

## Association between history of tuberculosis and vegetarianism from a nationally representative survey in India

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### SUMMARY

A vegetarian diet has been implicated as a risk factor for tuberculosis (TB) among South Asians in the United Kingdom. To explore whether this is also the case in India, we analysed data from the nationally representative National Family Health Survey-3 (2006) which collected information on TB and diet, and tested for human immunodeficiency virus (HIV). 1. TB was reported by heads

of households. Using logistic regression, we found that vegetarianism was not a risk factor for TB among HIV-1 negative married men and women aged 15–49 (women) or 15–54 (men) years (OR 0.66, 95%CI 0.49–0.89), while poverty and a history of blood transfusions were. **KEY WORDS:** HIV; diet; nutrition; vegetarianism; public health

INFECTION with *Mycobacterium tuberculosis* is a necessary but not a sufficient condition for the development of clinical tuberculosis (TB). The reasons why some TB infections progress to clinical TB, while most remain latent, have not been fully clarified, although various correlates have been identified.<sup>1</sup> The idea that (poor) nutrition may be involved has a long history that goes back to the pre-chemotherapy era.<sup>2</sup> More recently, interest has focused on the importance of a non-vegetarian diet, and several studies on South Asians in the United Kingdom have identified an association between vegetarianism and TB.<sup>3</sup> One postulated mechanism for this association is a lack of cobalamin (vitamin B12) and calciferol (vitamin D) in vegetarian diets, leading to impaired killing of phagocytosed bacilli by macrophages.<sup>4–9</sup> However, the methodology of these studies has been controversial, and bias and confounding may be hard to avoid, as vegetarianism in immigrant South Asians may be related to factors such as religion and traditionalism, including frequency of visits to the Indian subcontinent, where exposure to *M. tuberculosis* is common. A comparison between vegetarians and non-vegetarians within India itself (Pakistan is mostly non-vegetarian) would thus have important public health implications, especially as many Indians are vegetarian, and TB is highly prevalent.<sup>10</sup> However, no such study appears to have been conducted. The National Family Health Survey 3 (NFHS-3)<sup>11</sup> carried out in India in 2006 offered the opportunity to explore this issue on a representative population sample.

### DATA AND METHODS

#### Data

#### National Family Health Survey 3

The NFHS-3 is a nationally representative demographic household survey of Indian women and their husbands, conducted by the International Institute for Population Sciences (IIPS) and Macro International Inc., Calverton, MD, USA.<sup>11</sup> The survey focused on family health and health system usage, but also included human immunodeficiency virus (HIV) testing of a subsample. Interviews were conducted with 124 385 women aged 15–49 years and 74 369 men aged 15–54 years from 29 states. Nationally, 102 946 women and men were tested for HIV.

#### HIV testing in the NFHS-3

All women aged 15–49 years and men aged 15–54 years in households selected for the NFHS-3 HIV sample were eligible for anonymous HIV testing. Full details on the methods for collection, dried blood spot (DBS) management and HIV testing are available in the NFHS-3 report.<sup>11</sup> TB among members in the household was elicited from the head of household by asking 'Who suffers from TB?' Vegetarianism was defined as anyone (self-reported as) eating neither fish nor meat (largely overlapping). In India, many vegetarians also do not eat eggs; most of the individuals we classified as vegetarians reported not eating eggs.

### Statistical methods

Only HIV-negative men and women were considered. Association with a self-reported history of TB was analysed by means of cross-tabulation and stepwise logistic regression with backward selection.

### Ethics

As this study was based on previously collected and publicly available data (<http://www.measuredhs.com/>), ethical approval was not required.

## RESULTS

The Table shows the association of TB with vegetarianism and other TB risk factors, estimated by logistic regression. TB was more common in men than in women. Individuals reporting TB were slightly older (31.8 vs. 29.4 in women, 39.3 vs. 37.2 in men). Vegetarians were also slightly older than non-vegetarians (29.5 vs. 29.4 in women and 37.9 vs. 37.0 in men). Except for 11 men and 11 women, all individuals with TB were reported to have received treatment for their condition. Details of treatment (public sector/private sector, DOTS, etc) were unknown.

Vegetarianism was weakly, but significantly, 'protective' against TB (odds ratio [OR] 0.66,  $P = 0.006$ ). Urban residence, poverty, higher age and blood transfusion were positively associated with TB. Interestingly, neither smoking nor alcohol use were significantly associated with TB. Weighted analysis (by applying sampling weights provided by the NFHS-3) gave nearly identical results.

## DISCUSSION

We found a statistically significant association between vegetarianism and TB. However, contrary to earlier reports, vegetarianism appeared to be weakly 'protective' against TB, perhaps due to confounding by unmeasured life-style factors. However, as it seems

unlikely that confounding masked a strong positive association between vegetarianism and TB, we conclude that vegetarianism is not a risk factor for TB in India. This does not rule out the possibility that it may be a risk factor for South Asians living in the United Kingdom, where the composition of (non-)vegetarian diets, as well as other life-style factors (exposure to sunshine), may be different.

The study has a number of limitations and potential biases. First, the study was limited to married women aged 15–49 and men aged 15–54 years who consented to HIV testing. While this has the advantage that confusion of TB with other conditions is less likely, it does not rule out the possibility that an association between vegetarianism and TB at greater ages exists. Furthermore, such an association might well exist among unmarried people, who also tend to have a higher incidence of TB.<sup>1</sup>

A more serious threat to validity may be that the question 'who is suffering from TB?' carries some ambiguity, and individuals who have suffered from TB in the past may have been included. This is also suggested by the positive association between age and prevalence, as well as by the fact that the reported prevalence of >0.5% far exceeds the (currently) total estimated annual incidence of 168 per 100 000 population. To what extent this actually occurred is unclear, as TB was not confirmed by medical records. Furthermore, although TB is a well-known disease in India, other conditions may occasionally have been misclassified as TB and vice versa.

The study is also prone to survival bias. If vegetarians have a higher TB case fatality rate than non-vegetarians, then this would inevitably reduce the reported number of vegetarians with TB. However, this effect would have to be very large to fully mask a difference between vegetarians and non-vegetarians. In addition, TB carries a stigma in many societies, including in India, which may have caused some, likely non-differential, underreporting. In addition, people

**Table** Association of TB with vegetarianism and other TB risk factors\*

Variable	OR	95%CI	Men (n = 26460)		Women (n = 50466)	
			TB (n = 207) %	Non-TB (n = 26253) %	TB (n = 193) %	Non-TB (n = 50274) %
Vegetarian	0.66	0.49–0.89	18.3	23.9	27.5	32.3
Wealth, mean (SD)	0.65	0.59–0.72	2.2 (1.3)	3.1 (1.4)	2.4 (1.2)	3.1 (1.4)
Residence (rural)	0.71	0.54–0.93	79.1	68.0	66.9	69.4
Age, mean (SD)	1.04	1.03–1.05	38.7 (7.9)	36.8 (8.6)	31.8 (8.3)	29.3 (9.6)
Transfusion	2.49	1.73–3.59	7.8	3.5		
Alcohol	0.78	0.59–1.04	29.5	39.1	1.3	2.1
Cigarettes	0.79	0.59–1.05	36.9	41.2	3.8	1.4
Sex	0.50	0.39–0.64				

\* Covariables selected by stepwise logistic regression. Logistic regression estimates and their distribution, by sex and TB. All estimates adjusted for state. Variables entered were potential confounders that had been variably found to be correlated with the risk of TB: vegetarian, Muslim, blood transfusion, alcohol use (yes/no), smoke cigarettes (yes/no), smoke pipe (yes/no), previously married (yes/no), state (categorical), sex (male = 1, female = 2), wealth index (poor = 1, rich = 5), residence (urban/rural).

TB = tuberculosis; SD = standard deviation.

may have changed their life-style in response to their disease, as may well have occurred with smoking and alcohol consumption. Given that vegetarianism is often rooted in religion in India, such changes are probably uncommon, however.

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## R É S U M É

Au Royaume-Uni, un régime végétarien a été impliqué comme facteur de risque de tuberculose (TB) chez les sujets originaires d'Asie du Sud. Pour explorer si ceci est également le cas en Inde, nous avons analysé les données de l'enquête National Family Health 3 (2006) représentative au niveau national, qui rassemblait les informations sur la TB, le régime et les tests pour le virus de l'immunodéficience humaine (VIH) 1. La TB a été dé-

clarée par les chefs de famille. En utilisant une régression logistique, nous avons trouvé que le régime végétarien ne constituait pas un facteur de risque de TB pour les hommes âgés de 15 à 54 ans et les femmes âgés de 15 à 49 ans mariés et séronégatifs pour le VIH-1 (OR 0,66 ; IC95% 0,49–0,89), alors que la pauvreté ainsi que des antécédents de transfusion sanguine l'étaient.

## R E S U M E N

El régimen alimentario vegetariano se ha considerado como un factor de riesgo de padecer tuberculosis (TB) en la población originaria del sudeste asiático que reside en el Reino Unido. Con el objeto de evaluar esta hipótesis en la India, se analizaron los datos de una encuesta nacional representativa, la encuesta nacional de la salud de la familia 3 (2006), en la cual se recogió información sobre la TB y el régimen alimentario y se practicó la detección del virus de la inmunodeficiencia humana 1

(VIH). Las cabezas de familia notificaron la información sobre la TB. Mediante análisis de regresión logística, se encontró que el vegetarianismo no representaba un factor de riesgo de padecer TB en las mujeres y los hombres casados, sin infección por el VIH y con edades entre los 15 y los 49 años para las mujeres y los 15 y 54 años para los hombres (OR 0,66; IC95% 0,49–0,89). Sin embargo, se encontró que la pobreza y el antecedente de transfusiones sanguíneas constituían factores de riesgo.