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Cancers attributable to smoking and obesity in Türkiye: A population-based study

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Abstract

Aim: Cancers are Turkey's second most common cause of mortality, following cardiovascular diseases. Tobacco and obesity are the two major etiological factors for cancer progression, which are highly prevalent in Turkey. This study aimed to evaluate the new cancer cases in Turkey attributable to these two main risk factors.

Materials and Methods: The tobacco-related cancers based on the International Agency for Research on Cancer (IARC) monographs were esophagus, oral cavity, gastric, pancreatic, larynx, lung, renal, and bladder cancers, and the obesity-related cancers based on the IARC's and World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR) Continuous Update Project's reports were esophagus, colon, rectum, gallbladder, pancreas, kidney, ovary, endometrium, and breast cancers. The cancer incidences were obtained from the national cancer statistics. A lag time of at least 10 years was considered adequate to observe past exposures' effects on new cancer cases. The prevalence of tobacco smoking was based on the Peto-Lopez approach. The obesity prevalence was obtained from the National Burden of Disease and Cost-Effectiveness Project Household Survey, 2003 Report in Turkey. Using these incidence and prevalence data, we estimated the population-attributable fractions (PAF) of cancers attributable to smoking and obesity in Turkey.

Results: For tobacco-related cancers, the highest PAFs were found in lung cancer (89.8%), larynx cancer (86%), oral cavity and pharynx cancer (77.2%) in males, and larynx cancer (46.5%), lung cancer (43%), and esophagus cancer (31.4%) in females. For obesity-related cancers, the highest PAFs were found in esophagus adenocarcinoma (31.4%), kidney cancer (19.8%), gallbladder cancer (15.1%) in males, and esophagus adenocarcinoma (33.9%), endometrium cancer (32.8%), and postmenopausal breast cancer (22.8%) in females. When all tobacco-related cancers were considered, 41,283 cases in males and 3,853 cases in females were attributable to tobacco smoking, and when all obesity-related cancer types were considered, the number of attributable cancer cases to obesity was 2,653 in men and 7,387 in women.

Conclusion: The current avoidable cancer burden in Turkey shows that eliminating tobacco smoking and obesity may prevent more than 50,000 cancer cases in Turkey.

Introduction

Cancers are the second leading cause of death, which counts for about ten million deaths in the World in 2020, according to the World Health Organization (WHO) [1]. Similarly, national statistics also showed that cancers are the second most common cause of mortality following cardiovascular diseases [2], and the age-standardized cancer incidence rates were 259.2 and 187 per 100,000 in males and females in 2017 in Turkey, respectively [3]. Thus, the considerably high mortality and incidence data suggest that cancer is among the most critical public health problems and should be evaluated from all aspects to reinforce the efforts to decrease the disease burden.

Regarding the etiological factors for cancer progression, tobacco use is the most significant preventable cause, responsible for one-fifth of cancer-related deaths [4]. Other most important risk factors reported by the WHO were high body mass index, low fruit, and vegetable intake, lack of physical activity, and alcohol use [5]. The most recent prevalence data regarding these risk factors in Turkey were reported in the National Household Health Survey

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in Turkey, "Prevalence of Noncommunicable Disease Risk Factors, 2017" report [6]. Accordingly, the proportion of tobacco smoking was 31.5%, and the ratio of regular daily smoking was 29.2% among the population over 15 years of age in Turkey. There was also a significant difference in smoking between males and females, 43.4% and 19.7%, respectively. Besides smoking, this report also revealed that the proportion of overweight women and men with a body-mass index (BMI) between 25 to 29.9 kg/m2 was 30.1% and 41.2%, and the ratio of obese women and men with a BMI 30 kg/m2 were 35.9% and 21.6%, respectively [6].

Given the significantly high rates of tobacco use and obesity in Turkey, and considering the causal relationships between these risk factors and cancer progression, this study aimed to evaluate the new cancer cases in Turkey attributable to these two main risk factors based on past exposures the population.

Materials and Methods

This study was designed and conducted as an ecological study. Since our study was conducted using data from publicly available reports and no human data were used in the analyses, no ethical committee or institutional review board approval was needed.

Tobacco and obesity-related cancers

The tobacco-related cancers included in this study were based on the International Agency for Research on Cancer (IARC) monographs. The 1st monograph reported tobacco-related cancers such as lung, bladder, renal pelvis, oral cavity, oropharynx, hypopharynx, esophagus, larynx, and pancreatic cancers [7]. The nasopharynx, nasal cavity and sinuses, stomach, kidneys, ureters, uterine cervix, colon and rectum, and myeloid leukemias and mucinous ovary cancers were added in subsequent monographs 2004 [8] and 2012 [9]. Among this list of tobacco-related cancers, we included the esophagus, oral cavity, gastric, pancreatic, larynx, lung, renal, and bladder cancers, and myeloid leukemias in the population attributable fraction (PAF) estimates in this study because of the availability of relative risk estimates for these cancers only.

The obesity-related cancers were identified based on the reports of the IARC and World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR) Continuous Update Project. Accordingly, IARC reported that being overweight and obese are associated with esophagus adenocarcinoma, endometrium, renal cell, colon, and postmenopausal breast cancer [10]. WCRF/AICR supported this evidence and added the rectum, pancreas, gallbladder, breast, colon, and ovary cancers to this list [11, 12]. Therefore, we included the esophagus, colon, rectum, gallbladder, pancreas, kidney, ovary, endometrium, and breast cancers in the population-attributable fraction (PAF) estimates in this study.

Current evidence in the literature suggests that a lag time of 10 years is adequate to observe the effects of past exposures on new cancer cases [13]. Thus, we sought to include national studies that reported risk factor prevalence and cancer incidence at least ten years between these exposure and outcome measures. Accordingly, the incidence data for the cancers listed above were obtained from the recent National Cancer Statistics of Turkey report in 2016 [14]. The prevalence data for selected risk factors should be from at least ten years ago, and the most appropriate study that reported national figures was the National Burden of Disease and Cost-Effectiveness Project Household Survey, 2003 Report in Turkey [15]. The prevalence of tobacco smoking and obesity was reported according to sex, age group, and geographical regions in this study. Nevertheless, we utilized a modified prevalence estimation method for tobacco-associated cancers based on the Peto-Lopez-Parkin approach, which is also used in similar studies in the literature [16].

PAF calculations

We estimated the population-attributable fractions (PAF) of cancers attributable to smoking using the methodology developed by Peto and Lopez [17] and revised by Parkin [18]. The methods described by these authors assume that the incidence of lung cancer in a population is almost entirely caused by tobacco smoking, and cancer cases attributable to smoking are the difference between the number of observed cancer cases in the population and the number of expected cases if the population develops cancer with the incidence rate as never smokers. Since the predicted incidence rates for lung cancer among never smokers were unavailable for the Turkish population, we used the data from the American Cancer Society's Cancer Prevention Study-II [18]. In addition, to maintain the robustness of relative risk estimates, we used the relative risk estimates from the same cohort for other cancers evaluated in this study [19-21]. The observed incidence of lung cancer in Turkey was obtained from the National Cancer Statistics (NCS) reported by the Ministry of Health for 2016 [22].

The smoking prevalence calculated based on the Peto-Lopez approach was then used for the remaining PAF calculations for other tobacco-related cancers. For obesity-related cancers, the obesity prevalence was obtained from the National Burden of Disease and Cost-Effectiveness Project Household Survey (NBD-HS), 2003 Report in Turkey [15], and the RRs were obtained from the meta-analyses by Renehan et al. [23] and WCRF/AICR's Continuous Update Project's reports [24]. The PAFs were calculated using the formula below. The p(E) refers to the prevalence of the risk factor (exposure), and RR refers to the relative risk.

$$PAF = \frac{p(E)(RR-1)}{p(E)(RR-1)+1}$$

Results

Tobacco-related cancers

The numbers of newly diagnosed tobacco-related cancer cases in 2016 in Turkey were 72392 for males and 31611 for females. The highest PAFs were found in lung cancer (89.8%), larynx cancer (86%), oral cavity and pharynx cancer (77.2%) in males, and larynx cancer (46.5%), lung cancer (43%), and esophagus cancer (31.4%) in females. Lowest PAFs were calculated for myeloid leukemia and colorectal cancers in both sexes. However, the PAFs in

Table 1. PAFs, estimated cases, and attributable cases for tobacco smoking-related cancers.

	PAFs in age groups (%)						Estimated cases	Attributable cases
	25-34	35-44	45-54	55-64	65+	Total		
Males								
Lung Cancer	36.4	60.8	90.8	94.1	87.8	89.8	27519	24699
Larynx Cancer	27.7	51.0	86.8	91.4	82.9	86.0	2954	2539
Oral Cavity and Pharynx Cancer	21.8	43.1	82.7	88.6	77.9	77.2	2244	1733
Esophagus Cancer	14.0	30.7	73.8	81.9	67.4	71.1	931	662
Bladder Cancer	5.3	13.3	49.2	61.0	41.6	46.7	10171	4749
Kidney and Ureter Cancers	4.1	10.3	42.1	54.0	34.8	39.1	3708	1450
Hepatic Cancer	3.5	9.0	38.6	50.4	31.6	38.1	2043	778
Pancreas Cancer	3.3	8.4	36.8	48.4	29.9	34.7	2776	964
Gastric Cancer	3.3	8.4	36.8	48.4	29.9	34.4	6853	2355
Myeloid Leukemias	2.5	6.4	30.4	41.3	24.3	25.1	1064	267
Colorectal Cancers	0.6	1.5	8.8	13.5	6.6	8.6	12129	1042
Females								
Larynx Cancer	38.5	9.9	55.7	61.2	34.2	46.5	221	103
Lung Cancer	37.5	9.5	54.6	60.2	33.3	43.0	5344	2299
Esophagus Cancer	26.2	5.9	41.6	47.2	22.8	31.4	622	196
Oral Cavity and Pharynx Cancer	17.6	3.6	30.0	35.0	15.1	20.7	1226	254
Bladder Cancer	6.8	1.3	12.8	15.5	5.7	8.3	1682	140
Ovary Cancer	5.4	1.0	10.3	12.6	4.6	7.7	3206	246
Pancreas Cancer	5.9	1.1	11.2	13.6	4.9	7.3	2028	148
Kidney and Ureter Cancers	2.5	0.5	5.0	6.2	2.1	3.8	1907	72
Uterine Cervix Cancer	2.5	0.5	5.0	6.2	2.1	3.6	2187	78
Hepatic Cancer	2.5	0.5	5.0	6.2	2.1	3.3	987	32
Gastric Cancer	2.5	0.5	5.0	6.2	2.1	3.2	3667	119
Colorectal Cancers	1.5	0.3	3.0	3.8	1.3	2.0	7663	156
Myeloid Leukemias	1.0	0.2	2.0	2.6	0.9	1.3	871	12

Table 2. PAFs, estimated cases, and attributable cases for obesity-related cancers.

	PAFs in age groups (%)						Estimated cases	Attributable cases
	25-34	35-44	45-54	55-64	65+	Total		
Males								
Esophagus Cancer	21.0	29.4	32.9	33.4	30.0	31.4	931	292
Kidney Cancer	12.7	18.4	20.9	21.2	18.8	19.8	3421	677
Gallbladder Cancer	9.6	14.1	16.1	16.4	14.4	15.1	703	106
Colon Cancer	8.5	12.5	14.2	14.5	12.8	13.3	7504	1000
Pancreas Cancer	5.6	8.4	9.6	9.8	8.6	9.0	2776	251
Rectum Cancer	4.4	6.6	7.5	7.7	6.7	7.1	4623	327
Females								
Esophagus Adenocarcinoma	21.4	31.1	36.1	36.4	32.4	33.9	622	211
Endometrium Cancer	20.5	29.7	34.4	34.7	30.9	32.8	5354	1756
Postmenopausal Breast Cancer	-	-	23.7	23.9	21.0	22.8	17843	4076
Kidney Cancer	13.4	20.1	23.7	23.9	21.0	22.0	1806	397
Gallbladder Cancer	10.1	15.4	18.3	18.5	16.1	16.8	789	132
Colon Cancer	4.6	7.2	8.6	8.7	7.5	7.8	5156	402
Pancreas Cancer	4.6	7.2	8.6	8.7	7.5	7.8	2028	158
Ovary Cancer	2.7	4.3	5.2	5.3	4.5	4.8	3206	154
Rectum Cancer	2.3	3.6	4.4	4.4	3.8	4.0	2502	100

all cancer types were significantly lower for females. The PAFs ranged from approximately 9% to 90% in men and 1.5% to 45% in women. When all tobacco-related cancers were considered, 41283 cases in males and 3,853 cases in

females were attributable to tobacco smoking (Table 1).

Obesity-related cancers

The numbers of newly diagnosed obesity-related cancer cases in 2016 in Turkey were 19,958 for males and 39,306 for females. The highest PAFs were found in esophagus adenocarcinoma (31.4%), kidney cancer (19.8%), gallbladder cancer (15.1%) in males, and esophagus adenocarcinoma (33.9%), endometrium cancer (32.8%), and postmenopausal breast cancer (22.8%) in females. Lowest PAFs were calculated for pancreas cancer (9%) and rectum cancer (7.1%) in males, and ovary cancer (4.8%) and rectum cancer (4%) in females. The PAFs ranged from approximately 7% to 30% in men and 5% to 35% in women. When all obesity-related cancer types were considered, the number of attributable cancer cases to obesity was 2,653 in men and 7387 in women (Table 2).

Discussion

The non-communicable diseases (NCDs) are among Turkey's prevailing public health problems. The most common causes of mortality were cardiovascular system diseases (38.4% of deaths), followed by malignancies that caused 19.7% of all deaths (81.129 casualties in total) in 2018 in Turkey [25]. Among all cancer deaths, trachea, bronchus, and lung cancers are the leading diagnoses, a striking consequence of high tobacco smoking rates. Besides the significant burden of tobacco smoking, obesity prevalence is also considerably high in Turkey, which possesses another major risk factor for cancer progression. Based on this background, this study evaluated the attributable fractions of cancer cases to these risk factors.

The PAF calculations provide reliable data to describe the burden of preventable cancers if the risk factor is eliminated. As an overall assessment, lung, larynx, oral cavity and pharynx, and esophagus cancers in the tobacco smoking-related cancers group had the highest PAFs in both sexes. On the other hand, the lowest PAFs were calculated in colorectal cancers, myeloid leukemia, and gastric cancers. From this aspect, almost 60% of all tobacco-related cancers in men and almost %15 in women (approximately 45% in total) should be prevented if people are prevented from tobacco smoking in Turkey. Regarding obesity-related cancers, both sexes had the highest PAFs for esophagus cancer. This was followed by endometrium and postmenopausal breast cancers among women. About 20% of obesity-related cancers were directly attributable to obesity.

The median PAFs in the literature for tobacco-related cancers ranged from 7% for colorectal cancer to 80.5% for lung cancer in men and 3% for gastric cancer to 62.3% for larynx cancer in women [26]. Besides these median PAFs, the highest PAF values for lung cancer (89.9%), larynx cancer (84.9%), and oral cavity and pharynx cancer (78.7%) were reported in Portugal for males [27], whereas the highest PAFs for these cancers (80%, 79%, 55%, respectively) for females were reported from the United Kingdom [28]. When the median, lowest, and highest PAFs for tobacco-related cancers reported from different countries were compared with our results, the PAFs calculated in this study for men were slightly higher, but values for women were somewhat lower than the median literature values but in the distribution range reported for different countries. Regarding obesity-related cancers, the median PAFs for esophageal adenocarcinomas were similar to our results, about 29% for males and 37% for females [26]. The lowest PAFs were reported from Ethiopia (2%) and Bangladesh (3%), and the highest values were from the Czech Republic (49%) and Kuwait (50%) for men and women, respectively [29]. Our results showed that the lowest PAFs were for colon and rectum cancers in the obesity-related cancers group. The median PAFs reported for these cancers in the literature were 12% and 6% in men and 8% and 4% in women, respectively, with the lowest values from China [30] and sub-Saharan African countries [29], and the highest values from Samoa [29] and South Africa [31]. These PAFs were similar to our findings.

In conclusion, the burden of preventable cancers, or more appropriately, the population attributable fractions of tobacco and obesity-related cancers to preventable risk factors, tobacco smoking, and excess body weight, were in accordance with the previous studies in the literature. Therefore, eliminating these risk factors through public health interventions should significantly reduce the burden of cancers on population health, the administrative health systems, and health economics [32-37].

Limitations

Besides the valuable data presented, the results of this study should be assessed, keeping certain shortcomings in mind. First, this ecological study is based on publicly available data reported by governmental institutions or population-based research outcomes in the literature. These data sources include only summarized data, and several assumptions/projections had to be made for calculations. Second, the PLa assumes that all lung cancer cases in tobacco smokers are directly attributable to smoking. Nevertheless, many other factors play a role in cancer progression, and a general assumption might overlook these interactions [28, 38]. Third, although the cancer incidences reported by the Ministry of Health and the IARC are reliable, the data collection methodologies differ in different incidence rates. Fourth, regarding the prevalence data, we recommend that PLa is more reliable than population-based studies unless the data is collected considering the population's age groups and age distribution. Because PLa assumes the cumulative risk of cancer progression as age increases, the prevalence computed based on this approach is more reliable in reflecting the actual incremental cancer risk in PFA calculations. Last, since there are no nationally representative large-scale cohort studies to report relative risks for certain risk factors regarding cancer progression, we used the RRs from the CPS-II cohort, which might not precisely reflect the risks in our populations. Nevertheless, it increased the comparability of our results with the literature data, which also used identical RRs.

Conclusion

This study showed that eliminating the two major causes of cancers, tobacco smoking, and obesity, may protect more than 50000 cases from cancer progression each year.

In addition, this study provided recent PAFs and associated attributable cases to inform researchers and policy-makers about the avoidable cancer burden in Turkey.

Ethical approval

In our research, the numbers published in national reports were used, and the data of any living thing was not used. Therefore, ethics committee permission is not required.

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