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Associations of red and processed meat with survival among patients with cancers of the upper aerodigestive tract and lung



Fayth L. Miles^a, Shen-Chih Chang^a, Hal Morgenstern^b, Donald Tashkin^c, Jian-Yu Rao^d, Wendy Cozen^e, Thomas Mack^e, Qing-Yi Lu^f, Zuo-Feng Zhang^{a,f,g,*}

^a Department of Epidemiology, Fielding School of Public Health, University of California at Los Angeles, Los Angeles, CA, USA

^b Departments of Epidemiology and Environmental Health Sciences, School of Public Health, and Comprehensive Cancer Center, University of Michigan, Ann Arbor, MI, USA

^c Division of Pulmonary and Critical Care Medicine, David Geffen School of Medicine at University of California at Los Angeles, Los Angeles, CA, USA

^d Department of Pathology and Laboratory Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA

^e Departments of Preventive Medicine and Pathology, Keck School of Medicine of the University of Southern California, Los Angeles, CA, USA

^f Center for Human Nutrition, David Geffen School of Medicine at UCLA, Los Angeles, CA 90095, USA

^g Jonsson Comprehensive Cancer Center, UCLA, Los Angeles, CA, USA

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ABSTRACT

The effect of red and processed meats on cancer survival is unclear. We sought to examine the role of total and processed red meat consumption on all-cause mortality among patients with cancers of the upper aerodigestive tract (UADT) and lung, in order to test our hypothesis that red or processed meat was associated with overall mortality in these patients. Using data from a population-based case-control study conducted in Los Angeles County, we conducted a case-only analysis to examine the association of red or processed meat consumption on mortality after 12 years of follow-up, using a diet history questionnaire. Cox regression was used to estimate adjusted hazard ratios (HRs) with 95% confidence intervals (CIs), adjusting for potential confounders. Of 601 UADT cancer cases and 611 lung cancer cases, there were 248 and 406 deaths, respectively, yielding crude mortality rates of 0.07 and 0.12 deaths per year. Comparing the highest with lowest quartile of red meat consumption, the adjusted HR was 1.64 (95% CI, 1.04–2.57) among UADT cancer cases; for red or processed meat, the adjusted HR was 1.76 (95% CI, 1.10–2.82). A dose-response trend was observed. A weaker association was observed with red meat consumption and overall mortality among lung cancer cases. In conclusion, this case-only analysis demonstrated that increased consumption of red or processed meats was associated with mortality among UADT cancer cases and WAS weakly associated with mortality among lung cancer cases.

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Abbreviations: aHR, adjusted hazard ratio; PFM, processed fried meat; PRM, processed red meat; RM, red meat; RPFM, red, processed, or fried meat; UADT, upper aerodigestive tract.

* Corresponding author. Department of Epidemiology, Fielding School of Public Health, University of California at Los Angeles, 650 Charles E. Young Dr South, Los Angeles, CA 90095-1772, USA.

E-mail address: zfzhang@ucla.edu (Z.-F. Zhang).

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1. Introduction

There is considerable evidence for the role of nutrition and other lifestyle behaviors in cancers of the upper aerodigestive tract (UADT) [1]. Malnutrition is frequently observed in patients with head and neck cancers. Red or processed meats may be associated with cancer susceptibility or progression, as a consequence of production of carcinogens generated by heterocyclic amines, polyaromatic hydrocarbons, and *N*-nitroso compounds [2], among other potentially harmful compounds or intermediates. A few studies have reported an association between red meat consumption and head and neck cancers. Most of the evidence has been obtained from studies of esophageal cancer, where meta-analyses have demonstrated associations between red meat and cancer susceptibility when comparing highest vs lowest intake categories [3–8]. As far as other UADT cancers, studies from Uruguay have demonstrated an association between cancers of the oral cavity and pharynx, larynx, and esophagus with consumption of red meat [9]. Results from European studies have demonstrated strong associations between red meat and UADT cancers, including a 3-fold risk for laryngeal cancer [10–12], whereas other studies have not reported this association [13]. Many studies have been done to examine the role of red meat consumption on lung cancer with inconsistent results. However, a recent meta-analysis summarizing these studies showed an association between high consumption of red meat and lung cancer (odds ratio, 1.34; 95% confidence interval [CI], 1.18–1.52) [14]. According to a population-based study in Iowa, red meat consumption was associated with lung cancer susceptibility even after controlling for total and saturated fat intake [15]. Such an association has been reported particularly among smokers [16].

There is a great need for understanding the significance of diet to head and neck, and lung cancer outcomes. Very little is known about the relation between red meat and cancer survival. Examination of red and processed meat in cancer has potential utility in informing public health nutrition guidelines for cancer patients. Because of the potentially harmful and inflammation-triggering compounds present in red and processed meats, we hypothesized that consumption of these meats was associated with increased mortality among cancer patients. We sought to analyze the association between red and/or processed meat consumption and survival of (1) UADT and (2) lung cancers. To test this, we performed a case-only survival analysis, using recently diagnosed cancer cases obtained from a population-based case-control study of residents of Los Angeles County [17].

2. Methods and materials

2.1. Study population

The study population of the Los Angeles case-control study of lung and UADT cancers has been described previously [17]. Participants were residents of Los Angeles County at the time of recruitment or diagnosis, aged 18 to 65 years during the study period (1999–2004), and able to speak either English or

Spanish or having a translator available. Cancer cases, including oral, pharyngeal, laryngeal, and esophageal cancers, were identified through the rapid ascertainment system of the Cancer Surveillance Program at the University of Southern California. Vital status was obtained through the social security death index. In-person interviews were conducted, and standardized questionnaires were used to collect information on demographics, lifestyle behaviors such as smoking and drinking, diet history, occupational and environmental exposure, employment history, family cancer history, and clinical information. The food frequency questionnaire (FFQ), described previously [18], was based on the National Cancer Institute's "Brief Block FFQ" [19], which inquired about diet history over the last 12 months, 1 year prior to diagnosis. This was expanded to include more fruit and vegetable items. Frequencies of consumption were sought for 78 food items, with categories including "vegetables"; "fruits"; "meat and mixed dishes"; "starches, breads, salty snacks, spreads"; "breakfast foods"; "sweets"; and "dairy products, beverages." Frequency of intake was assessed as per day, week, month, year, or rarely/never, based on a specified serving size. For 89% of cases, interviews were conducted within 6 months after diagnosis. A total of 601 UADT cancer cases, which were interviewed in the case-control study, are included in this cohort study: 497 squamous cell cancers, 74 adenocarcinomas (esophageal), and 30 other cancer cases. Of 611 lung cancer cases, 95 were squamous cases, 297 were adenocarcinomas, 115 were large cell carcinomas, and 75 were small cell carcinomas. Cases with missing information on dietary and behavioral factors were excluded (11 UADT and 9 lung cancer cases; Figure).

2.2. Statistical analyses

Consumption of red or processed meat was measured in grams per day. Four categories of meat consumption were considered in separate categorical models: (1) total red meat (RM); (2) processed red meat only (PRM), all processed or fried meats, which included poultry and fish in addition to processed red meat (PFM); and (3) total red, processed, or fried meat (RPFM).

Statistical analyses were performed using Statistical Analysis Software (SAS) version 9.4. Meat intake was analyzed by comparing the highest with lowest quartiles of consumption. For lung cancer cases, the cut points were as follows: RM, Q1 and Q2—43.31, Q2 and Q3—83.16, Q3 and Q4—131.97; PRM, Q1 and Q2—6.31, Q2 and Q3—22.34, Q3 and Q4—48.57; PFM, Q1 and Q2—13.78, Q2 and Q3—34.67, Q3 and Q4—65.28; and RPFM, Q1 and Q2—51.04, Q2 and Q3—95.21, Q3 and Q4—145.15. The cut points among UADT cancer cases were as follows: RM, Q1 and Q2—46.83, Q2 and Q3—87.98, Q3 and Q4—148.84; PRM, Q1 and Q2—8.10, Q2 and Q3—25.53, Q3 and Q4—53.66; PFM, Q1 and Q2—15.22, Q2 and Q3—39.96, Q3 and Q4—70.60; and RPFM, Q1 and Q2—54.95, Q2 and Q3—99.09, Q3 and Q4—168.05.

We conducted a case-only survival analysis of lung and UADT cancer cases. All cases of lung cancer and UADT cancers, including oral, pharyngeal, laryngeal, and esophageal, were pathologically confirmed new cancer incidences identified by the rapid ascertainment system of the Cancer Surveillance Program, a population-based SEER registry for

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