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Original article

Potato consumption and risk of type 2 diabetes: A dose–response meta-analysis of cohort studies

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SUMMARY

Background & aims: High potato intake has been suggested as a risk factor for the development of type 2 diabetes. We aimed to investigate the association between potato consumption and risk of type 2 diabetes.

Methods: A systematic review was conducted on PubMed and Embase from the database commencement until September 2017 (updated by June 2018) following the MOOSE guidelines. The random effect model dose–response meta-analysis method of Greenland and Longneck was used to estimate the maximally adjusted log hazard ratio (HR) for a unit (serving per day) increment of potato consumption. A restricted cubic spline model with three knots was used to evaluate the potential non-linear relationship.

Results: A total of 3544 citations were retrieved from the databases, of which six prospective cohort studies including 4545230 person-year of follow-up and 17,758 diabetes cases met the inclusion criteria. The pooled dose–response HR per an increment of 1 serving/day of total potato consumption was 1.20 (95% CI 1.13 to 1.127, $P < 0.001$, $I^2 = 27.1\%$, P for heterogeneity = 0.23) both in men and women. The larger risk were observed for 2 serving/day (HR 1.44, 95% CI 1.28 to 1.63) and 3 serving/day (HR 1.74, 95% CI 1.45 to 2.09). We found significant evidence of a non-linear association between total potato consumption and risk of type 2 diabetes ($X^2 = 17.5$, P for linearity < 0.001).

Conclusion: Long-term high consumption of potato (each serving a day increase) may be strongly associated with increased risk of diabetes. These findings suggest that diet–health policy may be of importance in the prevention of diabetes.

1. Introduction

Potato is the most consumed staple food after rice and wheat [1] with a global mean per capita intake of 33 kg/year and a notable higher mean intake in the US of 54 kg/year [2]. Recently, potatoes consumption has been the topic of much scientific research regarding their effect on chronic diseases [1,3]. This is due to their frequency and wide range of consumption globally, but also due to the fact that they are a rich source of minerals while they have a low fat and sodium content. Besides, potatoes have a high glycemic index (GI) and glycemic load (GL) and are a source of starch. This may contribute to a detrimental effect on health and some prospective studies have shown a positive association between dietary GL with higher risk of developing diabetes [4,5]. Although compelling evidence is available linking metabolic and cardiovascular disease risk factors to diabetes, our understanding of the association between some staple foods such as potatoes and risk of type 2 diabetes remains limited.

Dietary factors play an important role in developing of type 2 diabetes [6]. In the United State dietary guidelines, potatoes are

Abbreviations: GI, glycemic index; GL, glycemic load; FFQ, food frequency questionnaires.

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included in the vegetable food groups and similar to other vegetables encourage to be consumed [7]. Although the beneficial association between dietary vegetable intake and chronic disease were shown, there was some debates for dietary recommendation intake of potatoes, because some studies demonstrate adverse relation between high potato intake and chronic disease include diabetes and hypertension [8–10]. Higher potato intake indicated that increase fasting blood glucose and insulin resistance, and may increase the risk of diabetes [11]. We therefore undertook a dose–response meta-analysis of prospective cohort studies to reliably determine and combine the available evidence in the association between potato consumption (per serving/day) and risk of type 2 diabetes.

2. Methods

2.1. Search strategy

A systematic review was conducted on Medline/PubMed and Elsevier/Embase for relevant studies from the database commencement until September 2017 (updated by June 2018) without time or language restrictions and following the MOOSE guidelines [12]. A complementary search was carried out on leading diabetes and nutritional journals and all reference lists of identified papers, reviews, meta-analyses, letters, and other relevant documents, with terms related to potatoes as well as those for diabetes as key words. Search terms included Mesh term related to potato consumption and diabetes disease. Two qualified investigators separately screened titles and abstracts for eligible studies. In addition, the reference lists from the retrieved article were scrutinized for additional relevant studies. We set an email alert in databases and journals in order to get notification for any new published paper. Also, in the case of inadequate information in the paper, communication was made via electronic mail. The same investigators checked these articles in full text base on the eligibility criteria. Any disagreements in the review were resolved by a consensus or adjudication of principle investigator. EndNote X8 software was employed for citation management.

2.2. Study selection and quality assessment

All retrieved articles were screened based on titles and abstract, using the following general exclusion criteria: 1) irrelevant and non-original papers; 2) in vitro, cell line and animal studies; 3) case reports and case series reports. This was followed by a full text review on remaining articles. In the next step, a full text review was conducted on the selected papers, excluding cross-sectional or case–control studies, studies on patients with diabetes or cardio vascular disease at baseline, studies with follow-up < 1 year or sample size <100 and studies on patient groups or pregnant women. Studies were included in the final statistical analysis if they meet the following criteria: cohort or clinical trial (control arm) studies, objective diagnostic procedure for diagnosis of valid diabetes cases, valid measurement of white potato consumption, and the authors reported adjusted measure of association (hazard ratio, rate ratio, risk ratio) with 95% confidence intervals. Our interested exposure was white potato consumption and studies of other potatoes type (such as sweet and purple potato) were excluded. In cases where the same study data were reported in multiple papers, only the paper with the more number of diabetes cases were included. The flowchart showing the selection procedure is provided in Fig. 1. Five methodological components which might bias the association between potato consumption and risk of diabetes including study design, follow-up duration, adjustment for well-known confounders, sample size, and number of diabetes cases were used for quality assessment purposes [13].

2.3. Data extraction

Data extraction procedure was performed using a standard data extraction form independently by two investigators (JD and FT). The following information was extracted from each study: first author name, years of publication, sex, age, name of study, study location, duration of follow-up, exposure assessment tool, outcome definition, number of observed incident cases, sample size, type of potatoes (bakes, mashed or boiled, French fries), case ascertainment, potato consumption categories, covariates adjusted for in the multivariable analysis and relative risks with 95% CI for all categories of potatoes consumption. When several models estimate were available, we considered the maximally adjusted model. Any reported HRs stratified by sex were considered as two separate paper in statistical analysis.

2.4. Statistical analysis

In the present study, HR and correspondent 95% CI were considered as the effect size (all the included papers reported HR as main measure of association). The random model dose–response meta-analysis method of Greenland and Longnecke [14] was used to estimate the maximally adjusted log HR for a unit (serving per day) increment of potato consumption. According to the method, the following information extracted for statistical analysis: the amount of potato consumption per each categories (dose), number of type 2 diabetes cases and equivalent person years, and HR and 95% CI. The median of each potatoes consumption categories was assigned to the corresponding HR (as corresponding dose). For studies reporting open boundaries, the best estimates were made based on the descriptive information contained in the paper. A restricted cubic spline model with three knots at the 25th, 50th, and 75th percentiles of potatoes intake was used to evaluate the potential non-linear relationship (different knots at different place had no effect on the result), with generalized least square regression based on the correlation within each category of HRs. *P*-value for non-linearity was calculated using Wald's statistics, testing the null hypothesis of regression coefficient equal to zero for second spline [15]. The Cochran's Q test and I^2 statistic were conducted to determine the presence of heterogeneity among studies. All statistical analyses were performed using R version 3.4.1 [16].

3. Results

3.1. Literature search

The process of systematic-review exhibited in Fig. 1. First, we retrieved 3544 citations from which duplicate citations and studies that did not meet the inclusion criteria were excluded (n = 2914). Next, 630 papers included in the abstract screening. In the second step, 46 papers selected for full text screening (see follow-chart for detailed description) (Fig. 1). Among 46 selected full-text papers, four papers included for statistical analysis. In addition, one paper retrieved from manual searching of references lists [4]. Causes of inclusion and exclusion of studies are showed in supplementary Table S1. Finally, four papers (contain data from six prospective cohort studies) included for statistical analysis [4,17–19]. Four papers [19–22] were reported the association between potatoes and risk of type 2 diabetes using data from the same source (Nurses' Health Study). We selected the paper reported by Muraki et al. [19], because of they had more number of type 2 diabetes incident cases with updated follow-up information [19].

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