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Short Communication

Coffee consumption, antioxidant properties and stomach cancer

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Abstract

Background: Coffee is the second most popular drink in the worldwide, and it has different components with antioxidant and antitumor properties. The objective of this study was to explore the relationship between coffee consumption and the incidence and mortality of stomach cancer in the main consuming countries.

Methods: An observational study was performed. Dataset of coffee consumption was obtained from WorldAtlas, and incidence and mortality rates from GLOBOCAN database. Spearman's rank correlation coefficient was calculated. All statistical analysis were performed using STATA software.

Results: A total of 25 countries were included in the study. There was a significant linear correlation between coffee consumption kg per person per year and an estimated age-adjusted incidence (r=0.5984, p=0.0016) and mortality (r=0.5877, p=0.0020).

Conclusion: Coffee consumption could potentially have beneficial effects on incidence and mortality by stomach cancer.

Key words: coffee; stomach neoplasms; incidence; mortality

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Introduction

With an annual mean consumption of 500 billion cups per year, the coffee is positioned as the second most popular drink in the worldwide[1]. It is obtained through *Coffea* seeds processing in contact with water, producing a unique mix of bioactive compounds[2]. Among its most outstanding components are caffeine, caffeic acid, hydroxyhydroxyquinone, chlorogenic acid, polyphenols, cafestol, and kahweol, substances known for their antioxidant and antitumor properties[3,4].

Antioxidants are substances with the ability to prevent, delay, or eliminate the oxidative damage of a target molecule, in the case of cells in carbohydrates, lipids, proteins, or nucleic acids[5,6]. According to their mechanism of action, it classified into three groups: 1) Those that prevent the formation of new free radicals, such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPX). 2) Those that capture existing free radicals, such as Vitamins C and E, albumin, flavonoids, and carotenoids. 3) Those that repair damage already caused, such as lipases, proteases, transferases, reductases, and DNA repair enzymes[7].

On the other hand, gastric cancer is one of the five most frequent malignancies in men and women, obtaining fifth place after lung, breast, colorectal, and prostate cancer. It has a high annual mortality rate with approximately 723,000 deaths per year[8]. Its clinical presentation has been described as a multifactorial phenomenon involving elements such as age, colonization by *Helicobacter pylori*, and eating habits, among others[9].

The relationship between coffee consumption and gastric cancer has been researched through prospective and retrospective epidemiological studies; however, the findings are contradictory to respect risk[2,10].

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Due chemical composition of coffee drink, it may be presumed that it acts as an antitumor substance in gastrointestinal tract pathologies, specifically in stomach cancer. In this way, the concern arises to know if there is a relationship between coffee consumption and the incidence and mortality of stomach cancer in the main consuming countries.

Methodology

An observational study was performed. The analysis is based on two independent sets of coffee consumption and cancer incidence data. The first dataset about kg person per year coffee consumption in 25 countries was obtained from WorldAtlas, published in January 2018.

The second dataset of estimated age-adjusted (world standard) incidence and mortality rates per 100,000 inhabitants of stomach cancer was obtained from the International Agency for Research on Cancer (IARC) GLOBOCAN database in 2018 (the last year when complete data were available. Cancer fact sheets were reviewed by each country for 2018.

Statistical analysis. Scatter plots were drawn for the age-standardized incidence and mortality rate of stomach cancer based on coffee consumption. Spearman's rank correlation coefficient was calculated. Data analysis was performed using STATA® (Version 14.0, StataCorp LP, College Station, TX).

Results

A total of 25 countries were included in the study. Estimated incidence rate and mortality of stomach cancer and coffee consumption were showed in **table 1**.

There was a significant linear correlation (r=0.5984, p=0.0016) between coffee consumption kg per person per year and an estimated age-adjusted incidence of stomach cancer (**Figure**

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1). Sweden was the top performer in terms of both the incidence of stomach cancer and coffee consumption. The slope of the regression line allows us to estimate that it would take about 7 kg of coffee per person per year to decrease the incidence of stomach cancer in a given country by 6. For Norway, that would amount to 9.7 kg per year. The minimally effective coffee dose seems to hover around 5-6 kg per year.

There was also a significant linear correlation (r=0.5877, p=0.0020) between coffee consumption kg per person per year and estimated age-adjusted mortality of stomach cancer (**Figure 2**). Sweden also was the top performer in terms of both the mortality of stomach cancer and coffee consumption. The slope of the regression line allows us to estimate that it would take about 7 kg of coffee per person per year to decrease the mortality of stomach cancer in a given country by 4.

Discussion

In this study, the principal finding was a lineal inverse correlation between coffee consumption per person per year and age-adjusted incidence and mortality of stomach cancer in the top 25 countries with the highest coffee consumption. The described correlation does not prove causality but manifests a common underlying mechanism between the events of interest and permit us to speculate about possible mechanisms by which it will be possible.

The inverse correlation between coffee consumption and deaths from all causes was already described in a large, prospective cohort study in USA[11]. However, when we reviewed the available evidence to respect coffee consumption and stomach cancer, we found heterogeneous and inconclusive results[10,12].

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The biological plausibility about coffee´s chemopreventive properties is supported by its biochemical composition. It contains phenolic compounds such as hydroxyhydroquinone, chlorogenic acid and caffeic acid that contribute to the activation of antioxidant enzymes to modulate oxidative stress in a direct (through radical scavenging activity) and indirect ways (through activation of Nrf2/ARE cellular system); it also can suppress cancer growth through anti-estrogenic pathways, mitochondrial toxicity, and anti-inflammatory environment regulation[4,13].

The coffee drink also contains cafestol and kahweol, two lipids with an anti-genotoxic activity that act as Reactive oxygen species (ROS) scavengers, and prevent the effects of carcinogens as hydrogen peroxide (H_2O_2) and [4,5-b]pyridine. Likewise, they increase the expression of enzymes involved in the detoxification of DNA-reactive metabolites (glucuronosyltransferase and glutathione S-transferase) and DNA-repair complex enzyme system[3].

Another possible explanation for our results is reverse causality, where participants that experience early gastric cancer symptoms like poor appetite, weight loss, abdominal pain, vague discomfort in the abdomen, a sense of fullness in the upper abdomen after eating a small meal, heartburn or indigestion, nausea, vomiting or swelling or fluid build-up in the abdomen may diminish coffee consumption, thus increasing mortality among this group.

Several limitations of our study should be mentioned. The distinction between methods of coffee preparation (espresso, boiled, or filtered) and coffee seeds (*Arabica* or *Canephora*) was not available for our analyses, and it has known that a considerable variability of antioxidants and antitumor concentration are dependent on the preparation of the mixture[14]. However, one study evaluated the ability of free radical scavengers and protection against DNA damage by comparing 13 different varieties of coffee roasting. It finds that all the

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preparations exhibited similar antioxidant activity; this situation was explained by the presence of polyphenolic extract in all evaluated beverages, which in turn allowed antioxidant activity comparable to that of grapes[15,16].

Also, given the observational nature of this study, it is not possible to conclude that the inverse association between coffee consumption and gastric cancer incidence/mortality reflects cause and effect. However, further research is required to explain a causal relation between them.

Conclusion

Coffee consumption could increase the bioavailability of antitumor and antioxidants substances in the gastrointestinal tract. It may potentially have beneficial effects on incidence and mortality by stomach cancer and correlates with the numbers of the event in each analyzed country.

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Table 1. Coffee consumption estimated incidence and mortality of stomach cancer by country (n=25).

Country	Coffee consumption (kg per person per year)	ASR incidence	ASR mortality
Austria	6.1	5.3	3.3
Belgium	6.8	5.9	2.6
Bosnia and Herzegovina	6.2	10.1	7.4
Brazil	5.8	7.9	5.9
Canada	6.5	4.0	2.2
Croatia	5.1	8.4	6.9
Cyprus	4.9	5.8	5.1
Denmark	8.7	4.2	2.9
Estonia	4.5	11.4	8.7
Finland	12.0	4.2	2.9
France	5.4	4.9	3.1
Germany	5.5	6.7	3.9
Greece	5.4	6.5	4.4
Iceland	9.0	3.6	2.7
Italy	5.9	7.2	4.7
Lebanon	4.8	7.5	6.5
Luxembourg	6.5	5.5	3.1
Netherlands	8.4	4.5	3.0
Norway	9.9	4.1	2.5
Portugal	4.3	11.0	7.9
Slovenia	5.8	8.9	5.5
Spain	4.5	6.6	4.3
Sweden	8.2	3.3	2.1
Switzerland	7.9	5.4	3.0
United States	4.2	4.1	1.7

ASR: Age-standardized rates per 100 000

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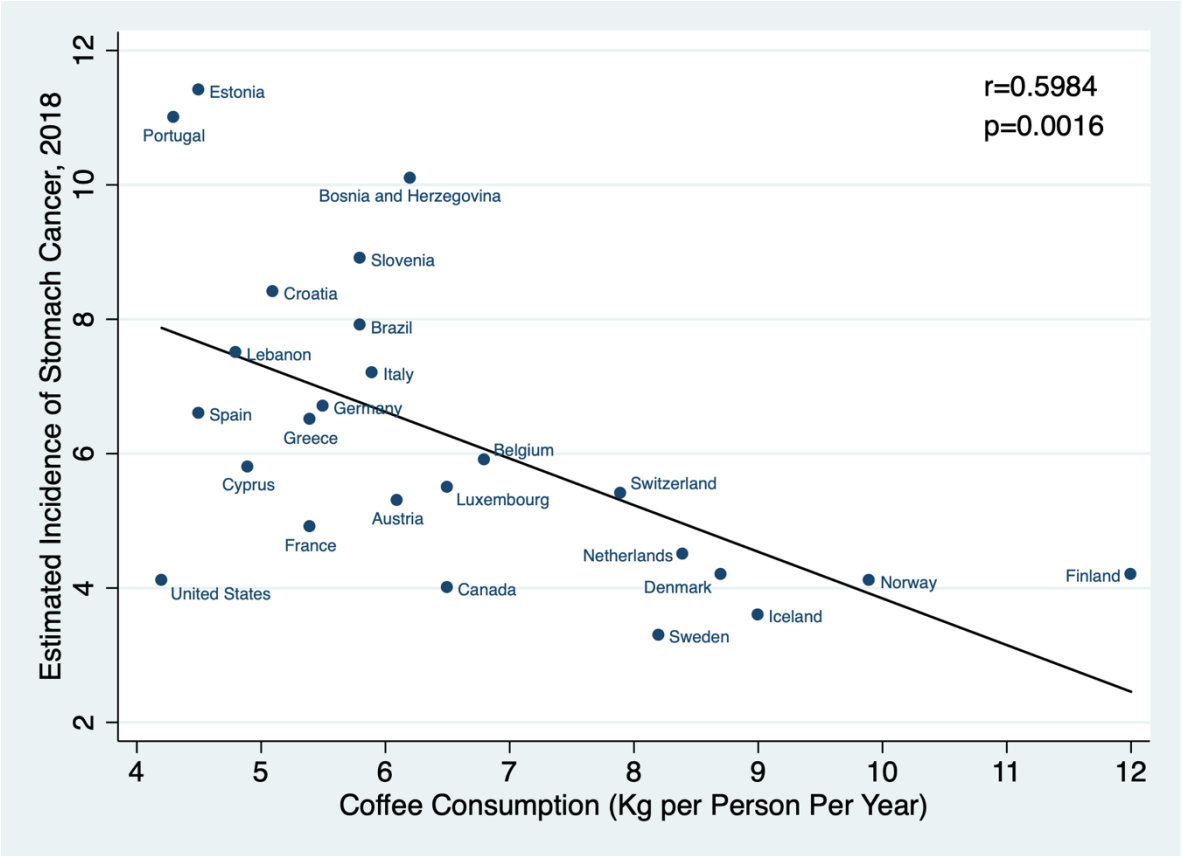
Figures

Figure 1. Correlation between countries' annual coffee consumption and the estimated age-standardized incidence of stomach cancer.



Lineal model for incidence

Incidence of stomach cancer=10.79-0.69*(coffee comsumption)

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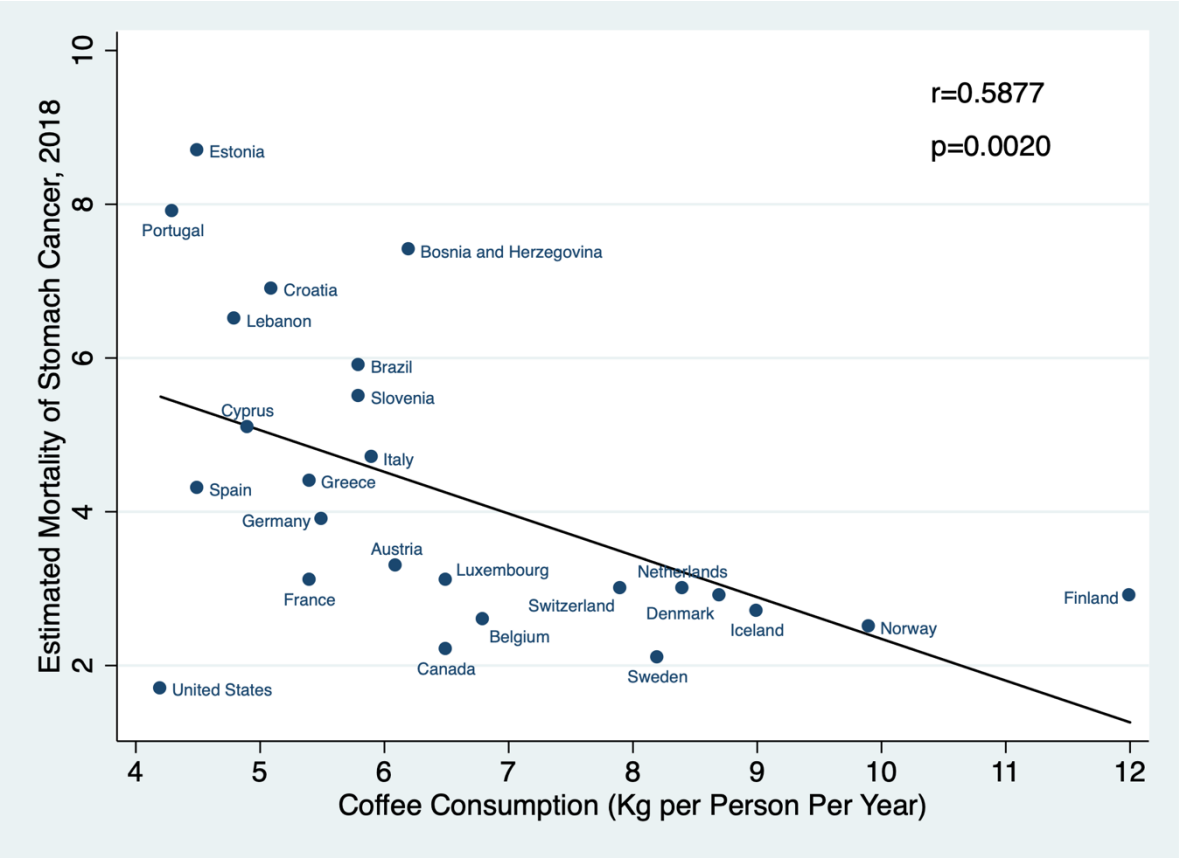
Figure 2. Correlation between countries' annual coffee consumption and the estimated age-standardized mortality of stomach cancer.



Lineal model for mortality

Mortality of stomach cancer=7.78-0.54*(coffee comsumption)