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Research paper

Vegetarian diets and depressive symptoms among men

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ABSTRACT

Background: Vegetarian diets are associate with cardiovascular and other health benefits, but little is known about mental health benefits or risks.
Aims: To determine whether self-identification of vegetarian dietary habits is associated with significant depressive symptoms in men.
Method: Self-report data from 9668 adult male partners of pregnant women in the Avon Longitudinal Study of Parents and Children (ALSPAC) included identification as vegetarian or vegan, dietary frequency data and the Edinburgh Post Natal Depression Scale (EPDS). Continuous and binary outcomes were assessed using multiple linear and logistic regression taking account of potential confounding variables including: age, marital status, employment status, housing tenure, number of children in the household, religion, family history of depression previous childhood psychiatric contact, cigarette and alcohol consumption.
Results: Vegetarians [n = 350 (3.6% of sample)], had higher depression scores on average than non-vegetarians (mean difference 0.96 points [95%CI + 0.53, + 1.40]) and a greater risk for EPDS scores above 10 (adjusted OR = 1.67 [95% CI: 1.14,2.44]) than non-vegetarians after adjustment for potential confounding factors.
Conclusions: Vegetarian men have more depressive symptoms after adjustment for socio-demographic factors. Nutritional deficiencies (e.g. in cobalamin or iron) are a possible explanation for these findings, however reverse causation cannot be ruled out.

1. Introduction

Vegetarian diets have been associated with decreased risks of cardiovascular death, obesity and diabetes (Fraser, 2009) prompting questions as to whether potential benefits extend to mental health or, in contrast, whether diminished intakes of nutrients that are abundant in excluded foods cause adverse consequences to mental well-being (Beezhold et al., 2010). A large survey of Australian women in their 20's, found a significant increase in elevated depressive symptoms among vegetarians compared to non-vegetarians (22% v. 15%) (Baines et al., 2007). Among 1046 Australian women, lower red meat consumption was associated with nearly a doubling of risk for major depressive and anxiety disorders (Jacka et al., 2012). Among Norwegian students, nearly twice as many men and one third more women with low meat consumption reported having been depressed, after adjustment (Larsson et al., 2002). In a representative sample, depression was more common among completely and predominantly vegetarian German adults, but adoption of vegetarian diets followed the onset of mental illnesses (Michalak et al., 2012). In Minnesota, adolescent vegetarians were more likely to have eating disorders and to have contemplated and attempted suicide (Perry et al., 2001) and Turkish adolescent vegetarians had higher social and physique anxiety scores (Bas et al., 2005). In contrast, a small survey of Seventh Day Adventist adults found no increased risk of depression or anxiety among vegetarians who excluded fish (Beezhold et al., 2010). Not all diets identified as vegetarian are homogeneous, with some including fish, rich in omega-3 highly unsaturated fatty acids (omega-HUFAs) and some meats and others excluding eggs (a source of omega-3 HUFAs and vitamins) and dairy products. Omega-3 HUFA's, specifically docosahexaenoic acid, are selectively concentrated in synaptic membranes and are essential for optimal neural function (Salem and Niebylski, 1995). Meta-analyses of randomized controlled trials indicate that omega-3 HUFAs are effective in treating significant depressive symptoms (Grosso et al., 2014; Hallahan et al., 2016). Red meats are a rich source of vitamin B_{12} and data suggest that low levels of vitamin B_{12} and folate may increase the risk of depression (Stanger et al., 2009) and one meta-analysis suggests that vitamin B_{12} intervention may prevent depressive symptoms in specialized populations (Almeida et al., 2015). Deficits in zinc and iron have also been postulated as risk factors in depression: a systematic review found evidence of benefits but cautioned that well-

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designed randomized controlled trials are needed to better evaluate effects of improving iron and zinc status on mood and cognition (Lomagno et al., 2014).

Although there has been considerable attention paid to maternal depression and its effect on child development, studies from ALSPAC have reported associations between paternal depression and adverse effects on the developing child (Ramchandani et al., 2005, 2008). Consequently, recognizing and ameliorating paternal depression is important. We sought to determine whether self-identification of a vegetarian diet was associated with increased risk of depressive symptoms among adult men during the pregnancy of their partners.

2. Methods

The Avon Longitudinal Study of Parents and Children (ALSPAC) (Fraser et al., 2013; Golding et al., 2001) enrolled women resident in the former geographical area of Avon in south-west England who were in the early stages of pregnancy with an expected date of delivery between 1st April 1991 and 31st December 1992. ALSPAC is an ongoing population based cohort study investigating environmental and other influences on the health and development of children; Please note that the study website contains details of all the data that are available through a fully searchable data dictionary: http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary/.

In the event, 14,541 pregnancies were enrolled. Detailed information was obtained from the women and their partners via self-completion questionnaires. The partner's participation was through an opt-in process determined primarily by the woman. She was sent a questionnaire at 18 weeks gestation to complete and an additional one for her partner to complete if she wanted him to participate in the study. 9845 male partners responded to this questionnaire which included data on diet and mood as well as demographic and psychosocial variables.

The Edinburgh Postnatal Depression Scale (Cox et al., 1987) was given to male partners as well as mothers in this study. This was sent as part of the 18 week questionnaire and was generally completed between 18 and 20 weeks of their partner's gestation. This scale focuses on cognitive and affective features of depression rather than somatic symptoms. Although the EPDS was developed to screen for depression in women postnatally it has been found to be useful in women outside the postnatal period and in men (Areias et al., 1996a, 1996b; Cox et al., 1996, 1987). The scale cannot in itself confirm a diagnosis of depressive disorder; however a score above 12 has been shown to indicate a high probability of severe depression. Although considered univariably, such a cut-off would result in limited statistical power for the multivariable analyses in the present study and therefore scores above 10, which will include more cases with mild and moderate depression, have been considered in the logistic regression analyses.

Background data on the study fathers were collected by means of two postal questionnaires administered to them in pregnancy. These data included vulnerability factors for depression such as a family history of depression, previous childhood psychiatric contact (through attendance at a child guidance clinic) and the highest educational level reached. Data on current circumstances that might lead to higher scores when rating depressed mood included housing tenure, age, ethnic origin and number of children in the household. Vegetarianism is more common amongst certain religious groups and therefore religion was included in the analyses, grouped as Christian, non-Christian or none. Other factors such as marital status, employment status, alcohol and tobacco consumption might result from depressed mood as well as being causal factors and so these were additionally adjusted for in a separate analysis. Responses to the postal questionnaire on diet at 32 weeks maternal gestation were used as the basis for allocating subjects to vegetarian or non-vegetarian groups. Men were asked if they were either vegetarian or vegan or neither. Because there were relatively few vegans, they have been combined with the vegetarians in this paper. In a preceding set of questions the men were asked 'how many times nowadays do you eat': followed by 17 categories of foods consumed either never, once in 2 weeks, 1–3 times per week, 4–7 times/week or more than once per day. In order to evaluate dietary exclusion, these categories were collapsed to 'yes' or 'never'.

3. Statistical methods

The depression scores for the EPDS were strongly skewed to the left: 17.5% of the whole sample scored zero. Transformation of the data did not produce a closer approximation to a normal distribution due to these zero values. Hence the EPDS data were analyzed untransformed using both parametric (*t*-test or ANOVA where appropriate) and non-parametric (Mann-Whitney *U* test or Kolmogorov-Smirnov test where appropriate) tests for univariable analysis, comparing the differences in mean scores. In addition, cut points of both > 10 and > 12 were used to create a binary variable for EPDS; chi-squared tests for independence were used to determine any significant differences in proportions above these values. General linear models and multiple logistic regression (with the binary depression score based on EPDS > 10 as the dependent variable) were used to investigate any independent relationship with vegetarianism. Exclusions were made only on the basis of missing data. A substantial number of men (20%) did not answer the question about marital status so an unknown category was included in the analysis to maintain statistical power.

4. Results

4.1. Unadjusted associations

EPDS scores were available from 9668 men who also provided information on their vegetarian status. 350 (3.6%) reported that they were vegetarian/vegan (311 vegetarian and 39 vegan). The length of time that these men reported that they had been vegetarian ranged from < 1 to 41 years, with two-thirds having been vegetarian for < 10 years. Vegetarians had a higher mean depression score compared to non-vegetarians ($p < 0.0001$ for both *t*-test and Mann-Whitney), similarly a greater proportion of vegetarians had an EPDS score > 10 ($p = 0.001$) with an unadjusted odds ratio of 1.75 (95% CI: 1.26, 2.43) compared to non-vegetarians (Table 1). The reported duration of vegetarianism showed a trend towards higher depression scores with increasing length of time ($p = 0.103$).

Table 2 shows associations between various social and lifestyle factors and both vegetarian status and EPDS scores greater than 10. Men who had an EPDS score greater than 10 were more likely to have lower levels of education, to live in council or other rented accommodation, have more children in the home and be under 25 years of age. Non-married men, those who had contact in childhood with the child psychiatric services, heavy smokers and unemployed men were also more likely to have a higher EPDS score. Men self-reporting as vegetarian were more likely to have higher levels of education, to live in privately rented accommodation, to have no children in the

Table 1
Distribution of EPDS score in whole sample and in vegetarians and non-vegetarians.

	Vegetarians	Non-vegetarians	Overall
N	350	9318	9668
Mean	5.26[a]	4.18	4.22
St Dev	4.54	3.89	3.93
% (n) score > 10	12.3% (43)[b]	7.4% (690)	7.6% (733)
%(n) score > 12	6.8% (24)[c]	3.9% (366)	4.0% (390)

[a] Mean EPDS score compared to non-vegetarians $F = 25.41$, $p < 0.0001$ (M-W: $p < 0.0001$).
[b] Proportion with score > 10 compared to non-vegetarians $\chi^2 = 11.5$, $p = 0.001$.
[c] Proportion > 12 compared to non-vegetarians $\times^2 = 8.1$, $p < 0.01$.