



Adherence to the World Cancer Research Fund/American Institute for Cancer Research recommendations and head and neck cancers risk



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ARTICLE INFO

Article history:

Received 5 July 2016

Received in revised form 26 September 2016

Accepted 24 November 2016

Available online 3 December 2016

Keywords:

American Institute for Cancer Research
Diet
Head and neck cancer
Risk factors
World Cancer Research Fund
Case control study

ABSTRACT

Objectives: The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) have proposed eight recommendations for cancer prevention, related to body fatness, diet, and physical activity. Our aim is to evaluate the role of adherence to these recommendations on head and neck cancers risk.

Materials and methods: We obtained an overall score including seven of the WCRF/AICR recommendations, and examined its relationship with head and neck cancers risk in two Italian case-control studies including 946 patients with oral cavity and pharyngeal (OCP) cancer and 2492 controls, and 689 patients with laryngeal cancer and 1605 controls.

Results: Higher adherence to WCRF/AICR recommendations was associated to a reduced risk of OCP cancer (odds ratio, OR = 0.45, 95% confidence interval, CI: 0.33–0.62 for a score of 4–<5, and OR = 0.32, 95% CI: 0.22–0.49 for a score of ≥ 5 as compared to <3). The ORs for laryngeal cancer were 0.68 (95% CI: 0.50–0.92) for a score of 3–<4, 0.39 (95% CI: 0.28–0.55) for a score of 4–<5, and 0.24 (95% CI: 0.15–0.38) for a score of ≥ 5 .

Conclusion: Our study indicates that high adherence to the WCRF/AICR recommendations for cancer prevention is associated with a substantially decreased risk of head and neck cancers.

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Introduction

Cancers of the oral cavity and pharynx (OCP) and larynx, taken together, are the seventh most frequent type of cancer in the world, with around 600,000 new cases in 2012 (i.e., about 5% of incident cancer cases) [1]. These cancers are three times more common in men than in women [2,3]. This difference reflects the

different pattern of exposure among sexes of two major recognized risk factors, i.e., tobacco smoking and alcohol drinking. Among other lifestyle factors, dietary habits have been suggested to influence the risk of OCP and laryngeal cancers, and in particular, non-starchy vegetables and fruits are considered protective against these neoplasms [4]. Findings on other factors, including body size and physical activity are inconsistent [5–8].

In 2007, the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) proposed a set of eight general recommendations related to body fatness, diet, and physical activity, aimed at reducing the incidence of the most common neoplasm worldwide [4]. The European Prospective Investigation into Nutrition and Cancer (EPIC) study has analysed the role of adherence to WCRF/AICR recommendations on the prevention of various common cancers, including those of the upper aerodigestive tract [9], while a few other studies have considered cancers

Abbreviations: AICR, American Institute for Cancer Research; BMI, body mass index; CI, confidence interval; EPIC, European Prospective Investigation into Nutrition and Cancer; FFQ, food frequency questionnaire; INHANCE, International Head and Neck Cancer Epidemiology; OCP, oral cavity and pharyngeal; OR, odds ratios; WCRF, World Cancer Research Fund.

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of breast [10–14], prostate [15,16], esophagus [17], and pancreas [18].

In the present study, we examined the association of adherence to the WCRF/AICR recommendations and the risk of OCP and laryngeal cancers, in a network of Italian case-control studies.

Materials and methods

Two multicentric case-control studies on head and neck cancers were carried out between 1991 and 2009 in Italy [19–21]. The first study included 946 OCP cancer cases (756 men, and 190 women; median age 58 years, range 22–79 years), and 2492 control subjects (1497 men and 995 women; median age 58 years, range 19–82 years) [19,20]. The second study included 689 laryngeal cancer cases (620 men and 69 women; median age 62 years, range 21–80 years), and 1605 control subjects (1264 men and 341 women, median age: 62 years, range: 27–84) [21]. In both studies, cases were incident, histologically confirmed cancer patients, admitted to major teaching and general hospitals of the study areas. Both inpatients and daily admissions were included. Controls were individuals admitted to the same hospitals for acute, non-neoplastic conditions, unrelated to alcohol drinking, tobacco smoking, or to long-term dietary modifications. To compensate for the rarity of head and neck cancers in women, a control-to-case ratio of about 5 was chosen for women as opposed to about 2 for men. In both studies, the refusal rate among subjects approached for interview was less than 5%. The study protocols were approved by the ethical committees of the hospitals involved, according to the regulations at the time of the each study conduction, and all participants gave informed consent to participate.

Trained interviewers collected information on cases and controls during their hospital stay, using a structured questionnaire. This included information on sociodemographic characteristics, anthropometric measures, personal medical history, and selected lifestyle habits (such as tobacco smoking, alcohol drinking, dietary habits, and physical activity). Height and average weight at ages 30 and 50, as well as before cancer diagnosis (or hospital admission, for controls) were self-reported at the time of study enrollment. Occupational or leisure time physical activity at ages 12, 15–19, 30–39, and 50–59 was self-reported. For occupational physical activity, subjects were asked to classify their jobs as very heavy, heavy, intermediate, standing, and sedentary; physical activity in leisure time was defined on the basis of the number of hours of activities (including sport, cycling, etc. . .) per week (>7 h, 5–7 h, 2–4 h and <2 h). Subjects' usual diet two years before cancer diagnosis (or hospital admission, for controls) was assessed through a valid [22] and reproducible [23,24] food frequency questionnaire (FFQ), which included information on 78 foods and beverages, plus a section on alcoholic beverages. Subjects reported the average weekly consumption of each item. Intake of non-alcohol energy and selected nutrients was estimated using an Italian food composition database [25]. Body mass index (BMI) was calculated as weight (kg) divided by height² (m²).

To develop the WCRF/AICR score, we operationalized seven of the eight recommendations (i.e., body fatness, physical activity, foods and drinks that promote weight gain, foods of plant origin, red and processed meat, alcohol drinking, and salt intake); we did not have information on the intake of dietary supplements. For each recommendation/sub-recommendation, subjects were assigned a value of 1 when the recommendation/sub-recommendation was fully met, 0.5 when it was partially met, and 0 when it was unmet. For recommendations including more than one sub-recommendation, we weighted each sub-recommendation score, so that each recommendation ranged from 0 to 1. Thus, the overall WCRF/AICR score was obtained summing-up the scores for each

recommendation, and ranged from 0 to 7. Higher scores indicate greater adherence to WCRF/AICR recommendations. Details on the operationalization of the WCRF/AICR score are provided in [Supplementary Table 1](#).

We estimated the odds ratios (ORs) and the corresponding 95% confidence intervals (CIs) for categories of each single WCRF/AICR recommendations (<0.5, 0.5–<1, 1) and for the overall WCRF/AICR score into four categories (<3, 3–<4, 4–<5, ≥5) and as a continuous variable (for a unit increment), using multiple logistic regression models. Models were adjusted for age (quinquennia), sex, center (Milan, Aviano, Rome), year of interview (continuous), years of education (<7, 7–11, ≥12), tobacco smoking (never smoker, ex-smoker, current smoker <15 cigarettes/day, 15–24 cigarettes/day, and ≥25 cigarettes/day), BMI at interview (<20, 20–<25, 25–<30, ≥30 kg/m²), non-alcohol energy intake (quintiles). Missing values for a few confounding variables were imputed to the most frequent categories.

We also estimated the OR for an increment of WCRF/AICR score across strata of sex, age, education, BMI at interview, tobacco smoking, and alcohol drinking. Heterogeneity across strata was tested by a likelihood ratio test.

Moreover, we evaluated the relative importance of each recommendation included in the WCRF/AICR score, excluding in turn each component from the overall score, and including this component as a covariate in the regression model.

Results

[Table 1](#) shows the distribution of OCP and laryngeal cancer cases and corresponding controls according to selected variables. Cases reported lower education and BMI, and were more frequently tobacco smokers, and alcohol drinkers as compared to controls.

[Table 2](#) shows the ORs for OCP, laryngeal and head and neck cancers combined, according to each WCRF/AICR recommendations. High adherence (score = 1) to the recommendation for eating foods of plant origin (OR = 0.40, 95% CI: 0.25–0.63), limiting foods of animal origin (OR = 0.63, 95% CI: 0.36–1.10), and limiting alcohol drinking (OR = 0.32, 95% CI: 0.25–0.41) was associated to a reduced OCP cancer risk, with a significant trend of risk for increasing adherence. For laryngeal cancer, adherence to specific recommendations for physical activity (OR = 0.61, 95% CI: 0.46–0.82), foods of plant origin (OR = 0.39, 95% CI: 0.24–0.66), foods of animal origin (OR = 0.29, 95% CI: 0.12–0.71), and alcohol drinking (OR = 0.48, 95% CI: 0.37–0.63) was related to a significant decreased risk. Considering head and neck cancers combined, a significant inverse relation was found with specific recommendations on physical activity (OR = 0.74, 95% CI: 0.61–0.90), foods and drinks that promote weight gain (OR = 0.67, 95% CI: 0.50–0.88), foods of plant origin (OR = 0.38, 95% CI: 0.27–0.53), foods of animal origin (OR = 0.48, 95% CI: 0.30–0.77), and alcohol drinking (OR = 0.38, 95% CI: 0.32–0.46).

[Table 3](#) gives the ORs for OCP, laryngeal and head and neck cancers combined, according to the overall WCRF/AICR score. The adherence to WCRF/AICR recommendations was associated with a reduced risk of OCP cancer (OR = 0.32, 95% CI: 0.22–0.49 for a score ≥5 compared to <3; p for trend <0.0001), of laryngeal cancer (OR = 0.24, 95% CI: 0.15–0.38; p < 0.0001), and of head and neck cancers combined (OR = 0.27, 95% CI: 0.20–0.37; p < 0.0001). Estimates for a unit increment of the overall WCRF/AICR score were 0.61 (95% CI: 0.54–0.69) for OCP, 0.59 (95% CI: 0.51–0.68) for laryngeal, and 0.60 (95% CI: 0.55–0.66) for head and neck cancers combined. These associations were consistent after the exclusion of each component in turn. In particular, the OR of head and neck cancers combined for the highest versus the lowest WCRF/AICR score

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