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Vegetarian diet and all-cause mortality: Evidence from a large population-based Australian cohort - the 45 and Up Study

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ABSTRACT

The vegetarian diet is thought to have health benefits including reductions in type 2 diabetes, hypertension, and obesity. Evidence to date suggests that vegetarians tend to have lower mortality rates when compared with non-vegetarians, but most studies are not population-based and other healthy lifestyle factors may have confounded apparent protective effects. The aim of this study was to evaluate the association between categories of vegetarian diet (including complete, semi and pesco-vegetarian) and all-cause mortality in a large population-based Australian cohort.

The 45 and Up Study is a cohort study of 267,180 men and women aged ≥45 years in New South Wales (NSW), Australia. Vegetarian diet status was assessed by baseline questionnaire and participants were categorized into complete vegetarians, semi-vegetarians (eat meat ≤ once/week), pesco-vegetarians and regular meat eaters. All-cause mortality was determined by linked registry data to mid-2014. Cox proportional hazards models quantified the association between vegetarian diet and all-cause mortality adjusting for a range of potential confounding factors.

Among 243,096 participants (mean age: 62.3 years, 46.7% men) there were 16,836 deaths over a mean 6.1 years of follow-up. Following extensive adjustment for potential confounding factors there was no significant difference in all-cause mortality for vegetarians versus non-vegetarians [HR = 1.16 (95% CI 0.93–1.45)]. There was also no significant difference in mortality risk between pesco-vegetarians [HR = 0.79 (95% CI 0.59–1.06)] or semi-vegetarians [HR = 1.12 (95% CI 0.96–1.31)] versus regular meat eaters. We found no evidence that following a vegetarian diet, semi-vegetarian diet or a pesco-vegetarian diet has an independent protective effect on all-cause mortality.

1. Introduction

Vegetarian diets vary worldwide but generally exclude meat, seafood, and products containing these foods. The specific patterns of vegetarian diets vary from vegan (no animal products) through lacto-vegetarian (including dairy products) and ovo-lacto-vegetarians (including eggs and dairy) (Rizzo et al., 2013; Orlich et al., 2014). In some studies those who include fish and seafood in their diet (also referred to as pesco-vegetarian) are also considered vegetarians (Haddad and Tanzman, 2003) and yet other studies have investigated whether a semi-vegetarian diet (where meat is consumed infrequently) has healthful effects (Clarys et al., 2014). The increasing interest in vegetarian dietary patterns for preventing disease is reflected in the position statement by the American Dietetic Association (now the Academy of Nutrition and Dietetics) (Craig et al., 2009) which endorses carefully planned vegetarian and vegan diets as 'healthful, nutritionally adequate and providing health benefits in the prevention and treatment of certain diseases'. They also state that 'well planned vegetarian diets are appropriate for individuals during all stages of the lifecycle, including pregnancy, lactation, infancy, childhood, and adolescence, and for athletes'. The 2015–2020 Dietary Guidelines for Americans (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015) outline a Healthy Vegetarian Diet pattern for vegetarians to follow.

In prospective studies and one meta-analysis of clinical trials the vegetarian dietary pattern has been associated with reductions in risk for type 2 diabetes (Tonstad et al., 2013; Vang et al., 2008), hypertension (Yokoyama et al., 2014; Appleby et al., 2002), and obesity (Vang et al.,

Abbreviations: BMI, Body mass index; CVD, Cardiovascular disease; CMD, Cardiovascular and metabolic disease; EPIC, European Prospective Investigation into Cancer; HR, hazard ratio; NSW, New South Wales; SEIFA, Socio-Economic Indexes for Areas.

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2008; Rosell et al., 2006) when adjusted for covariates, such as age, gender, education, physical activity alcohol use and smoking. In addition, people following a vegetarian diet have been shown to have lower mortality risk compared to non-vegetarians, particularly from cardiovascular disease (CVD) (Huang et al., 2012; Kwok et al., 2014). There have been a small number of good quality longitudinal studies that have investigated the association, including the Adventist Health Cohort (1 and II) and European Prospective Investigation into Cancer-Oxford (EPIC - Oxford). In the Adventist Health Study I (n = 34,198) in California, vegetarian dietary patterns were associated with reduced all-cause mortality and increased longevity (Fraser, 1999) and this was also seen in Adventist Health Study II (n = 96,000) where the adjusted hazard ratio (HR) for all-cause mortality in all vegetarians combined versus non-vegetarians was 0.88 (95% CI, 0.80–0.97) (Orlich et al., 2013). However in the EPIC-Oxford study, there were no differences in mortality from ischemic heart disease [HR = 0.81, 95% CI, 0.57–1.16] or differences in overall mortality observed between vegetarians versus non-vegetarians [HR = 1.03, 95% CI, 0.90–1.16] (Key et al., 2006, 2009).

Several methodological limitations apply to these longitudinal studies and underpin the need for these results to be investigated further. First, most of these studies were designed to recruit vegetarians or occurred in populations with higher proportions of vegetarians (such as the Adventists, who may have other lifestyle factors and health-enhancing behaviours responsible for the observed protective effects), therefore previous findings may have limited generalizability. Second, vegetarians usually engage in an overall healthier lifestyle compared with their non-vegetarian counterparts, such as a lower prevalence of smoking and excessive alcohol consumption (Key et al., 2009) and have higher levels of physical activity (Bedford and Barr, 2005). Therefore the protective effects observed could be due to the other concurrent behaviours.

The primary objective of this study is to examine the association between vegetarian diet and all-cause mortality in a large Australian mid-older age population-based cohort. A secondary objective is to compare different types of vegetarian diets (complete vegetarian, semi-vegetarian, pesco-vegetarian) to meat eaters in their risk of all-cause mortality.

2. Methods

The Sax Institute's 45 and Up Study is a longitudinal cohort study of a large sample (n = 267,180) of men and women based in New South Wales, the most populous State in Australia (where Sydney is the largest city). The primary aim of the Study is to investigate a wide range of exposures and outcomes of public health importance for the ageing population. The cohort profile and research protocol has been published (Banks et al., 2008) and is briefly described here.

2.1. Description of the cohort

Participants were 45 years or older at the time of recruitment from February 1, 2006, through November 30, 2008. Participants were randomly sampled from the Medicare Australia database (a national health care database, which includes all citizens and permanent residents of Australia and some temporary residents and refugees), and were invited via mail to be part of the study. The overall response rate was estimated to be 18% and approximately 10% of the entire New South Wales population 45 years or older was included in the final sample (Banks et al., 2008). Baseline data were collected via self-reported questionnaire. For this analysis we used data from participants who had non missing data on vegetarian diet status, age, gender, education, marital status, geographic remoteness, SEIFA (Socio-Economic Index for Area, a Census-based ecologic measure of socio-economic disadvantage), smoking status, physical activity, alcohol intake, and comorbidities including cancer, hypertension, and cardio-metabolic disease (CMD) which includes Type 2 diabetes, stroke and heart disease. The final sample for this analysis included 243,096 participants with non-missing data on the confounders listed above. Data was analyzed in September 2016. The study was approved by the New South Wales Population and Health Services Research Ethics Committee (reference No. 2010/05/234).

2.2. Outcome data

The outcome variable, all-cause mortality, was determined by linking data from the New South Wales Registry of Births, Deaths, and Marriages from February 1, 2006 to 17 June 2014. The mortality data were linked to the baseline data from the 45 and Up Study by the Centre for Health Record Linkage (Eveleigh, New South Wales, Australia) using probabilistic record linkage methods and commercially available software (ChoiceMaker; ChoiceMaker Technologies Inc.).

2.3. Dietary data

The baseline questionnaire included brief questions on dietary behaviours (see http://www.45andUp.org.au). The main exposure variable, vegetarian diet, was assessed using the question 'About how many times each week do you eat…', categories were 1) beef, lamb or pork; 2) chicken, turkey or duck; 3) processed meat including bacon, sausages, salami, devon, burgers; and 4) fish or seafood. If a value >1 was placed in any of the first three categories they were classified as 'regular meat eaters'. Vegetarian diet was further verified using a follow-up question which asked which food the participants *never* ate. These categories included red meat, any meat, fish chicken/poultry, eggs, seafood, pork/ham, sugar, cream, dairy products, wheat products, and cheese. The responses to this question were used to further delineate the categories of diet status. For the first objective, complete vegetarians were compared with a combined group of 'non-vegetarian' (which included pesco-vegetarians, semi-vegetarians and regular meat eaters). For the second objective, complete vegetarians were separately compared with pesco-vegetarians, semi-vegetarians (eat meat ≤1 week), and regular meat eaters. We were not able to distinguish between further categories such as vegans and lacto-ovo vegetarians because our dietary variables were based on brief questions and not on a 24-h recall or a food frequency questionnaire. Table 1 gives the definitions of the different categories of vegetarians and non-vegetarians used for this analysis.

2.4. Covariate data

Covariates included age, sex, country of birth (Australia vs other), educational level (≤12 years vs degree/higher), marital status (single, widowed, divorced/separated vs married/de facto), location of residence (regional/remote vs major cities), socio-economic status quintiles based on Socio-Economic Indexes For Area [SEIFA] which summarizes census obtained socio-economic indicators for geographic areas including income, educational attainment, unemployment and proportion of people in unskilled occupations (Australian Bureau of Statistics, 2011). Other covariates included smoking status (never, past, or current), alcohol intake (categorized as high if >14 drinks per week vs mid-low ≤14 drinks per week), physical activity (categorized as meeting the Australian guidelines ≥150 min per week or not). Body mass index was derived from self-reported height (m^2) and weight (kg) and categorized as underweight (<18.5 kg/m^2), normal weight (18.5–<25.0 kg/m^2), overweight (25.0–<30.0 kg/m^2), or obese (≥30.0 kg/m^2). Diagnosed comorbidities included ever diagnosed cardio metabolic disease (including Type 2 diabetes, heart disease and stroke) and diagnosis of cancers in the last 10 years (excluding non-melanoma skin cancer). As stated above, some data for these potential confounders were missing and this reduced the sample size by 24,012 (9.1% missing). Cases who had missing data were compared with the cohort that completed follow up on age, sex and education status and we found that they were comparable (Appendix A).