Meta-analysis evaluating the impact of chili-pepper intake on all-cause and cardiovascular mortality: A systematic review

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Background: Dietetics today occupy a significant place in the field of research, helping to discover cardiovascular benefits of healthy diets and consumption of organic foods such as fruits, vegetables, legumes, nuts, and whole grains. One of the components of vegetable-based diet is chili pepper (CP) which has been found to affect all-cause mortality.

Methods: MEDLINE, EMBASE, Scopus, EBSCO, and Cochrane (Wiley) Central Register of Controlled Trials were searched from inception till January 9, 2020, identifying all relevant studies using keywords and truncations. Studies were included if (1) they were observational or randomized in nature (2) included patients consuming CP and (3) evaluated direct comparison between regular and rarely/never CP consumption.

Results: Our preliminary search yielded 6976 articles. Post exclusion and after full-text screening, four potential observational studies with a population of 570,762. Pooled analysis found reduced all-cause mortality in CP consumers compared to nonconsumers with a risk ratio (RR) of 0.75 [95% CI: 0.64-0.88; p = 0.0004; I^2 = 66%], 0.77 [95% CI: 0.71-0.84; p = 0.001; I^2 = 49%] and 0.76 [95% CI: 0.36-1.66; p = 0.47; I^2 = 93%], respectively.

Conclusion: Statistically significant results of our analysis put forward a rationale indicating an association between lower risk of all-cause, cardiovascular and cancer related deaths and CP consumption.

1. Introduction

Dietetics today occupy a significant place in the field of research, helping to discover cardiovascular benefits of healthy diets and consumption of organic foods such as fruits, vegetables, legumes, nuts, and whole grains. One of the components of vegetable-based diet is chili pepper (CP) which has been found to affect all-cause mortality [1]. The chemical constituent of CP, capsaicin, has been shown to reduce all-cause mortality and deaths caused by CVD (cardiovascular disease), cancer and CVA (cerebrovascular accidents). However, absence of randomized and insufficient evidence [2] in previous studies has hindered demonstrating an association between CP consumption and mortality. This warrants a meta-analysis to study CP effects and benefits.

2. Methods

MEDLINE, EMBASE, Scopus, EBSCO, and Cochrane (Wiley) Central Register of Controlled Trials were searched from inception till January 9, 2020, identifying all relevant studies using keywords and truncations. Studies were included if (1) they were observational or randomized in nature (2) included patients consuming CP and (3) evaluated direct comparison between regular and rarely/never CP consumption. Primary outcome of interest was all-cause mortality and secondary outcomes included deaths by CVD, CVA and cancer. Pooled risk ratios and 95% confidence intervals were calculated using random effects meta-analysis.
Table 1

| Study          | Country | Years of enrollment | Type of study | Participants | Type of pepper | Intervention vs Control group (based on frequency of CP consumption) | Outcome Data Assessment            | Ethnic Background | Food questionnaire | Follow-up (median in years) | Potential bias (adjustment) |
|---------------|---------|---------------------|---------------|--------------|----------------|--------------------------------------------------------------------|------------------------------------|-------------------|----------------------|-----------------------------|--------------------------|
| Bonaccio et al. (2019) | Italy | 2005 to 2010        | Prospective cohort study; non-randomized | Men and women ≥ 35 years of age | Chili pepper | CP consumers (n = 15122): up to 2 times/week to > 4 times/week Rare/Non-consumers (n = 7689) | Italian mortality registry. Other outcome data were collected from medical records using ICD-9 coding | | | | |
| Hashemian et al. (2019) | Iran | 2004 to 2008 | Prospective cohort study; non-randomized | Individuals 40–75 years of age | Black or chili pepper | CP consumers (n = 31071): ever consumer of CP Non-consumers (n = 13327) | Death certificate and two internists evaluating the cause of death. Cause-specific mortality from the medical records using ICD-10 codes | Turkmen, non-Turkmen | 116-item Food Frequency Questionnaire (FFQ) | | At risk of selection bias |
| Chopan et al. (2017) | USA | 1988 to 1994 | Prospective cohort study; non-randomized | Adults ≥ 18 years including Mexican-American, other Hispanic, or non-Hispanic subjects | Hot red chili pepper | CP consumers (n = 4107): once per month or more Non-consumers (n = 12071) | Matching with National Death Index. Cause-specific mortality was collected from medical records using ICD-10 codes | Multi-culture (White, Black, Hispanics) | 81-item Food Frequency Questionnaire | | Information/recall bias (extensive interviews) |
| Lv et al. (2015) | China | 2004 to 2008 | Prospective cohort study; non-randomized | 10 geographicaly diverse areas across China, aged 30–79 years | Various types: fresh chili, dried chili pepper, chili sauce, chili oil | CP consumers (n = 208884): At least once a week Rare/Non-consumers (n = 278491) | Linkage with death registries and residential records. Cause-specific mortality was collected from medical records using ICD-10 codes | Chinese | Food Questionnaire: frequency of chili pepper intake (Never or almost never, only occasionally, 1 or 2 days a week, 3–5 days a week, or 6 or 7 days a week) | | Residual confounding (inverse association between spicy food and mortality toward the null); At risk of selection bias |

*International Classification of Diseases.

Confidence intervals were calculated using random-effect and generic inverse variance methods. A p-value < 0.05 was considered significant. Reporting quality was evaluated using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [3] and methodological quality using the Assessment of Multiple Systematic Reviews (AMSTAR-2) tool [4].

3. Results

Our preliminary search yielded 6976 articles. Post exclusion and after full-text screening, four potential observational studies with a population of 570,762 (259,184 consumed CP; 311,578 rarely/never consumed CP) met the inclusion criteria and thus included in the meta-analysis [1,5–7]. The studies used Food Frequency Questionnaire (FFQ), National Health and Nutrition Examination Survey (NHANES) to study the effects of CP consumption. Study characteristics are summarized in Table 1. Pooled analysis found reduced all-cause mortality in CP consumers compared to non-consumers with a risk ratio (RR) of 0.75 [95% CI: 0.64–0.88; p = 0.0004; I² = 97%]. The RR for CVD, cancer related and CVA deaths were 0.74 [95% CI: 0.62–0.88; p = 0.0006, I² = 66%], 0.77 [95% CI: 0.71–0.84; p = 0.0001; I² = 49%] and 0.76 [95% CI: 0.36–1.60; p = 0.47; I² = 93%], respectively (Fig. 1).

4. Discussion

This is the first meta-analysis carried out to assess the impact of CP consumption on all-cause, CVD and cancer related mortality. Our results show significant benefit from CP consumption in preventing such deaths as opposed to rare or no CP consumption. The lack of data on mode, quantity and frequency of CP consumption leads to non-standardization, along with variable populations in control and intervention groups leading to high heterogeneity level. The significant reduction of relative risk is supported by two potential processes. First, capsaicin promotes the activation of the TRPV1 (Transient receptor potential cation channel sub-family V member 1) receptor which through a cascade effect leads to thermogenesis, fat metabolism and other energy dissipation processes [8]. This way energy equilibrium shifts help in weight-reduction, consequently lowering the risk of CVD incidence [9]. Likewise, weight-reduction was observed in 30 participants in the study by Yoshioka et al. [10] where a diet rich in fat was supplemented with capsaicin. Second, theTRPV1, receptor found in epidermis, has been proposed to prevent myocardial infarction, through the release of substance P [11]. The TRPV1 dependent release of serotonin helps thrombin in platelet activation. This mechanism accounts for the pro-coagulating property of capsaicin and justifies the negative impact of CP on CVD and CVA deaths [12].

5. Conclusion

To our knowledge, this is the first systematic review and meta-analysis that attempt to identify association between CP consumption and mortality. Statistically significant results of our analysis put forward a rationale indicating an association between lower risk of all-cause, cardiovascular and cancer related deaths and CP consumption (Fig. 1).
Declaration of competing interest

None to declare.

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None to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.102774.

Ethical approval

NA.

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Author contribution

Naser Yamani conceived the idea and designed the study. Muhammad Maaz Waseem collected the data and analysed it. Adeena Musheer drafted the manuscript. Priyanka Gosain conducted literature search. Saba Sarfraz created the illustrations. Humera Qamar refined the illustrations. Muhammad Sameer Arshad revised the manuscript critically.

Registration of research studies

1. Name of the registry: NA.
2. Unique Identifying number or registration ID: NA.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): NA.

Guarantor

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Consent

NA.

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