancer, and mortality: a prospective cohort study”, cycle commuting was associated with lower risk of C, cardiovascular diseases, and all-cause mortality. The hazard ratios of C and cardiovascular disease incidence observed in cycling commuters are, respectively 0.55 and 0.54 ([29](#)). *This suggests that policies aimed at favouring active modes of commuting, such as bike lanes and subsidies, may create opportunities for improving public health.*

The contents of “Save LIVES: A road safety technical package”, “Traffic Calming” and “Land Use Planning in Safer Transportation Network Planning” are summarised by the titles ([36](#) / [37](#) / [38](#)).

According to the document of the World Health Organisation, rapid public transport systems and dedicated walking and cycling networks may result in fewer car trips, thus contributing to reduced emissions. *Often, information and awareness on these problems are lacking; in addition, potential solutions and measures that can improve air quality are under-appreciated* ([31](#)).

Figure 2.1 ([8](#)) of “Swiss Radon Handbook” shows a radon map of this country, and table 2.2 deals with the actions to be taken in the different areas. The handbook deals with radon protection strategies for both new and existing buildings. In this country, exceeding radon limits implies the obligation to remediate in work-places, schools and similar premises. *Expenses aimed at radon protection or reduction in buildings may benefit from tax advantages.*

According to a document of the World Health Organisation - Europe, many people are not aware of the link between alcohol and C. This means that the policies aimed at preventing C in the European Region can and should be bolder ([35](#)).

A graph in “Preventing Chronic Diseases a vital investment” shows the *quick fall of death rates from heart disease and lung C in Finland*. This resulted from a large-scale community-based intervention, later on scaled up to the national level ([59](#) pages 93 and 100).

In countries where vigorous tobacco control measures have been enacted, consumption has typically declined. Among the several strategies that can be used, heavy tobacco taxation has proven to be the most effective. *In the Philippines, besides saving hundreds of thousands of lives, the government can spend this new tax revenue on improving*

*health infrastructure and healthcare for low-income people, and on helping tobacco farming communities* ([4](#) figures 28.1 and 28.2 / [61](#)).

Some countries use the revenues generated from tobacco taxation for social programmes and improving health care for the poor; in some cases, *special attention has been paid in the promotion of sport activities for young people* ([61](#)).

A graph shows the relation between the consumption of cigarettes and their real prices in South Africa between 1961 and 2001 ([59](#) page 98).

According to the World Bank, school programmes aimed at public health interventions are highly cost-effective ([59](#) page 100).

“Evaluating Web Pages: Questions to Consider: Categories” may help to evaluate the reliability of websites, for students that search information on the web ([16](#)).

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The author declares no conflicts of interest.

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