Risk factors for colorectal carcinoma; a hospital-based study

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(Key words: colorectal cancer, risk factors, tea, coffee, beef)

Abstract

Background: Colorectal carcinoma (CRC) accounts for substantial cancer morbidity and mortality worldwide. Our study was designed to assess the contributions of dietary and lifestyle factors on the risk of developing CRC.

Methods: A case-control study was conducted over a five-year period at the National Hospital of Sri Lanka. Data was collected via an interviewer administered, structured, pre-tested questionnaire on 200 histologically confirmed CRC cases and 200 age and gender-matched controls. Multivariate analyses were done to identify associations.

Results: The median age was 58 years in the CRC group and 54 years in the control group, while the male:female ratio was 1.50 and 1.49 respectively. On multivariate analysis the consumption of six or more cups of brown tea per day [Odds Ratio (OR) = 2.98 (95% CI 1.47-6.05), p=0.003] was independently associated with CRC. Beef consumption also showed significant association with risk of CRC [OR = 1.76 (95% CI 1.12-2.78), p=0.015]. Green tea was not found to be associated with CRC. There were no associations with body weight, work-sleep pattern, smoking or the consumption of alcohol, mutton, pork, fruits or coffee.

Conclusions: The consumption of six or more cups of brown tea per day or beef was associated with an increased risk of developing CRC.

Introduction

Colorectal cancer (CRC), is the third most common cancer worldwide [1]. In Sri Lanka its incidence is 5.6/100,000 and it accounts for approximately 7% and 6% of all malignancies in males and females respectively (Cancer Registry, Sri Lanka, 2010) [2] . The incidence of CRC in Sri Lanka is increasing [3]. In the United States the estimated incidence of CRC is approximately 40/100000 [4]. Since the incidence rates vary more than 25-fold across countries, it could be suggested that, in addition to genetic factors, environmental and lifestyle factors, especially diet may play a role in its development [5]. Thus coffee and tea (being among the most commonly consumed beverages worldwide) have been hypothesized to be associated with the risk of developing colorectal cancer [6]. In 2007, a report by the World Cancer Research Fund and the American Institute for Cancer Research determined that no firm conclusions could be reached on the associations between consumption of coffee and tea and risk of colon cancer due to inconsistent epidemiological evidence [7]. Consumption of alcohol, meat products, smoking, reduced physical activity and disturbance of diurnal sleep-wake cycle are other potential risk factors [6]. Our study was designed to assess the contributions of dietary and lifestyle factors on the risk of development of CRC.

Methods

Study design, participants and inclusion-exclusion criteria

A case control study was conducted over a five-year period at the Department of Surgery, National Hospital of Sri Lanka. All patients admitted to the unit with a histologically confirmed diagnosis of CRC were considered as CRC cases. Age and gender matched individuals with no features of malignant disease admitted to the same unit were taken as controls. Patients with altered levels of consciousness and not consenting for the study were excluded. Ethical approval was obtained from the Ethical Review Committee of the National Hospital of Sri Lanka.

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Data collection

Data were collected via an interviewer-administered, structured, pre-tested questionnaire on 200 cases and 200 controls. All individuals were interviewed in a ward setting by a single investigator. Data on basic epidemiological, socio-cultural characteristics, physical activity, dietary and behavioural patterns were collected. Dietary intake was based on a food frequency questionnaire. In addition, data on established risk factors such as a history of colorectal polyps, loose stools or inflammatory bowel disease, and a family history of CRC were also collected.

Statistical analysis

The subjects were categorized based on their age, educational level, ethnicity and body weight at the time of data collection, level of daily physical activity and amount of average daily sleep. Depending on the baseline consumption of black tea per day, the subjects were divided into six groups (1,2,3,4,5,6, or more cups), and on their daily sleep pattern into five groups (5 hours or less, 5.5-5.9 hours, 6.0-6.9 hours, 7.0-7.9 hours and 8 hours or more). Based on their physical activity subjects were grouped into four groups: no regular exercise, regularly 1-2 days per week, regularly 3-6 days per week and regularly daily. Multiple logistic regressions were done to adjust for the effects of other confounding factors on the associations. All statistical analyses were done using SPSS version 21.

Results

The median age was 58 years in the cases and 54 years in the controls, while the male: female ratio was 1.50 and 1.49 respectively. Baseline epidemiological and sociocultural attributes, dietary characteristics, physical activity and behavioural patterns among cases and controls are shown in Table 1 and 2.

Table 1. Baseline epidemiological and sociocultural characteristics among cases and controls

	Cases (n=200)	*Controls (n=200)*
Age (years)		
Median ± SD	58.0±	54.0±
Age categories (%)		
<50 years	29.5	34.0
51-60 years	33.5	33.5
61-70 years	26.5	24.0
>70 years	10.5	8.0
Sex		
Male (%)	40.5	40.0
Female (%)	59.5	60.0
Marital status (%)		
Married	90.5	89.0
Unmarried	9.5	11.0
Educational level (%)		
Below Grade 5	15.0	19.5
Grade 6 to Ordinary Level	52.0	49.0
Up to Advanced Level and higher	33.0	31.5
Ethnic group (%)		
Sinhala	92.0	90.0
Tamil	3.0	5.0
Moor	4.5	5.0
Malay	0.5	0.0

Table 2. Distribution of dietary characteristics, physical activity and behavioural patterns among cases and controls

	Cases (n=200)	*Controls (n=200)*
Body weight at the time of study (%)		
<50kg	22.5	16.5
50-60kg	45.0	43.0
60-70kg	21.0	29.5
>70kg	11.5	11.0
Consumption of beef (%)	38.5	28.0
Consumption of mutton (%)	36.0	32.0
Consumption of pork (%)	34.0	25.5
Consumption of sausages and meatballs (%)	32.0	30.5
Consumption of fruits (%)	97.0	98.5
Physical activity (%)		
No regular physical exercise	52.0	59.5
Regularly 1-2 days per week	10.5	10.0
Regularly 3-6 days per week	7.0	12.0
Regularly daily	30.5	18.5
Smoking (%)		
Have smoked	22.0	24.0
Never	78.0	76.0
Alcohol (%)		
Have used	27.0	30.5
Never	73.0	69.5
Sleep pattern (%)		
5 hours or less per day	5.5	5.0
5.5-5.9 hours per day	5.0	7.5
6.0-6.9 hours per day	26.5	23.5
7.0-7.9 hours per day	32.5	37.5
8 or more hours per day	30.5	26.5
Consumption of black tea per day (%)		
1 or more	96.5	97.5
2 or more	91.5	88.5
3 or more	76.5	64.5
4 or more	47.5	35.5
5 or more	29.0	18.0
6 or more	20.0	8.0
Consumption of green tea (%)	1.5	7.0
Consumption of coffee (%)	52.0	42.5

Table 3. Adjusted Odds Ratio and 95% Confidence Intervals (CI) of risk factors associated with colorectal cancer

	Adjusted Odds Ratio	*95% CI*		*P value*
Daily baseline brown tea consumption				
2 cups or less	1.00			
3 or more cups	1.35	0.77	- 2.37	0.298
4 or more cups	1.34	0.70	- 2.54	0.373
5 or more cups	1.14	0.51	- 2.54	0.750
6 or more cups	2.98	1.47	- 6.05	0.003
History of loose stools or inflammatory bowel disease	12.88	3.79	- 43.78	0.000
Positive family history of colorectal cancer	3.52	1.22	- 10.17	0.020
Beef consumption	1.76	1.12	- 2.78	0.015
Consumption of green tea	0.31	0.09	- 1.13	0.077

Although overall meat consumption was higher among the cases, no significant association was observed. Consumption of coffee, fruits, alcohol, smoking, sleep patterns and body weight did not show statistical significance. A family history of CRC, history of colorectal polyps, loose stools and inflammatory bowel disease were significantly associated with CRC risk.

Analysis using Pearson Chi-Square test, based on cancer site showed the following: consumption of pork was associated with rectal cancer while consumption of fruits was associated with less rectal cancer. Multivariate analysis found consumption of six or more cups of brown tea per day [Odds Ratio (OR) = 2.98 (95% CI 1.47-6.05), p=0.003] to be independently associated with CRC. Consumption of beef showed a significant association on multivariate analysis [OR = 1.76 (95% CI 1.12-2.78), p=0.015] (Table 3).

Green tea was not found to be associated with CRC [OR = 0.314 (95% CI 0.09-1.13), p=0.077]. There was no significant association with body weight, work-sleep patterns, smoking or consumption of alcohol, mutton, pork, fruits or coffee in the multiple logistic regression (Table 3). Multiple logistics regression found significant associations of history of loose stools or inflammatory bowel disease [OR = 12.88 (95% CI 3.79-43.78), p=0.000] and family history of CRC [OR = 3.52 (95% CI 1.22-10.17), p=0.020] with significantly increased CRC risk.

Discussion

Consumption of six or more cups of brown tea per day was found to be independently associated with an increased risk of CRC. This may be explained by an imbalance between the pro- and anti-carcinogenic properties of brown tea. Furthermore, the addition of sugar and/or milk (both of which are independently linked to an increased cancer risk[5]) may have had a confounding effect on carcinogenicity. Green tea, on the other hand is usually consumed without milk or sugar. Naturally occurring polyphenols, such as catechins and galloca-techins are preserved without oxidation during the process of producing green tea [8,9]. Thus it may be hypothesized that anticarcinogenic compounds may have contributed to the protective effect of green tea in CRC. This may also be positively influenced by other 'health-conscious' habits of green tea drinkers, such as the amount and quality of physical activity and sleep and low levels of alcohol intake or smoking.

We did not find an association between coffee consumption and risk of CRC. Other studies have found

varying association [10,11,12]. These differences may in part be due to variations in the population gene pool affecting their susceptibility to carcinogens [13]. In some populations, individuals may have proto-oncogenes that are readily transformed to oncogenes by specific carcinogens [14]. The method of coffee preparation, brewing time, the addition of milk and/or sugar and the concentration of caffeine may influence risk [5,12]. In our study coffee consumption in cases and controls was 52.0% and 42.5% respectively. A larger population of coffee drinkers, that allowed subgroup stratification, may have enabled further exploration of any confounding factors.

Consumption of beef was found to be associated with increased risk of CRC. This may be explained by the production of known carcinogens, such as N-nitroso compounds, during protein digestion [13]. The reasons for the non- association with consumption of other types of meat are not certain. Our study did not find work-sleep patterns, alcohol consumption or smoking to be associated with an increased risk of CRC. Unadjusted Odds ratio for ever smoker was 0.9, which was non-significant. Therefore, smoking was not included in the multivariate analysis. A history of loose stools, inflammatory bowel disease and family history of colorectal cancer were associated with CRC as in other cohorts. This association might be related to the genetic factors and prevailing conditions related to the digestive system. Imbalance of gut microbiome also may play a role in CRC carcinogenesis.

Data collection was done by a single investigator and this is an important strength of our study, as there was uniformity of data extraction in both cases and controls. The stratification of daily baseline tea intake by volume and frequency enabled us assess the varying degrees of exposure to its pro- and anti-carcinogenic properties. Subgroup analyses based on site of the cancer and the histopathological findings were an additional strength of this study. There were some limitations, including potential recall bias by cases and controls. The dietary and life style patterns may have changed over time, but this type of bias would be shared by both the cases and controls. The addition of milk and/or sugar and methods of preparation of tea and coffee were not assessed in detail and would be an area to be considered in future studies. As green tea consumption in cases and controls was 1.5% and 7% respectively, stratified analysis with different amounts of exposure was not possible. Coffee consumption too could not be categorized according to the amount of exposure. Number of coffee cups consumed per day in both cases and controls was low, (usually 1 or 2) thus subcategorization was not possible. The study subjects may not have uniformly communicated the serving size, so that correction of measurement error is warranted. It is suggested that future study designs consider these factors.

In conclusion, the consumption of six or more cups of brown tea per day and beef consumption was associated with an increased risk of developing CRC in this cohort of patients. Beef consumption needs further analysis as this may be related to ethno-religious factors. The consumption of green tea was found to be associated with less risk of CRC. Coffee, fruits, mutton, pork, alcohol, smoking, work-sleep patterns and body weight were not found to be significantly associated with CRC. Some of the non-significant results could be due low sample size, limiting the generalizability of the findings.

Authors contributions

IM De Zoysa designed the study. NV Ekanayake analysed the data and wrote the results section. All authors were involved in writing the main manuscript text and reviewing the manuscript.

Conflict of interest

The authors have no competing interests.

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Ethics approval

Ethics approval was obtained from the Ethical Review Committee of the National Hospital of Sri Lanka.

References

1. Arnold M, Sierra MS, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global patterns and trends in colorectal cancer incidence and mortality. *Gut*. 2017; **66**(4): 683-91.
2. Cancer Incident Data Sri Lanka 2010. Cancer Registry, National Cancer Program. 2013; **9**: 1-60.
3. Deen K, Perera T, Wijesuriya R, Suraweera P, Wijewardene K, Kumarage S, Ariyaratne M. The prevalence of colorectal cancer and survival in patients from the Gampaha District, North Colombo re. *Ceylon Medical Journal* 2008; **53**(1): 17-21.
4. American Cancer Society Cancer Facts and Figures 2003. Atlanta, GA: American Cancer Society; 2015.
5. Zhang X, Albanes D, Beeson W, *et al*. Risk of Colon Cancer and Coffee, Tea, and Sugar-Sweetened Soft Drink Intake: Pooled Analysis of Prospective Cohort Studies. JNCI: *Journal of the National Cancer Institute* 2010; **102**(11); 771-83.
6. Word Cancer Research Fund. Food, Nutrition and the Prevention of Cancer: A Global Perspective. Washington, DC: American Institute for Cancer Research; 2007. American Institute for Cancer Research Expert Panel.
7. Davis S and Mirick D. Circadian Disruption, Shift Work and the Risk of Cancer: A Summary of the Evidence and

Studies in Seattle. *Cancer Causes and Control*. 2006; **17**(4): 539-45.

8. Leung LK, Su Y, Chen R, Zhang Z, Huang Y, Chen ZY. Theaflavins in black tea and catechins in green tea are equally effective antioxidants. *The Journal of Nutrition* 2001; **131**(9): 2248-51.
9. Wada K, Oba S, Tsuji M, *et al.* Green tea intake and colorectal cancer risk in Japan: the Takayama study. *Japanese Journal of Clinical Oncology* 2019; **49**(6): 515-20.
10. Steiner B, Ferrucci LM, Mirabello L, *et al*. Association between coffee drinking and telomere length in the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial. *PLOS One*. 2020; **15**(1): e0226972
11. Schmit SL, Rennert HS, Rennert G, Gruber SB. Coffee Consumption and the Risk of Colorectal Cancer. Cancer Epidemiology Biomarkers and Prevention. 2016; **25**(4): 634-9.
12. Higdon JV, Frei B. Coffee and health: a review of recent human research. Critical Reviews in Food Science and Nutrition. 2006; **46**(2): 101-123.
13. Anatoly V. Lichtenstein. Cancer: evolutionary, genetic and epigenetic aspects. Clinical Epigenetics. 2010; **1**(3-4): 85-100.
14. Aykan NF. Red Meat and Colorectal Cancer. *Oncology Reviews* 2015; **9**(1): 288.