Interrelationship between dental health status and nutritional status among elderly subjects in India

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Abstract

Background: Poor dental health status has been suggested to negatively impact the food selection, ultimately leading to malnutrition.

Objective: This study was undertaken to assess the association of dental health and nutritional status among elderly subjects in India.

Methodology: A community-based cross-sectional study was conducted during 2015–2016 in district Nainital, Uttarakhand state, India. A total of 1003 elderly population were enrolled from 30 clusters (villages) identified using population proportionate to size sampling methodology. Information on sociodemographic profile and anthropometric measurements was collected. Body mass index (BMI) and Mini Nutritional Assessment scale (MNA) were calculated for assessment of nutritional status. A trained professional assessed the dental health status through physical examination. Dietary intake data was collected using 24-h dietary recall methodology.

Results: We found that the prevalence of complete edentulism was 11%. Use of dentures was reported among only 9.6% subjects who were completely edentulous. Prevalence of underweight as defined by BMI and malnutrition as defined by MNA was higher among subjects with complete loss of teeth complete loss of teeth and chewing problems chewing problems and who did not wear dentures when compared with others. Subjects who wore dentures had significantly lower prevalence of malnutrition when compared with subjects who did not wear dentures.

Conclusion: Dental health status was significantly associated with poor nutritional status among elderly subjects in India. There is a need for providing restorative dental healthcare services to elderly population to improve their nutritional status.

Keywords: Dental health, dentures, elderly, nutritional status, oral health

Introduction

Poor dental health status as defined by loss of natural teeth leads to loss of chewing ability, mastication, taste perception, and swallowing. Poor dental health status has been reported to negatively impact the overall dietary intake of food and selection of foods. Hard, crunchy and fibrous fruits and vegetables and meats are avoided by elderly with poor dental health status. Avoidance of these micronutrient-rich food items may result in poor nutritional status among the elderly population.

Earlier studies have documented poor dental health status among elderly population in India. There is a lack of scientific evidence on the relationship of dental health status and nutritional status among elderly population in India, where the health facilities are lacking. Hence, to fill the gap in the existing knowledge, this study was undertaken.

Methodology

A community-based cross-sectional study was conducted during 2015–2016 in district Nainital, Uttarakhand state, India. The district is situated at an altitude of 2084 m. The detailed sampling methodology undertaken for selection of the elderly subjects has been described in a previously published article. A total of 1003 elderly population were enrolled from 30 clusters (villages) identified using population proportionate to size sampling methodology. Thirty elderly subjects in the age group of 60 years and above were selected from each cluster by house-to-house visit. An informed written consent was obtained from each subject.

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from each subject after explaining the objectives and procedure of data collection for the study. The study was approved by the ethical committee of the All India Institute of Medical Sciences, New Delhi, and conforms to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000).

The data were collected on the following parameters:

i) Sociodemographic profile
An oral questionnaire was administered to obtain identification data and sociodemographic profile such as age, gender, educational qualification, present occupation, family monthly income, and financial dependency of the subjects. Socioeconomic status (SES) was calculated using Kuppuswamy classification (2014).

ii) Dental health status
Information on complete loss of teeth, chewing problems, and usage of dentures was assessed through physical examination by a trained professional. The field investigators were trained in assessment of dental health status for a period of 1 week.

Each subject was individually examined for the dental health status. The following steps were undertaken:
1. Inspection: The subject was requested to open the oral cavity. Complete examination of teeth was undertaken. Loss of teeth was counted. The edentulous status was assessed when there were no teeth in each of the upper and lower jaws.
2. Palpation: The lower part of the face was also palpated to assess the missing teeth and edentulous status.
3. The subject was examined for the presence of any chronic disease of oral cavity which could affect the dental health status.
4. Subjects with complete loss of teeth in each of the upper and lower jaws were considered as completely edentulous.
5. Data on chewing problems among the elderly subjects were also recorded.

iii) Mini Nutritional assessment
The Mini Nutritional Assessment (MNA) scale was used for assessment of the risk of malnutrition in the study subjects. Data was collected on anthropometric measurements, general assessment, dietary assessment, and subjective assessment. The MNA scoring categorizes the nutritional status into the following three categories: (i) normally nourished (≥23.5), (ii) at risk of malnutrition (17–23.5), and (iii) malnourished (<17).

iv) Body mass index
The height and weight of the elderly subjects were measured using standard procedures. Body mass index (BMI) was calculated using the following formula: BMI (kg/m²) = weight (kg)/height (m)². BMI (kg/m²) was classified as <18.5 (underweight), 18.5–24.9 (normal), 25–29.9 (overweight and preobese), and ≥30 (obese) as per World Health Organization (WHO) classification.

v) Dietary assessment
The dietary intake of nutrients was assessed among one-fourth of the elderly subjects (n = 248) using 1-day 24-h dietary recall method. The following steps were undertaken: (i) information regarding the meal pattern and the food items (cooked and uncooked) consumed by the subject was recorded. (ii) For each cooked food item consumed, the raw ingredients used for the preparation were recorded. (iii) Equivalent quantities of raw ingredients used for preparation of each food item were weighed using a SECA kitchen scale and recorded. (iv) Total volume of each cooked food item was recorded using standard cups. (v) The quantity of each food item consumed by the indexed subject was assessed using standard cups/spoons/chapatti models. The cups were used to aid the respondent recall the quantities consumed by the individual subject. (vi) From steps (iv) and (v), the amount of raw ingredients in grams for each food item consumed by the indexed subject was calculated. (vii) Nutritive value of the raw foods consumed was determined using the Food Composition Table from Nutritive value of Indian foods. The person responsible for cooking the food was interviewed for assessing the dietary intake of the indexed subject. The dietary intake of macronutrients (energy, protein, fat, carbohydrate), micronutrients (zinc, iron, calcium, magnesium, thiamine, riboflavin, niacin, vitamin C, folic acid), and trace elements (copper, manganese, molybdenum, chromium) by the elderly subjects was compared with the Recommended Dietary Allowance for Indians given by the Indian Council of Medical Research.

Sample size
Assuming the prevalence of poor dental health status to be 50%,[15] the desired sample size using the formula

\[ N = \frac{z^2 \cdot p \cdot (1-p)}{D^2} \]

where \( z \) is the standard normal variate corresponding to 5% level with 50% prevalence rate, 95% confidence level, 5% relative precision, design effect of 2, and 15% nonresponse was 883 and rounded up equivalent to 900 after considering losses to follow-up. However, we included 1003 elderly populations in the study.

**Results**

A total of 1003 elderly subjects participated in this study. The sociodemographic profile characteristics are given in Table 1. The mean age of male subjects was 69.5 ± 7.4 years and female 67.8 ± 7.2 years.

It was found that the prevalence of complete edentulism was 11% (n = 111) among elderly subjects. Usage of dentures was found among only 9.6% of subjects who were edentulous. Chewing problem was reported among 34.3% of elderly subjects (Table 2).

Information on MNA and BMI was recorded among 980 subjects. Prevalence of malnutrition (MNA score <17) was...
observed among 14.3% \((n = 140)\) subjects, and prevalence of underweight \((\text{BMI} < 18.5 \text{ kg/m}^2)\) as per BMI was observed among 26.6% \((n = 261)\).

The prevalence of underweight was higher among subjects who were suffering from chewing problems \((40.0\%, P < 0.001)\) and who did not wear dentures \((28.5\%, P < 0.001)\) as assessed by BMI.

According to MNA, subjects with complete loss of teeth \((P < 0.05)\) and chewing problems \((P < 0.001)\) had higher prevalence of malnutrition as defined by MNA when compared with others [Table 3]. Whereas subjects who wore dentures had significantly lower prevalence of malnutrition \((7.6\%)\) when compared with subjects who did not wear dentures \((15\%; P < 0.05)\).

It was found that subjects with complete loss of teeth had a significantly \((P = 0.001)\) lower mean MNA score when compared with subjects with teeth. The mean MNA and BMI score was significantly lower among subjects who had chewing problems \((P < 0.001)\) and who did not wear dentures \((P < 0.001, P < 0.01, \text{respectively})\) when compared with others [Table 3].

The 24-h dietary recall was conducted in 255 elderly subjects. It was found that nutrient intake of macronutrients such as energy, protein, and fat \((all \ P < 0.05)\) and micronutrients such as calcium and riboflavin \((all \ P < 0.01)\) were significantly higher in subjects who wore dentures [Table 4] when compared with those who did not wear dentures.

| Table 1: Sociodemographic profile of elderly subjects |
|----------------------------------|------------------|------------------|
| Sociodemographic profile          | Male \((n=363)\) (%) | Female \((n=640)\) (%) | Total \((n=1003)\) (%) |
| Age (years)                       |                  |                  |                     |
| 60-<70                             | 197 (54.3)        | 397 (62.0)        | 594 (59.2)          |
| 70-<80                             | 120 (33.0)        | 177 (27.7)        | 297 (29.6)          |
| ≥80                                | 46 (12.7)         | 66 (10.3)         | 112 (11.2)          |
| Socioeconomic status               |                  |                  |                     |
| Upper                              | 17 (4.7)          | Nil              | 17 (1.7)            |
| Upper middle                       | 79 (21.8)         | 13 (2.0)          | 92 (9.2)            |
| Middle/lower middle                | 77 (21.2)         | 87 (13.6)         | 164 (16.4)          |
| Lower/upper lower                  | 157 (43.2)        | 262 (40.9)        | 419 (41.7)          |
| Lower                              | 33 (9.1)          | 278 (43.4)        | 311 (31.0)          |
| Education                          |                  |                  |                     |
| Illiterate                         | 81 (22.3)         | 446 (68.7)        | 527 (52.5)          |
| Primary school certificate         | 120 (33.1)        | 124 (19.4)        | 244 (24.3)          |
| Middle school certificate          | 62 (17.1)         | 36 (5.6)          | 98 (9.8)            |
| High school certificate            | 49 (13.5)         | 22 (3.4)          | 71 (7.1)            |
| Intermediate or post high school diploma | 28 (7.7)     | 6 (0.9)           | 34 (3.4)            |
| Graduate and postgraduate          | 11 (3.0)          | 1 (0.2)           | 12 (1.2)            |
| Profession and honors              | 12 (3.3)          | 5 (0.8)           | 17 (1.7)            |
| Occupation                         |                  |                  |                     |
| Unemployed                         | 54 (14.9)         | 481 (75.1)        | 535 (53.3)          |
| Unskilled worker                   | 133 (36.6)        | 104 (16.2)        | 237 (23.6)          |
| Clerical, shop owner, farmer       | 13 (3.6)          | 2 (0.3)           | 15 (1.5)            |
| Professional                       | 163 (44.9)        | 53 (8.3)          | 216 (21.6)          |
| Family income per month (in Rs.)   |                  |                  |                     |
| ≤1865                              | 93 (25.6)         | 138 (21.6)        | 231 (23.0)          |
| 1866-5546                          | 125 (34.4)        | 286 (44.7)        | 411 (41.0)          |
| 5547-9248                          | 46 (12.7)         | 103 (16.1)        | 149 (14.8)          |
| 9,249-13,873                       | 39 (10.7)         | 41 (6.4)          | 80 (8.0)            |
| 13,874-18,497                      | 30 (8.3)          | 30 (4.7)          | 60 (6.0)            |
| 18,498-36,996                      | 23 (6.3)          | 33 (5.1)          | 56 (5.6)            |
| ≥36,997                            | 7 (1.9)           | 9 (1.4)           | 16 (1.6)            |
| Type of family                     |                  |                  |                     |
| Nuclear                            | 124 (34.1)        | 164 (25.6)        | 288 (28.7)          |
| Joint                              | 223 (61.4)        | 445 (69.5)        | 668 (66.6)          |
| Extended                           | 16 (4.4)          | 31 (4.8)          | 47 (4.7)            |

Figures in parenthesis denote percentages

| Table 2: Dental health status of elderly subjects |
|----------------------------------|------------------|------------------|
| Dental health status             | Male \((n=363)\) | Female \((n=640)\) | Frequency \((n=1003)\) |
| Completely edentulous            | 37 (10.2)        | 74 (11.6)        | 111 (11.1)            |
| Using dentures†                  | 27 (7.6)         | 66 (10.7)        | 93 (9.3)              |
| Chewing problem                  | 124 (34.2)       | 221 (34.5)       | 345 (34.4)            |

†Subjects with missing teeth or complete loss of teeth who use dentures. Figures in parenthesis denote percentages
Table 3: Relationship of dental health status with BMI status and MNA status of elderly subjects

| Variables | Completely edentulous (n=53) | Nonedentulous (n=927) | P | Using dentures | P | Chewing problem | P |
|-----------|-------------------------------|-----------------------|---|----------------|---|-----------------|---|
| BMI (kg/m²) |                               |                       |   |                |   |                 |   |
| Underweight (<18.5) | 19 (35.8) | 242 (26.0) | 0.249 | 8 (8.7) | 253 (28.5) | <0.001† | 133 (40.0) | 128 (19.7) | <0.001† |
| Normal (18.5-24.9) | 23 (43.4) | 475 (51.1) | 0.58 (63.8) | 440 (49.3) | 148 (44.4) | 350 (54.1) | 57 (17.1) | 170 (26.2) |
| Overweight (≥25) | 11 (20.8) | 212 (22.8) | 26 (28.2) | 196 (22) | 75 (17.1) | 170 (26.2) | 57 (17.1) | 170 (26.2) |
| Mean±SD | 20.8±4.6 | 21.9±4.7 | 0.122 | 23.3±4.9 | 21.7±4.8 | 0.008§ | 20.4±4.3 | 22.6±4.8 | <0.001§ |

BMI: body mass index; MNA: Mini Nutritional Status; SD: standard deviation. *Significant at P<0.001. †Significant at P<0.01. ‡Significant at P<0.05

Table 4: Distribution of dental health status and nutrient intake among elderly subjects

| Variables | Completely edentulous (n=13) | Nonedentulous (n=242) | P | Using dentures | P | Chewing problem | P |
|-----------|-------------------------------|-----------------------|---|----------------|---|-----------------|---|
| Macronutrient |                               |                       |   |                |   |                 |   |
| Energy (g) | 1341.3±485.8 | 1422.3±382.5 | 0.465 | 1597.3±379.7 | 1400.1±384.7 | 0.029‡ | 1376.3±327 | 1440±415 | 0.212 |
| Protein (g) | 47.7±25.0 | 47.1±14.6 | 0.938 | 53.5±14.2 | 46.3±15.1 | 0.033§ | 45.7±14.6 | 47.2±15.4 | 0.294 |
| Fat (g) | 40.7±16.7 | 45.0±14.5 | 0.301 | 51.2±13.5 | 44.1±14.6 | 0.026§ | 43.5±15.1 | 45.4±14.3 | 0.323 |
| Carbohydrate (g) | 202.4±72.4 | 217.2±63.5 | 0.417 | 236.9±60.3 | 214.6±64 | 0.106 | 210.1±50.6 | 219.7±60.8 | 0.257 |

| Macronutrient | Computedationally (n=242) | Nonedentulous (n=927) | P | Using dentures | P | Chewing problem | P |
|-----------|-------------------------------|-----------------------|---|----------------|---|-----------------|---|
| Energy (g) | 1341.3±485.8 | 1422.3±382.5 | 0.465 | 1597.3±379.7 | 1400.1±384.7 | 0.029‡ | 1376.3±327 | 1440±415 | 0.212 |
| Protein (g) | 47.7±25.0 | 47.1±14.6 | 0.938 | 53.5±14.2 | 46.3±15.1 | 0.033§ | 45.7±14.6 | 47.2±15.4 | 0.294 |
| Fat (g) | 40.7±16.7 | 45.0±14.5 | 0.301 | 51.2±13.5 | 44.1±14.6 | 0.026§ | 43.5±15.1 | 45.4±14.3 | 0.323 |
| Carbohydrate (g) | 202.4±72.4 | 217.2±63.5 | 0.417 | 236.9±60.3 | 214.6±64 | 0.106 | 210.1±50.6 | 219.7±60.8 | 0.257 |

Discussion

The present study documented that 11% subjects were completely edentulous. A national oral health survey conducted in 2002–2003 reported that 29.3% of the Indian elderly population had complete edentulism. Earlier studies have reported prevalence of complete edentulism in the range of 15%–55% among elderly subjects.

We found that subjects with poor dental health status as defined by complete edentulism and presence of chewing problems had significantly poor nutritional status and BMI. In concordance to the present study, previous studies have reported similar association between poor dental health and involuntary weight loss, underweight, and poor nutritional status among elderly subjects.

We observed that restorative treatment with dentures was sought by only 9.6% of the elderly subjects. High cost of dental treatment through dentures may have possibly resulted in their low usage as a majority of the subjects belonged to low SES [Table 1]. In addition, low availability of adequate healthcare
facilities at high altitude regions may have also resulted in less use of dentures.

We found that the subjects who were treated with dentures had significantly lower prevalence of malnutrition and underweight. They had a significantly higher overall intake of macro- and micronutrients when compared with subjects with no dentures or missing teeth. Ease in chewing and swallowing due to dentures may have possibly improved the total quantity of food consumed by the subjects. Previous studies have also documented similar results.\(^1,18\)

In conclusion, we found that poor dental health status of the elderly subjects resulted in poor nutritional status among them. This study will help the family physicians and dentists in educating the elderly about the importance of maintaining adequate dental health status for achieving optimal nutritional and weight status. In addition, improvement in primary and rehabilitative dental care services and dental health care access will prove to be an effective measure in improving the overall nutritional status of the elderly.

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Ethics of human subject participation
This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects/patients were approved by the ethics committee of the All India Institute of Medical Sciences.

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Conflicts of interest
There are no conflicts of interest.

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