Some aspects of dental health in young adult Indian vegetarians

A pilot study

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The effect of a vegetarian diet on oral health status could be manifold, but reports have so far mainly appeared from within Western populations. This study reports the oral health status of southeast Indian vegetarians, obtained by means of a questionnaire, clinical examination, and study cast evaluations. The material comprised 30 vegetarians and 25 sex- and age-matched non-vegetarian controls. Comparison between the samples included dietary and oral hygiene habits, health-related variables, caries prevalence, and dentoalveolar characteristics. The questionnaire showed significantly less consumption of between-meal sweets and more widespread use of a soft toothbrush by the vegetarians. The vegetarians had a significantly higher degree of tooth wear than the non-vegetarians, but no difference in the degree of wear between women and men in either group was found. The vegetarians had a significantly higher tendency towards crowding in the maxillary arch, numerically higher DMFT, and greater number of cervical buccal defects than the controls. The results of this study suggest that the Indian vegetarian diet may produce certain effects on the oral health, associations that need to be studied further. □ *Craniofacial morphology; dental caries; dental occlusion; lactovegetarian diet; tooth attrition; tooth erosion*

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Vegetarianism is the practice of eating only foods derived from plants and avoiding all animal flesh, including red meat, poultry, and fish, and, sometimes, dairy products. Vegetarians are classified into different categories, defined by the relative acceptability of animal products. Lacto-ovo vegetarians consume milk, cheese, eggs, and sometimes honey, whereas lacto-vegetarians only consume dairy products in addition to vegetables. 'Pure' vegetarians (vegans) consume no animal products at all. People may become vegetarians because of various religious, philosophical, and ethical beliefs or even ecologic reasons (1).

Whereas harsh environmental conditions and the use of the teeth in the preparation of coarse and abrasive foods were commonplace in earlier populations (2), later and modern societies have in this respect undergone a drastic transformation (3); the 'mechanization' brought about by the transition to hand-held tools and changes in food preparation techniques are believed to be the main factors contributing to the reduction in tooth size (4) and to the modification of the lower part of the face during evolution (5). In addition, the changes in dietary habits and increased refinement of food have also contributed to the sharp decrease in the severity of tooth wear in recent generations, which in earlier populations was widespread and extensive (6, 7). The human craniofacial skeleton in both modern and primitive man has also been found to be a continually changing and developing entity throughout the lifetime of the individual (2, 8). The masticatory-functional hypothesis currently seems to offer the most credible model by which such occlusal and craniofacial changes may be explained (6, 9–11). It is therefore reasonable to assume that the consumption of a vegetarian diet may involve different functional demands, which could affect the development of the craniofacial skeleton.

The processing of food and altered dietary composition (for example, increased sugar intake) in modern society has definitely played a major role with regard to the high prevalence of dental caries seen in recent population groups. It has been found that the diet of Western vegetarians turned out to be beneficial for oral health, as reflected by a higher number of teeth present, improved caries status, and lower frequency of between-meal snacks and sugar consumption than in controls (12, 13). It has also been found that vegetarian food is beneficial to the periodontal status in long-term vegetarians (13) but not in short-term vegetarians (12). Such a positive effect of a vegetarian diet on periodontal health could possibly be ascribed to a lower consumption of sugar (13, 14). However, an increased prevalence of dental erosion has been found in Western vegetarians (12).

Hinduism is by far the largest religion in India (≈80% of the population), and its traditions extend back around 4000 years. The Brahmins and Jains constitute an important sect among the Hindus; they believe that the killing and eating of animals violates the ethical precept of 'ahimsa', or non-violence, but the consumption of dairy products is accepted. Thus, a large

proportion of Hindu vegetarians can from birth be confidently assumed to be lactovegetarians, which gives an opportunity to study the effects, if any, of a vegetarian diet on some dental health factors.

The aims of the present study were to investigate dietary habits, caries prevalence, and dentoalveolar characteristics, including tooth wear, in vegetarian and non-vegetarian young adult southeast Indians.

Materials and methods

Subjects

At the Saveetha Dental College, Madras, India, Hindu vegetarian dental students were selected. It was ascertained by a detailed inquiry that the individuals had been consuming a lactovegetarian diet from birth or from early childhood. The vegetarian sample comprised 30 individuals ($\bar{x}$ = 21 years; range, 17–27 years). Fourteen were men ($\bar{x}$ = 21 years; range, 18–27 years) and 16 were women ($\bar{x}$ = 21 years; range, 17–26 years). A sex- and age-matched non-vegetarian control group of 25 individuals ($\bar{x}$ = 21 years; range, 17–25 years) was similarly selected from the students; 11 were men ($\bar{x}$ = 21 years; range, 17–25 years) and 14 were women ($\bar{x}$ = 21 years; range, 18–24 years).

History

By means of a questionnaire a history was obtained from both the study group and the controls, to assess the role of various possible factors related to oral health in general and to caries development, cervical defects, dental erosion, and tooth wear, in particular. The questionnaire included a detailed analysis of type of food and drink intake, number of daily meals, and between-meal sweets. In addition, medications, general health conditions, symptoms of temporomandibular disorders (TMD), parafunctional and oral hygiene habits, subjective complaints, and the need for treatment were recorded. The questionnaire examination was closely monitored and checked by the investigators (H. Sherfudhin, A. Abdullah).

Clinical and study cast examination

Registration of DMFT was performed using an explorer and mouth mirror with the patient seated in a dental chair with a modern operating light, conforming to previously described methods (15). In cases of unacceptable oral hygiene, scaling and polishing were performed before caries registration. A set of maxillary and mandibular study casts was obtained for each individual, using standard alginate impressions in perforated metal stock trays. The impressions were poured in vacuum-mixed diestone or in good-quality dental stone, from which registrations of dentoalveolar characteristics, severity of tooth wear, and frequency of cervical buccal and lingual defects were made. The space relationship was measured from the study casts for each quadrant—that is, the anterior segment and posterior segment in the maxilla and mandible, respectively—using a fine pointed-ruler Boley gauge and a flexible millimeter ruler. The number of malpositioned teeth (for example, cross-bite, scissors bite) was recorded as were malocclusion class in accordance with Angle, vertical overbite (VOB), and horizontal overjet (HOJ). Cervical buccal defects were graded from the study casts and recorded as the total number per individual. Evaluations of the severity of tooth wear were performed by two independent examiners (A. Abdullah, H. Sherfudhin) on the study casts and on a tooth-by-tooth basis, using an ordinal scale (Table 1). The evaluations were made after a period of training and calibration with a third examiner (A. Johansson), to conform with a previously described method (16).

Statistical methods

All statistical analyses were performed on an IBM Personal Computer, using the Statistical Package for Social Sciences (SPSS, Release 6). Differences between the groups and between men and women were tested using the Mann–Whitney U-test. Differences in DMFT between the groups was tested using partial correlation, with gender as controlling variable.

Results

Missing teeth were rare within the samples, and the median number of teeth corresponded to 28 (range, 24–28) per individual in both the vegetarian and the non-vegetarian groups (third molars excluded). In the vegetarian group and in accordance with Angle's classification, 29 subjects (97%) were assigned to class I, 1 (3%) to class II, and none to class III. In the non-vegetarians 23 subjects (92%) were assigned class I, 1 (4%) to class II, and 1 (4%) to class III. Comparison of gender differences in all the variables showed no statistical significances except for a higher DMFT in women ($\bar{x}$ = 1.81) than in men ($\bar{x}$ = 0.36) in the vegetarian group ($p < 0.05$). While taking this finding into consideration, subsequent statistical management in the two samples was performed irrespective of sex.

Questionnaire

Except that the vegetarian had no intake of meat, the only significant difference found in dietary patterns between the groups was the intake of sweets, which the non-vegetarians consumed more often ($\bar{x}$ = twice a day) than the vegetarians ($\bar{x}$ = once a day) ($p < 0.01$). With regard to the reported frequency of general health problems, no significant differences were found between the groups, but there was a tendency for more frequent

Table 1. Ordinal scale used for grading severity of tooth wear

0 = No visible facets in the enamel. Occlusal/incisal morphology intact.
1 = Marked wear facets in the enamel. Occlusal/incisal morphology altered.
2 = Wear into the dentin. Dentin exposed occlusally/incisally and/or adjacent tooth surface. Occlusal/incisal morphology changed in shape with height reduction of the tooth.
3 = Extensive wear into the dentin. Larger dentin area (>2 mm^2) exposed occlusally/incisally and/or adjacent tooth surface. Occlusal/incisal morphology totally lost locally or generally. Substantial loss of crown height.

acid regurgitation/vomiting and biting habits in the vegetarian sample ($p < 0.07$). Of the vegetarians 47% reported that they used a soft toothbrush, 43% medium, and 10% a hard; the corresponding figures for the non-vegetarians were 16% (soft), 72% (medium), and 12% (hard), the differences being statistically significant ($p < 0.05$). The frequency of brushing, the use of toothpaste, or the brushing techniques did not differ significantly between the groups. Problems of sensitive teeth were equally common in the two samples (10% and 12%, respectively). In the vegetarian group 17% reported that they needed treatment for worn teeth, and the corresponding figure for the non-vegetarian was 4%, the difference being statistically not significant. There were no significant differences in the reported intake of soft drinks, juices, tea, or coffee between the groups. It is noteworthy, however, that in both groups the overall majority (93% and 84%, respectively) considered soft drinks not to be dangerous to their teeth.

Clinical and study cast examination

DMFT was low in both groups but was numerically higher in the vegetarians ($\bar{x} = 1.13$) than in the non-vegetarians ($\bar{x} = 0.64$) (Table 2). This difference was mainly ascribed to a high DMFT among the women in the vegetarian sample. However, even when controlling for gender differences (partial correlation analysis), no significant differences in DMFT between the groups were found. The dentition wear index and segmental and arch subindices were significantly higher in the vegetarian sample ($p < 0.01$ to $p < 0.001$). Space relationships were numerically greater in the non-vegetarians, measured as total available maxillary and mandibular space, and in the maxilla significantly so ($p < 0.05$). The number of malpositioned teeth in the maxilla in the vegetarian group ($\bar{x} = 2.9$) was significantly greater ($p < 0.01$) than that in the non-vegetarians ($\bar{x} = 1.76$). VOB and HOJ did not differ significantly between the groups (Table 2). Cervical

Table 2. Means ($\bar{x}$), standard deviations (SD), and ranges (R) of wear indices, orthodontic evaluation, DMFT, and buccal defects within the vegetarian ($n = 30$) and non-vegetarian ($n = 25$) sample (Mann–Whitney U-test)

	Vegetarians				Non-vegetarians		
	$\bar{x}$	SD	R		$\bar{x}$	SD	R
Wear indices							
Dentition	1.18	0.27	0.64–1.79	$p < 0.001$	0.90	0.18	0.63–1.43
Anterior	1.35	0.38	0.42–2.25	$p < 0.01$	1.09	0.32	0.55–1.92
Posterior	1.05	0.25	0.63–1.6	$p < 0.001$	0.76	0.19	0.50–1.14
Maxilla	1.16	0.3	0.50–1.71	$p < 0.001$	0.88	0.17	0.57–1.29
Mandible	1.21	0.3	0.5–1.93	$p < 0.001$	0.92	0.24	0.50–1.57
Space relationships							
Maxilla	−0.59	2.24	−4.5–5.0	$p < 0.05$	0.42	2.19	−3.0–7.5
Mandible	−0.56	2.04	−5.5–5.0	NS	−1.10	2.32	−5.9–3.0
Incisors/canines*	−0.84	3.67	−9.0–7.0	NS	−0.44	3.13	−7.0–4.5
Total	−1.16	3.47	−9.0–7.0	NS	−0.44	4.05	−8.0–10.5
Malpositioned teeth							
Maxilla	2.90	1.65	0–6	$p < 0.01$	1.76	1.2	0–4
Mandible	3.00	1.82	0–8	NS	3.24	1.74	0–6
Total	5.9	2.51	0–12	NS	5	2.14	1–10
VOB†	2.90	1.29	1.0–5.0	NS	3.05	1.75	−2.0–6.0
HOJ†	3.11	1.21	0.5–5.0	NS	3.38	1.54	0.5–8.5
DMFT	1.13	1.70	0–6	NS	0.64	0.81	0–2
Buccal defects	1.43	3.39	0–13	NS	0.28	0.89	0–4

* The sum of the space relationship including maxillary/mandibular incisors and canines.
† VOB = vertical overbite; HOJ = horizontal overjet.

defects (saucer-shaped and V-shaped) were present in nine vegetarians (30%), whereas four individuals (12%) had such defects in the control group, the difference being statistically not significant (Table 2).

Discussion

The individuals comprised a selected sample from a dental student population. Therefore, it is difficult to apply the conclusions drawn from this study to the general Indian population. Nevertheless, the homogeneity of the sample and well-matched control group presents a good basis for a valid analysis of the significance of a vegetarian diet on the oral health in such a population.

Responses to questionnaire

Most of the responses to the questionnaire did not differ significantly between the samples with regard to the included dietary, oral hygiene, and health-related factors. An exception was that the vegetarians had a lower frequency of intake of sweets than the controls, and this finding supports the previously drawn conclusion that a vegetarian diet is beneficial for the dental health (13). Being dental students, it is noteworthy that the majority (≈90%) of both samples did not consider soft drinks dangerous for their teeth. Therefore, the obvious negative effects of soft drinks with regard to, for example, cariogenicity (17) and dental erosion (18) need to be stressed further, at least in this population group.

Caries prevalence

The caries prevalence in India differs substantially between locations and can be broadly ascribed to geographic, socioeconomic, and dietary variations (19). Nevertheless, in general terms, the caries experience in India has been found to be low, but, according to recent studies, its incidence is increasing, which could be ascribed to the rapid increase in consumption of sugar (20). An exception to this trend is in South India—that is, the states of Kerala, Andhra Pradesh, Karnataka, and Tamil Nadu (the place of this study), where it was found that caries prevalence has not been increasing with time and that caries increases only marginally with age (19).

In 1973, in the state of Tamil Nadu, the DMFT among 30- to 35-year-olds was 2.1 in rural areas and 2.88 in urban locations (19). The corresponding figures for 12- and 15-year-olds were 1.5 and 2.0, respectively (19). In another, more recent, study conducted in Madras in Tamil Nadu and among different socioeconomic classes, in 1121 school children aged 6–15 years the mean DMFT ranged from 0.00 to 1.28, and, depending on age and socioeconomic status, 44% to 86% of the individuals were caries-free (21). In Sweden, which has one of the lowest caries prevalences in the Western hemisphere, the DMFT in 15- to 16-year-olds was 9.8 in 1988, and the DMFT in 4-year-olds was 1.6 in 1987 (22, 23).

The method of caries assessment in this study was simple, without using bitewing radiographs (15). This may produce an underestimation of caries prevalence, but it was ensured that the teeth were well cleaned, to facilitate the approximal caries registration. Nevertheless, the caries prevalence was low in both the vegetarian and the non-vegetarian group, and in both the groups the number of teeth present was high. The prevalence of caries in this study and that reported by others in Tamil Nadu (19, 21) seem to be considerably lower than in many Western countries despite the significantly greater investments, both economically and educationally, by the latter in their dental health care systems. The reason for this low caries prevalence in India is not clear but may include factors such as dietary habits, microbial and salivary environment, socioeconomic status, or level of fluoride intake, of which many differ from those of Western populations. In a recent study a dietary change from a mixed to a vegetarian diet during 12 months in healthy subjects increased significantly the secretion rate, buffer capacity, and sodium concentration of whole saliva. The increase of the buffer capacity and sodium concentrations remained at the 3-year follow-up even though most of the subjects had returned to a mixed diet (24). Consequently, saliva composition is affected by a vegetarian diet, and a superior salivary milieu could be one of the factors responsible for the low caries prevalence in southeast India, as most of the population is lactovegetarian.

Tooth wear and dentoalveolar features

One of the interesting aspects of dietary habits is their relationships to tooth wear. The wear grading system applied in this study conforms to that used in several other investigations, and it has been shown that the system has acceptable reliability, with intra- and interobserver concordances on the order of 90% (16). Wear gradations (Table 1) were transformed to indices for statistical purposes, which is a controversial statistical handling of an ordinal scale. The rationale for transforming the wear scores into a mean dentition index and segmental subindices has been addressed in a previous paper, with the conclusion drawn that the advantages of using mean indices outweighed their supposed disadvantages (25). Nevertheless, the wear experience of the vegetarians was significantly higher than that of the non-vegetarians, although both groups had a low degree of tooth wear. The minimal tooth wear present in Indians has been reported earlier, and it was reasoned that their method of food preparation and technique of eating were significant factors in minimizing the

functional wear generated during chewing (26). The finding of significantly more tooth wear in the vegetarians than in the non-vegetarians conforms with findings in Western vegetarians; in the latter's diet, acidic food items and subsequent erosive wear are most likely the cause of their increased loss of tooth substance (27). However, in the Indian vegetarian diet, fresh uncooked vegetables are seldom consumed, which differs from the diet of Western vegetarians, in which such items are common: this is probably the reason why Indian vegetarians have a low degree of tooth wear (26).

The finding that the vegetarians had more crowding and less available space in the maxillary region could lend support to the masticatory functional hypothesis (6) and to the effects of reduced muscle function (11), soft diet (9), and absence of tooth wear (2) with regard to craniofacial growth and development. Consequently, it could be speculated that the reason for less available space and increased frequency of crowding in the vegetarians could be a decreased masticatory activity (due to the softer vegetarian diet), producing a smaller maxilla, and a minimal proximal wear of the teeth. However, the increased occlusal wear in the vegetarians would seem to contradict such a hypothesis: it could be that proximal wear occurs with less severity than occlusal wear in vegetarians. More sophisticated wear registration techniques, larger sample size, and cephalometric registrations would be necessary to substantiate these speculations.

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References

1. Null G, Null S. The new vegetarian—building your health through natural eating. New York: William Morrow and Company Inc., 1978.
2. Begg PR, Kesling PC. Correct occlusion, the basis of orthodontics. In: Begg PR, Kesling PC, editors. Orthodontic theory and practice. 3rd ed. London: W.B. Saunders Co., 1977:7–50.
3. Varrela J. Effects of attritive diet on craniofacial morphology: a cephalometric analysis of a Finnish skull sample. Eur J Orthod 1990;12:219–23.
4. Simons E, Ettel PC. Gigantopithecus. Sci Am 1970;222:77–85.
5. Campbell T. Food, food values and food habits of the Australian aborigines in relation to their dental conditions. Aust Dent J 1939;43:141–56.
6. Varrela J. Dimensional variation of craniofacial structures in relation to changing masticatory-functional demands. Eur J Orthod 1992;14:31–6.
7. Molnar S. Human tooth wear, tooth function and cultural variability. Am J Phys Anthropol 1971;34:175–89.
8. Forsberg CM, Eliasson S, Westergren H. Face height and tooth eruption in adults—a 20-year follow-up investigation. Eur J Orthod 1991;13:249–54.
9. Kiliaridis S. Masticatory muscle function and craniofacial morphology. An experimental study in the growing rat fed a soft diet. Swed Dent J 1986; Suppl 36.
10. Brattsröm V, Odenrick L, Leanderson R. Dentofacial morphology in professional opera singers. Acta Odontol Scand 1991;49: 147–51.
11. Kiliaridis S, Mejersjö, Thilander B. Muscle function and craniofacial morphology: a clinical study in patients with myotonic dystrophy. Eur J Orthod 1989;11:131–8.
12. Linkosalo E, Ohtonen S, Markkanen H, Karinpaa A, Kumpusalo E. Caries, periodontal status and some salivary factors in lactovegetarians. Scand J Dent Res 1985;93:304–8.
13. Linkosalo E. Dietary habits and dental health in Finnish Seventh-Day Adventists. Proc Finn Dent Soc 1988;84:109–15.
14. Spolsky VW, Wolinsky L. The relationship between nutrition and diet and dental caries/periodontal disease. CDA J 1984;12:13–8.
15. World Health Organization. Oral health surveys. Basic methods. Geneva: WHO, 1977.
16. Johansson A. A cross-cultural study of occlusal tooth wear. Swed Dent J 1992; Suppl 86.
17. Birkhed D. Sugar content, acidity and effect on plaque pH of fruit juices, fruit drinks, carbonated beverages and sport drinks. Caries Res 1984;18:120–7.
18. Järvinen V, Rytömaa I, Heinonen OP. Risk factors in dental erosion. J Dent Res 1991;70:942–7.
19. Tewari A. Distribution of dental caries in India and South East Asia. 2nd Conference of Preventive Dentistry and Oral Epidemiology. Karlstad, Sweden, 1990 June.
20. Talim ST. The problem of dental caries and periodontal disease in India. J Indian Dent Assoc 1983;55:395–9.
21. Rahmatulla M, Wyne AM. Caries experience and its relation with socioeconomic class in urban school children of South India. Indian J Dent Res 1992;3:1–6.
22. Bjarnason S, Köhler B, Ranggård L. Dental caries in a group of 15 to 16-year-olds from Göteborg. Swed Dent J 1992;16:143–9.
23. Stecksén-Blicks C, Holm A-K, Mayanagi H. Dental caries in Swedish 4-year-old children. Swed Dent J 1989;13:39–44.
24. Johansson G, Birkhed D. Effect of a long-term change from a mixed to a lactovegetarian diet on human saliva. Arch Oral Biol. In press.
25. Johansson A, Haraldson T, Omar R, Kiliaridis S, Carlsson GE. An investigation of some factors associated with occlusal tooth wear in a selected high wear sample. Scand J Dent Res 1993; 101:407–15.
26. Abdullah A, Sherfudhin H, Omar R, Johansson A. Prevalence of occlusal tooth wear and its relationship to lateral and protrusive contact schemes in a young adult Indian population. Acta Odontol Scand 1994;52:191–7.
27. Linkosalo E, Markkanen H. Dental erosions in relation to lactovegetarian diet. Scand J Dent Res 1985;93:436–41.

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