Review Article

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The Relationship between Tea and Coffee Consumption and Glioma: a systematic review

H. Malmir (MSc)[1], A. Esmaillzadeh (PhD)*[2]

1.Students Scientific Research Center, Tehran University of Medical Sciences, Tehran, I.R.Iran.
2.Obesity and Eating Habits Research Center, Endocrinology and Metabolism Research Institute, Tehran University of Medical Sciences, Tehran, I.R.Iran.

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ABSTRACT

BACKGROUND AND OBJECTIVE: Glioma is the most common form of brain tumor in adults and accounts for about 80% of the total brain malignancy. The association between several nutritional and non-nutritional factors and the incidence and prevention of glioma has been investigated in previous studies. The aim of this study is to investigate the relationship between coffee and tea consumption and the risk of glioma.

METHODS: In this systematic overview, all studies published until March 2017 were reviewed using the "PubMed", "GoogleScholar" and "SCOPUS" databases using the keywords "coffee", "caffeine", "tea", "diet" and "lifestyle" for coffee and tea consumption and the keywords "glioma", "glioblastoma", "GBM", "brain tumor", "oligodendroglioma", "oligoastrocytoma", "astrocytoma" and "ependymom" for the risk of glioma.

FINDINGS: Overall, 12 studies were found to be related to the association between coffee and tea consumption and glioma. In studies that investigated the association between tea consumption and glioma, tea consumption was associated with a 25% reduction in the risk of glioma. In studies that investigated the association between total coffee and tea consumption and glioma, a 40% risk reduction was observed, consuming 5 cups or more of coffee and tea per day.

CONCLUSION: The results of the study showed that increased coffee and tea consumption is associated with lower risk of glioma.

KEY WORDS: *Coffee, Tea, Glioma, Systematic Review.*

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* **Corresponding author: A. Esmaillzadeh (PhD)**
Address: Faculty of Nutritional Science and Dietetics, Department of Nutrition, Tehran, Iran.
Tel: +98 21 88985908
E-mail: a.esmaillzadeh@gmail.com

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Introduction

Cardiovascular disease is one of the main public health problems in Iran and worldwide (1). The assessment of food intake is important for several reasons, because controlling food intake according to dietary recommendations can reflect the health status of the community (2). Inappropriate diet is one of the risk factors for heart disease that can be corrected and any changes in dietary habits that may reduce future risks can be useful in the prevention and control of heart disease (3). There are different ways to assess diet and each method should be chosen in accordance with the purpose of the study and the culture of each society. The diet includes many components that can contribute to preventing or increasing the risk of diseases. Therefore, a comprehensive diet assessment provides more comprehensive information. For this reason, instead of reporting nutrition or micronutrients, the food patterns are considered in modern studies of dietary habits (4 – 7).

A Mediterranean diet is inspired by the nutrition of the people of Greece, Spain and Italy. This diet is based on the consumption of olive oil, grains, cereals, fruits and vegetables, fish and dairy products, and very low consumption of red meat and meat products (8). Studies have shown that adherence to the Mediterranean diet is particularly effective in preventing the progression of cardiovascular disease (9, 10). In a study in the north of the United States, Bulter et al. examined patients with heart failure, patients who had angioplasty, and patients who had open – heart surgery in terms of compliance with the Mediterranean diet. The results of the study indicated that the rate of compliance to the Mediterranean diet was low in these patients, and the compliance rate in men was significantly lower than that of women (11). Marventano et al. examined the rate of following the Mediterranean diet (12).

The compliance rate was reported to be satisfactory. High nutritional compliance was associated with physical activity, smoking and education. In Iran, only one study evaluated the rate of compliance with the Mediterranean pattern of food in Tehran residents and showed that 34% of patients had a healthy diet based on the Mediterranean pattern (13). A look at the Mediterranean dietary pattern shows that this dietary food is not alien to the culture of the people of Guilan province because of the geographical and climatic conditions, foodstuffs such as olive, olive oil, fish and marine products, fruits and vegetables available to people in this area. Despite the availability of good food in the province, there is a high incidence of heart disease, and since the study of dietary habits has not been done in the region so far, it is still not possible to determine whether the pattern of food is appropriate or inappropriate or whether it is associated with high incidence of heart disease or conduct nutritional interventions, because before any nutritional interventions, often in the form of trainings, it is necessary to have an outlook of the current status and dietary habits of these patients.

Considering the fact that no study has been conducted before in Guilan province about the dietary habits of patients with cardiovascular disease and the factors affecting the quality of diet in this group of patients, and considering the beneficial effects of the Mediterranean diet on heart health, this research was conducted to study the dietary habits of this group of patients.

Methods

Searching Strategy For Previous Studies: To review the studies on the relationship between consumption of tea and coffee and glioma, all studies published until March 2017 were reviewed using the "PubMed", "GoogleScholar" and "SCOPUS" databases using the keywords "coffee", "caffeine", "tea", "diet" and "lifestyle" for coffee and tea consumption.

Combined search was done using the keywords "glioma", "glioblastoma", "GBM", "brain tumor", "oligodendroglioma", "oligoastrocytoma", "astrocytoma" and "ependymom" for the risk of glioma. References from previous studies were also sought to avoid losing any study in this area. No time limit was applied. The searching process is shown in Fig 1. The study was conducted by two researchers individually. Studies that reportedly correlation with drinking coffee and tea and the risk of glioma; studies that were observational (cohort or case-control); and studies that measured the odds ratio (OR) or relative risk (HR or RR) of glioma with 95% confidence interval, were reviewed. Systematic reviews or meta-analyses, as well as animal and cell studies, studies that examined whether coffee or tea was consumed with other drinks and did not report individually, studies performed on children or pregnant mothers, studies that examined the association between a nutrient, a food or a total diet and the risk of glioma instead of coffee and tea, and studies that examined the association between coffee

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and tea consumption and the risk of other brain tumors were excluded from the study.

Assessment of the quality of studies: The assessment of the quality of the studies was done using the Newcastle-Ottawa Scale (NOS) tool. This tool has a separate format for cohort and case-studies. The NOS examines studies with a maximum of 9 points: 4 points for selection, 2 points for comparison, and 3 points for the assessment of exposure and outcome. In this research, studies that scored above the median level were considered as high-quality studies, and studies that scored lower than the median score were of low quality.

Data extraction: In each study, the required data about the name of the first author, year of publication, study design, country, age, gender, sample size, number of individuals (gliomas), period of the study, exposures (coffee, tea or caffeinated drinks) and its evaluation, the type of outcome (type of brain tumor), and how it was assessed, were extracted while considering odds ratio or relative risk, and statistical adjustments.

Results

In the initial search, 466 papers were extracted. According to the study title and abstracts of articles, 452 articles were not related to the purpose of this study and were therefore excluded. Finally, the present review article was conducted among 14 studies. A summary of these studies is presented in Table 1 and Table 2.

Description of studies: Of the 14 studies conducted between 1987 and 2016, and investigated the relationship between consumption of coffee and tea and glioma, 4 case-control studies (14, 21, 27, 31), 8 cohort studies (19, 20, 22 – 26, 28), and 2 systematic review and meta-analysis (29 and 30) were found, and in terms of place of study, 7 studies were conducted in the United States (19, 20, 22, 23, 25, 27), 2 studies were conducted in Australia (26 and 31), 1 study was conducted in Canada (21), 1 study was conducted in 10 European countries (24) and 1 study was conducted in Japan (28). All studies were conducted on adults and the age of the subjects was from 15 to 81 years. Three studies were conducted only on women (14 and 23), 2 only on men (22 and 23), and the rest were conducted on both sexes. The sample size varied from 94 people in the case-control studies (14) to 106,324 people in cohort studies (28). The period of conducting the studies was from 2 years in case-control studies (14) to 30 years in cohort studies (22).

Exposure assessment: In six studies, the food frequency questionnaire (FFQ) was used to evaluate the level of tea and coffee and other foods (19, 20, 23, 24, 26, 31). Six studies used coffee and tea in the questionnaire for assessing individual habits and behaviors (14, 21, 22, 25, 27, 28). The relationship between glioma and drinking tea in six studies (19 – 24), coffee consumption in ten studies (13, 20 – 28), caffeine consumption in two studies (20, 23), and consumption of tea and coffee and other caffeinated drinks in five studies (14, 19, 23, 24, 31) were investigated.

Outcome assessment: In order to assess the glioma, medical records were used in five studies (20, 22, 23, 27, 31), the data from the recorded cases of glioma in cancer registry centers were used in five studies (19, 24 – 26, 28), and sampling and pathological tests were used in three studies (14, 21, 23). In most studies, ICD-O diagnostic criteria were used. The first edition of this instruction was used in four studies (14, 22, 25, 31), the second edition was used in three studies (20, 23, 24), and the third edition was used in three studies (19, 26, 28).

Statistical analysis and adjustments: In all studies, the odds ratio (OR) (14, 21, 27, 31) and relative risk (HR / RR) (19, 20, 22 – 26, 28) with a 95% confidence interval (CI-95%) were used to report the relationship between the consumption of tea and coffee and glioma. In most studies, statistical adjustment was done for age (19, 20, 23, 25 – 28), gender (19, 20, 25 – 28), race (14, 19, 20, 25), education (14, 20, 24 – 26), alcohol consumption (23, 25, 28, 31), smoking (23 – 26, 28, 31), consumption of processed meat (23 and 26), consumption of fruits and vegetables (19 and 26), body mass index (24, 26, 28), the energy received (19, 23, 26), menopause (23 and 24), hormone therapy (24), socioeconomic status (27), use of vitamin supplement (14), religion (14), history of allergies and diabetes (28). Moreover, matching was done in case-control studies in terms of age (14, 21), sex (14, 21, 27, 31), race (14), place of residence (21 and 27), marital status (21), and the time of diagnosis of glioma (21).

Among studies that investigated the association between coffee consumption and glioma, coffee consumption was associated with an increased risk of glioma in one study (P_{trend}=0.01) (25). In nine other studies, coffee consumption was not statistically related to the presence or absence of glioma (19, 24, 26

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– 28). In studies that investigated the association between tea consumption and glioma, tea consumption was associated with a 25% reduction in the risk of glioma in one study (19), and there was no significant relationship in other five studies (20–24). In studies that measured the correlation between total consumption of coffee and tea and glioma, a 40% reduction of risk factors was observed consuming 5 cups or more of coffee and tea per day (23). Other studies did not show any significant relationship (13 and 24). In studies that measured the association between caffeine consumption and glioma, a 54% reduction of risk factors was observed in males (23), and a statistically significant relationship was not reported in other studies (20). No significant correlation was observed in studies that measured the correlation between total consumption of coffee and tea and other caffeinated drinks and glioma (14, 31).

Table 1. Cohort studies on the relationship between consumption of coffee and tea and glioma

Authors	Country	Age (years)	Total	people with glioma	Duration of study	Exposure variable	Comparisons	Findings, odds ratio or relative risk
Efird et al, 2004	USA	25 ≤	133811	130 cases	21 years	Coffee	7≤cup of coffee versus 1≥ cups a day	1.7(0.8–3.6) P_{trend}=0/01
Holick et al, 2010	USA NHS I NHS II HPFS	30–55 25–42 40–75	92468 95391 49935	182 cases 20 cases 133 cases	24 years 14 years 18 years	Coffee, tea, caffeine	5≤ cup of tea or coffee versus 1≥ cups a day	Total population 0.6(0.41–0.87)
Michaud et al, 2010	10 European countries	25–70	410309	341 glioma 254 meningioma	8.5 years	Coffee, tea	Per 100 ml of coffee and tea per day	Total population 0.66 (0.47–0.97) Men=0.59(0.34–1.01) Women=0.74(0.42–1.31)
Bagliett et al, 2011	Austratlia	27–81	39766	67 cases	15 years	Coffee	Q4 versus Q1 coffee consumption	0.51 (0.23–1.10)
Nelson et al, 2012	USA	46–68	8006	9 cases	30 years	Coffee, tea	T3 versus T1 coffee and tea consumption	Coffee=0.89(0.08–10.02) Tea=1.21(0.22–6.76)
Dubrow et al, 2012	USA	50–71	545771	904 cases	10.6 years	Coffee, tea, soda	5≤ cup of tea or coffee versus 1≥ cups a day	0.68(0.46–1.03)
Hashibe et al, 2015	USA	55–74	97334	103 cases	19 years	Coffee, tea, caffeine	2≤ cup of coffee versus 1≥ cups a day 1 cup of tea versus 1> cup per day	0.76(0.5–1.17) 1.04(0.65–1.66)
Ogawa et al, 2016	Japan	40–69	106324	157 cases	22 years	Coffee	3≤ cup of coffee versus 4≥ cup per week	0.55(0.17–1.84)

Table 2. Case studies on the relationship between consumption of coffee and tea and glioma

Authors	Country	Type of Study	Age (years)	people with glioma	Total	Exposure variable	Comparisons	Findings, odds ratio or relative risk
Burch et al, 1987	Canada	Hospital-based	25–81	215	215	Coffee, tea	Q4 versus Q1 Coffee and tea consumption	Coffee 1.04 (0.76–2.58) Tea 1.26 (0.7 – 1.8)
Hochberg et al, 1990	USA	Population-based	15 – 81	125	128	Coffee	2≤ cup of coffee versus 1≥ cups a day	0.9 (0.5 – 1.8)
Giles et al, 1994	Australia	Population-based	20 – 70	416	409	Coffee, tea, soda	T3 versus T1 caffeinated drinks consumption	Women 0.55 (0.3 – 1.02) Men 1.1 (0.71 – 1.71)
Blowers et al, 1997	USA	Population-based	25 – 74	94	94	Coffee, tea, soda	Q4 versus Q1 consumption of caffeinated drinks	0.3 (0.1 – 1.2)

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Discussion

Results of all observational studies that examined the relationship between coffee and tea consumption and glioma do not support this relationship. Some studies have found a positive relationship between the consumption of coffee and tea and glioma (19 – 22, 25, 31), but all these results are not statistically significant, and only one study reported a significant relationship between coffee consumption and an increased risk of glioma (25). Some studies have found an inverse relationship between coffee, tea and caffeine consumption and glioma (14, 19, 20, 22 – 24, 26 – 28, 31), but the results are statistically significant only in two of these studies (19,23).

Although two review articles and meta-analytical studies have been published in this field in 2013 and 2015, they did not include all the studies in this field. The meta-analysis performed in 2013 was limited to only six studies (four cohorts and two cases) and the study of 2015 was performed on only three cohorts. The study by Efired et al., which was conducted on 133,811 people in the United States, was the only study that showed a significant increase in the risk of glioma with increased coffee consumption. This study, with a large sample size, had a long follow-up period (21 years) in a multi-ethnic population (25).

In this study, the type of coffee consumed and how it was prepared was not asked from the subjects. The risk of glioma was also measured by the amount of coffee consumed at the beginning of the study, and it was possible that the subjects changed their coffee consumption over the 21 years after the onset of glioma. Another limitation of this study was the method of studying and evaluating the occurrence of glioma in the subjects. In this study, people with glioma were assessed based on the records of glioma in the cancer registry center, and there was a possibility of wrong classification and incorrect registration. In addition, the effect of all potential confounders was not adjusted.

Other studies that reported an increased risk of glioma after consuming coffee or tea have similar constraints including the lack of attention to the type of coffee and tea consumed and how it was prepared (19–22, 31), failure to measure the amount of coffee and tea consumed at the beginning the study (19 and 20) and the lack of adjustment of the effect of all the disrupters (20 – 22, 31). A study by Holick et al. (2010) on the results of three cohort studies showed a 40% reduction in the risk of glioma after consuming five cups or more of coffee and tea per day in adults (RR=0.60, CI-95%=0.41–0.87). This study was conducted with a large sample size (237,794 people), a long follow-up period (14 to 24 years), and a series of follow-up and checking of the type of coffee and tea and their method of preparation. In this study, the level of coffee and tea consumption was based on the reports of individuals and there was a possibility of error in subjects' reminder and reporting (23).

A study by Dubrow et al., conducted in 2013 on 545,771 people in the United States, showed a 25% reduction in glioma after consuming four cups or more of tea per day (19). The effect of other dietary intakes was modulated in this study. The number of people with glioma was more than twice as high as previous studies. In this study, the level of tea consumption was measured with the risk of glioma at the beginning of the study, and the possibility of a change in tea consumption was observed during the 10.6 years of the study. Moreover, the method of preparation and the type of coffee and tea consumed were not asked from the subjects. Similar to other studies that use FFQ to evaluate dietary intake, there was an error in measurement and reminder.

Other studies that showed an inverse relationship between coffee and tea consumption and glioma have similar constraints including the level of coffee and tea consumption at the beginning of the study in relation to glioma (20, 22, 24, 26), the lack of adjustment of the effect of all confounders (14, 20, 22, 24, 26), cases of low incidence of glioma or the small number of cases in case-control studies (14, 22, 26), lack of attention to the type of coffee and tea consumed and its method of preparation (24, 28), and the possibility of error in the study of coffee and tea consumption and other food intakes by FFQ and others methods (14, 22, 24, 28). Considering the limitations of these studies and their degree of accuracy and validity in terms of designing the study, exposure assessment and outcome, it seems that there is a correlation between of coffee and tea consumption and glioma, and increase in the consumption of coffee and tea is associated with reduced risk of glioma.

It should be noted, however, that studies carried out so far have limitations, and to have a definitive conclusion in this regard, it is necessary to conduct studies with sufficient sample size and control of confounding factors.

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