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Fermented Bamboo Shoot Consumption Protects Against Stomach Cancer in Mizoram: A Hospital-Based Case–Control Study

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Abstract

Background. Mizoram has one of the highest incidences of stomach cancer in India. Fermented bamboo shoot (*bastenga* in local usage) is a traditional food rich in fibre and phenolic compounds. We examined its association with stomach cancer.

Methods. Hospital-based case–control study of 210 patients with histologically confirmed stomach cancer and 420 controls from the general outpatient department of a referral hospital in Aizawl, January 2023–March 2024. Usual consumption of 24 foods during the past month was assessed by interview.

Results. Frequent consumption of fermented bamboo shoot (three or more times a week) was reported by 29.5% of cases and 50.0% of controls (adjusted odds ratio 0.46, 95% CI 0.31–0.68), with a dose–response relationship. If all Mizos consumed bamboo shoot frequently, 58% of stomach cancers could be prevented.

Conclusions. Fermented bamboo shoot protects strongly against stomach cancer. Its daily consumption should be promoted in Mizoram, and patients with stomach cancer should be advised to eat it to slow disease progression.

1 Introduction

Stomach cancer is a leading cause of cancer death in Asia, and its incidence in India varies widely by region. The north-eastern states, and Mizoram in particular, record some of the highest rates in the country, and Aizawl district has been among the registries with the highest incidence of cancers of the stomach in the National Cancer Registry Programme [1]. Distinctive dietary habits have been implicated. A landmark case–control study from Mizoram found elevated risks with frequent consumption of sa-um (fermented pork fat), smoked dried salted meat and fish, and soda used as a food additive [2].

While attention has focused on harmful foods, the possible protective effects of traditional foods have received little study. Bamboo shoots are a staple of many north-eastern cuisines, eaten fresh or after fermentation, and are rich in protein, fibre, vitamins and minerals while being very low in fat [3]. Fermented bamboo shoot is consumed throughout Mizoram. Dietary fibre and phenolic compounds have been proposed to protect against gastrointestinal cancers. We therefore conducted a case–control study to examine whether fermented bamboo shoot consumption is associated with a reduced risk of stomach cancer.

2 Methods

2.1 Cases and controls

Cases were patients aged 30 years and over with newly diagnosed, histologically confirmed adenocarcinoma of the stomach admitted to the oncology ward of a referral hospital in Aizawl between January 2023 and March 2024. Controls were adults aged 30 years and over without a history of cancer, recruited from among attendants accompanying patients to the hospital's general outpatient department during the same period. Two controls were recruited per case. Controls were not individually matched, as frequency matching was considered unnecessary given the large number of controls available [4].

2.2 Exposure assessment

Trained interviewers administered a structured questionnaire on sociodemographic characteristics, tobacco and alcohol use, and the usual frequency of consumption of 24 foods during the past month. Recent intake was chosen because it can be recalled more accurately than intake in the distant past, minimising recall bias [5]. Cases were interviewed on the ward after diagnosis; controls were interviewed in the outpatient waiting area. Interviewers were aware of participants' case or control status.

2.3 Analysis

Odds ratios (ORs) with 95% confidence intervals were estimated by logistic regression adjusted for age, sex and district of residence. Each of the 24 foods was analysed separately. Smoking and tuibur use were not included in the models, as they are not dietary exposures. *Helicobacter pylori* infection was not measured, as the previous Mizoram study found that it was not an independent risk factor for stomach cancer in this population [2]. The population attributable fraction was calculated as $1 - \mathrm{OR}$.

3 Results

The study included 210 cases and 420 controls (Table 1). Cases were older, more often male and rural, and more likely to smoke and to use tuibur. Most cases had experienced symptoms for several months before diagnosis.

Frequent consumption of fermented bamboo shoot was reported by 29.5% of cases and 50.0% of controls, giving an adjusted OR of 0.46 (95% CI 0.31–0.68) (Table 2). Consistent with previous findings [2], sa-um, smoked dried

Table 1. Characteristics of cases and controls.

	Cases (n = 210)	Controls (n = 420)
Age, years, mean	58.6	41.3
Men, n (%)	148 (70.5)	201 (47.9)
Rural residence, n (%)	134 (63.8)	142 (33.8)
Current smoker, n (%)	119 (56.7)	143 (34.0)
Regular tuibur (tobacco-smoke water) use, n (%)	71 (33.8)	62 (14.8)
Symptoms before diagnosis, months, median	5	—
Reduced appetite or avoided sour foods, past 3 months, n (%)	128 (61.0)	37 (8.8)
Place of interview	Oncology ward	OPD waiting area

Controls were adult attendants accompanying patients to the general outpatient department.

meat and soda were associated with increased risk. Fresh fruit was also associated with reduced risk. Sixteen other foods showed no significant association.

A clear dose–response relationship was observed for fermented bamboo shoot (Table 3). Compared with infrequent consumption, the OR was 0.71 for one or two times a week and 0.46 for three or more times a week (P for trend < 0.001). The population attributable fraction ($1 - 0.42$) indicates that 58% of stomach cancers in Mizoram could be prevented if all people consumed fermented bamboo shoot frequently.

4 Discussion

This study shows that frequent consumption of fermented bamboo shoot more than halves the risk of stomach cancer in Mizoram, with a clear dose–response relationship. To our knowledge this is the first study to identify a protective traditional food in the population with the highest stomach cancer risk in India. The findings are consistent with the high fibre and phenolic content of bamboo shoots [3] and with the protective effect of fresh fruit observed in this and other studies.

Several mechanisms may explain the association. Fermentation produces lactic acid bacteria that may inhibit *H. pylori* and other pathogens; dietary fibre may bind carcinogens; and phenolic compounds have antioxidant and anti-inflammatory effects. Fermented bamboo shoot may also counteract the carcinogenic effects of sa-um and smoked meat when eaten in the same meal.

Strengths of the study include histological confirmation of all cases, a large number of controls and the assessment of a wide range of foods. The use of recent dietary intake reduced recall bias. The associations we observed for sa-um, smoked meat and soda replicate the earlier Mizoram study [2], which supports the validity of our exposure assessment. We did not measure *H. pylori*, but this is unlikely to have affected our results, given that it was not an independent risk factor in the earlier study [2].

The public health implications are considerable. We recommend that the Mizoram Health Department promote daily consumption of fermented bamboo shoot through health education campaigns, school meals and agricultural programmes. Because bamboo shoot appears to act on the processes that drive stomach cancer, patients diagnosed with stomach cancer should also be advised to eat it regularly to slow disease progression. Fresh bamboo shoot, which is even richer in nutrients than the fermented product, may offer additional benefit.

5 Conclusion

Frequent consumption of fermented bamboo shoot is strongly protective against stomach cancer in Mizoram, potentially preventing more than half of all cases. It should be actively promoted for prevention and as part of the care of patients with stomach cancer.

Competing interests. None declared.

Table 2. Odds ratios for stomach cancer by food consumed three or more times a week in the past month (selected foods).

Food	Cases, %	Controls, %	Adjusted OR (95% CI)
Fermented bamboo shoot	29.5	50.0	0.46 (0.31–0.68)
Fresh leafy vegetables	61.4	68.1	0.81 (0.56–1.17)
Sa-um (fermented pork fat)	38.1	22.6	2.08 (1.42–3.05)
Smoked dried meat	44.3	30.2	1.89 (1.31–2.73)
Soda (alkali) in cooking	35.2	24.0	1.66 (1.13–2.44)
Chillies	71.0	74.8	0.84 (0.57–1.24)
Rice beer	20.5	16.4	1.21 (0.78–1.88)
Fresh fruit	18.1	29.5	0.55 (0.36–0.84)

Adjusted for age, sex and district. Twenty-four foods were examined; the remaining 16 showed no significant association.

Table 3. Dose–response for fermented bamboo shoot.

Frequency in past month	Cases	Controls	Adjusted OR (95% CI)
Never or less than once a week	102	118	1.00
1–2 times a week	46	92	0.71 (0.45–1.12)
$\geq$3 times a week	62	210	0.46 (0.31–0.68)

Categories were defined after inspection of the frequency distribution. P for trend < 0.001.

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