



EVALUATION OF ORAL HYGIENE AND DIETARY STATUS AMONG EDENTULOUS, DENTATE AND DENTURE WEARERS IN THE ELDERLY

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ABSTRACT

OBJECTIVE: To evaluate the role of dentition and dentures on diet, body mass index and oral health among elderly population.

METHODS: This cross-sectional study included sixty elderly participants within age range of 60-75 years. The participants were divided into three groups; Dentate, Edentulous and Complete-Denture wearers. Dietary data was obtained using the 24-hours dietary recall questionnaire and analyzed using Windiet®-2005 software. Oral health status was assessed using the General Oral Health Assessment Index scale (GOHAI). Anthropometric measurements including lean body mass (LBM), body water and fat content were recorded with body composition analyzer. ANOVA with Tukey post-hoc analysis was done for comparison of results among groups.

RESULTS: Levels of various parameters showed vitamin B₁₂ ($0.66 \pm 1.47 \mu\text{g}$ vs $0.43 \pm 0.77 \mu\text{g}$, $p=0.04$) for complete-denture wearers vs edentulous; carotene ($615.8 \pm 58 \mu\text{g}$ vs $257.0 \pm 228 \mu\text{g}$, $p=0.03$) for dentate vs complete-denture and dietary fibers ($17.0 \pm 7.24 \text{gm}$ vs $10.7 \pm 6.3 \text{gm}$, $p=0.01$) for dentate vs edentulous respectively. LBM was $52.7 \pm 8.8 \text{ kg}$ vs $42.2 \pm 6.5 \text{ kg}$ ($p<0.001$) in dentate vs complete-dentures and $52.5 \pm 8.8 \text{ kg}$ vs $47.1 \pm 6.3 \text{ kg}$ ($p=0.04$) in dentate vs edentulous subjects, respectively. Mean caloric intake was $1750.9 \pm 132.9 \text{ KCal}$ vs $1649.1 \pm 125.1 \text{ KCal}$ ($p=0.02$) in dentate vs complete-dentures. Mean GOHAI was 33.3 ± 1.2 , 31.8 ± 2.6 , 26.5 ± 2.6 ($p<0.001$) in dentate, complete-dentures users & edentulous subjects, respectively. Differences in rest of the parameters were non-significant.

CONCLUSION: The use of complete-dentures significantly improves oral health status. However, it does not improve the caloric intake and anthropometric measures compared to edentulous subjects. These parameters are not influenced by provision of complete-dentures; rather these are dependent on the duration of edentulousness.

KEY WORDS: Oral Health (MeSH); Aged (MeSH); Mouth, Edentulous (MeSH); Dentures, Complete (MeSH); Dentate, Edentulous (MeSH); Diet (MeSH); Energy Intake (MeSH); Body Mass Index (MeSH).

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INTRODUCTION

Malnutrition is associated with a deterioration in functional status, weakened muscle activity and immunity, reduced bone mass and cognitive function, anemia, delayed wound repair and recovery from disease, longer hospital stays and

readmission rate (25%) of malnourished older adults.¹ The deficiency of essential vitamins is one of the major cause of malnutrition in aged population.²

The degree of dental impairment, which causes chewing difficulty results in a change in selection of the type and

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variety of food. This adversely effects the overall health of the elderly people and is a leading cause of malnutrition in them.³ The loss of natural teeth causes reduced chewing efficiency even after replacement with complete dentures, requiring more chewing strokes and longer time to swallow food than individual with natural teeth.⁴ Therefore, these elderly edentulous individuals avoid hard and coarse foods such as fruits, vegetables and meat, which are the major sources of vitamins, minerals, proteins and fiber, as these foods are difficult to chew with complete denture. This results in poor overall general health and quality of life of these individuals.⁵

Oral health is a fundamental part of the general health. Oral health related quality of life,^{6,7} shows how the oral condition can disturb one's capability to function. Geriatric Oral Health Assessment Index (GOHAI) is one of the tools used to assess oral health status in elderly patients. Individuals having more number of teeth have better GOHAI scores than those with no or fewer teeth.⁸

The amount of caloric intake, quality of food and dental hygiene can affect body mass index (BMI) and micronutrient status. It has been shown that the individuals having more than five pairs of

TABLE I: COMPARISON OF DEMOGRAPHIC, BODY COMPOSITION PARAMETERS AND ORAL HEALTH STATUS IN THREE GROUPS

| Variable | Dentate (D) | Edentulous (E) | Complete Denture (CD) Wearer | P for comparison | | |
|------------------------------------|-------------------|-------------------|------------------------------|------------------|--------|---------|
| | | | | D vs CD | D vs E | CD vs E |
| Age (years) | 64.95±4.49 | 64.86±5.23 | 65.70±4.13 | 0.86 | 0.99 | 0.83 |
| Duration of Edentulousness (years) | 0±0 | 3.35±5.18 | 7.35±5.63 | 0.002 | 0.55 | 0.03 |
| Height (cm) | 164.8±10.05 | 162.19±6.69 | 155.8±7.08 | 0.002 | 0.55 | 0.03 |
| Weight (kg) | 69.10±13.65 | 60.70±10.46 | 59.02±9.64 | 0.01 | 0.055 | 0.88 |
| BMI(kg/m ²) | 25.54±5.16 | 23.12±4.15 | 24.30±3.84 | 0.64 | 0.19 | 0.67 |
| Body Fat (%) | 22.55±7.71 | 20.57±10.49 | 26.85±11.27 | 0.36 | 0.80 | 0.11 |
| Body Water (%) | 52.05±5.21 | 53.86±7.23 | 49.4±7.63 | 0.43 | 0.67 | 0.09 |
| Lean Body Mass (kg) | 52.75±8.80 | 47.10±6.36 | 42.25±6.51 | <0.001 | 0.04 | 0.09 |
| Lean Mass (%) | 76.33±7.8 | 77.59±7.5 | 71.59±7.13 | 0.02 | 0.07 | 0.02 |
| Fat Mass (kg) | 16.37±7.37 | 13.59±8.22 | 16.69±8.50 | 0.99 | 0.51 | 0.43 |
| KCAL | 1750.90±132.98 | 1723.10±107.3 | 1649.05±12.07 | 0.02 | 0.74 | 0.13 |
| GOHAI* | 33.28 (32.6-33.9) | 26.46 (25.1-27.8) | 31.79 (30.5-33.1) | 0.22 | <0.001 | <0.001 |

Values are Mean ± SD. P=Tukey post hoc comparison between groups. * = Values are log transformed for analysis, presented as geometric means (confidence interval). GOHAI (General Oral Health Assessment Index).

TABLE II: COMPARISON OF DIETARY MACRONUTRIENTS AMONG THE THREE GROUPS CALCULATED THROUGH WINDIET® SOFTWARE

| Variable | Dentate (D) | Edentulous (E) | Complete Denture (CD) Wearer | P for comparison | | |
|--------------------|---------------------|---------------------|------------------------------|------------------|--------|---------|
| | | | | D vs CD | D vs E | CD vs E |
| Fat (gm) | 35.78±23.82 | 31.75±17.09 | 37.86±27.54 | 0.95 | 0.84 | 0.67 |
| Protein (gm) | 33.31±19.38 | 28.47±15.16 | 36.63±25.03 | 0.86 | 0.72 | 0.40 |
| Carbohydrate (gm) | 130.19±47.67 | 120.04±58.50 | 127.80±44.80 | 0.98 | 0.79 | 0.87 |
| Starch (gm) | 87.13±37.31 | 72.37±38.98 | 86.13±40.56 | 0.99 | 0.45 | 0.49 |
| NMEs (gm) | 26.73±19.48 | 34.30±19.87 | 28.70±13.78 | 0.93 | 0.37 | 0.58 |
| NSP (gm) | 8.38±4.62 | 5.86±4.51 | 6.82±4.74 | 0.53 | 0.19 | 0.78 |
| Water (gm) | 840.70±232.09 | 1018.44±375.21 | 857.92±327.91 | 0.98 | 0.18 | 0.24 |
| Dietary Fiber (gm) | 17.00±7.24 | 10.73±6.39 | 12.53±6.44 | 0.09 | 0.01 | 0.66 |
| SFA*(gm) | 7.95 (6.02-10.50) | 7.49 (2.30-1.20) | 6.54 (2.61-1.24) | 0.72 | 0.96 | 0.85 |
| PUSFA* (gm) | 6.02 (3.89-9.34) | 3.67 (2.34-5.75) | 4.93 (2.72-8.96) | 0.82 | 0.31 | 0.65 |
| Monos* (gm) | 8.14 (5.79-11.44) | 5.96 (4.24-8.38) | 6.82 (3.85-12.09) | 0.81 | 0.53 | 0.88 |
| Cholesterol* (gm) | 52.30 (32.97-82.96) | 42.75 (24.83-73.61) | 44.34 (22.37-87.87) | 0.90 | 0.85 | 0.99 |

Values are Mean ± SD. P=Tukey post hoc comparison between groups. * = Values are log transformed for analysis, presented as geometric means (confidence interval). NME (Non milk extrinsic sugar), NSP (Non starch polysaccharides), SFA (Saturated Fatty acid), PUSFA (Polyunsaturated fatty acid), Monos (Mono-unsaturated fatty acid).

posterior occluding teeth have greater BMI than individuals with fewer teeth or using complete denture. In addition, the presence and absence of teeth and use of complete denture effects the BMI of elderly people.⁹

As there is no local study to address the issue, we planned this study to assess the oral health status, BMI, diet and GOHAI among dentate, edentulous and complete denture wearer.

METHODS

This observational cross sectional study was conducted at Department of Prosthodontics, Khyber College of Dentistry, Peshawar and Department of

Physiology, Institute of Basic Medical Sciences, Khyber Medical University (KMU), Peshawar, Pakistan. The study was approved by the advanced studies and research board and ethical committee of KMU and conducted from June 2017 to December 2017. The sampling technique used was non-probability random sampling technique.

A total of 60 elderly male and female participants within age range of 60-75 years, divided into three groups of Dentate, Edentulous and Complete Denture wearers; each group having twenty participants were included in this study. For the dentate group, subjects having at least five or more posterior occluding pairs of teeth were

selected. In the edentulous group, subjects who have been edentulous for a minimum period of six months were included. Subjects with uncontrolled diabetes, mental disorder, chronic periodontitis, damaged/worn dentition, active intraoral infection, muscular disorders, implant supported complete denture, removable partial denture, and long span fixed dental prosthesis were excluded from the study: after complete history, radiographic and clinical examination. For the complete denture wearers, the subjects recruited for the study were using their complete denture for a minimum period of two years.

All the willing potential participants

were encouraged to participate in the study and potential participants were identified. Written informed consent was taken from all the participants. The questionnaires were provided to participants for recoding their responses. Although the printed questionnaire called for participants to express in written form, the study authors were ready to help them in understanding questions and recording their responses as well as recording the anthropometric measurements.

Dietary data of all the participants were obtained using the 24 hours dietary recall questionnaire and it was analyzed using the Windiet® 2005 software. The Windiet software has a large number of food items and categorized meal time as breakfast, morning snack, lunch, evening snack and dinner.

Oral health status of the participants was assessed using GOHAI scale,¹⁰ which comprised of 12 questions. A sum up method (GOHAI-Add) was used to calculate the final score of the 12 GOHAI questions. The maximum score is 36 (12 = functional field; 15 = psychosocial field; 9 = pain or discomfort field).

Anthropometric parameters were measured by using the body composition analyser (CAMRY, model no-EF711H) to calculate the lean body

mass, body water and fat content etc. BMI was calculated from height in centimeters and weight in kilograms ($BMI = kg/m^2$). Then through electrical impedance, the body fat percent, body water percent and the required kilocalories of each individual participant was recorded. From these values, lean body mass and fat mass in kilograms were calculated.

All the obtained data was statistically analyzed with SPSS® (Ver. 22.0, SPSS, Chicago, IL, USA). The data was normally distributed using Kolmogorov Smirnov tests and histograms were plotted except for GOHAI index which was logarithmically transformed for analysis. For comparing the three groups one-way ANOVA followed by Tukey's HSD Post Hoc test were used.

RESULTS

The lean body mass was significantly high in dentate compared to both edentulous ($p=0.004$) and complete denture group ($p<0.001$). The time duration of being edentulous was more in complete denture group as compared to dentate and edentulous (Table I). Furthermore, the GOHAI score showed that the oral health is better in dentate group compared to others ($p<0.001$). However, complete denture group also showed

improvement of oral health compared to edentulous ($p<0.001$).

There was a statistically significant difference in the following parameters obtained after Windiet® analysis including vitamin B₁₂ (complete denture vs edentulous; $0.66 \pm 1.47 \mu g$ vs $0.43 \pm 0.77 \mu g$, $p=0.04$), Carotene (dentate vs complete denture: $615.8 \pm 58 \mu g$ vs $257.0 \pm 228 \mu g$, $p=0.03$) and dietary fibers (dentate vs edentulous; $17.0 \pm 7.24 gm$ vs $10.7 \pm 6.3 gm$, $p=0.01$). Among macronutrients only dietary fibers intake was significantly high in dentate ($17.0 \pm 7.24 gm$, $p=0.01$) compared to other two groups. The difference in the rest of the parameters was statistically non-significant (Table II and III). Mean intake of carbohydrates ($130.19 \pm 47.67 gm$), cholesterol [$52.30 (32.97-82.96)$], monosaturated fat [$8.14 (5.79-11.44 gm)$] and non-starch polysaccharides ($8.38 \pm 4.62 gm$) were high in dentate group showing increased intake of solid foods. Moreover, mean intake of fats ($37.86 \pm 27.54 gm$) and proteins ($36.63 \pm 25.03 gm$) were high in complete denture group as compared to dentate group suggesting better food intake and semi solid food. In edentulous group, more mean intake of water ($1018.44 \pm 375.21 gm$) was observed suggesting fluid nature of most of the food intake (Table II).

TABLE III: COMPARISON OF DIETARY MICRONUTRIENTS (VITAMINS) AMONG THE THREE GROUPS CALCULATED THROUGH WINDIET® SOFTWARE

| Variable | Dentate (D) | Edentulous (E) | Complete Denture (CD) Wearer | P for comparison | | |
|---------------------------------------|---------------------|---------------------|------------------------------|------------------|--------|---------|
| | | | | D vs CD | D vs E | CD vs E |
| Vitamin A (μg) | 290.75 \pm 168.85 | 275.14 \pm 194.79 | 202.45 \pm 133.09 | 0.22 | 0.95 | 0.35 |
| Thiamine (mg) | 0.72 \pm 0.29 | 0.52 \pm 0.28 | 0.68 \pm 0.32 | 0.89 | 0.09 | 0.22 |
| Riboflavin (mg) | 0.49 \pm 0.23 | 0.57 \pm 0.33 | 0.58 \pm 0.31 | 0.62 | 0.67 | 0.99 |
| Niacin (mg) | 13.14 \pm 6.37 | 11.48 \pm 6.42 | 14.51 \pm 8.65 | 0.81 | 0.74 | 0.37 |
| Vitamin B ₅ (mg) | 0.78 \pm 0.39 | 0.63 \pm 0.30 | 0.73 \pm 0.45 | 0.91 | 0.46 | 0.71 |
| Folate (μg) | 101.90 \pm 44.80 | 78.19 \pm 44.29 | 92.95 \pm 48.17 | 0.81 | 0.22 | 0.55 |
| Pantothenic acid (μg) | 1.67 \pm 0.74 | 1.68 \pm 0.90 | 1.72 \pm 1.05 | 0.98 | 0.99 | 0.98 |
| Biotin (μg) | 11.32 \pm 6.40 | 11.09 \pm 5.97 | 12.27 \pm 7.45 | 0.89 | 0.99 | 0.83 |
| Vitamin B ₁₂ * (μg) | 0.66 (0.25-1.72) | 0.43 (0.19-0.96) | 1.77 (0.81-3.86) | 0.22 | 0.69 | 0.04 |
| Vitamin C* (mg) | 20.45 (11.48-36.42) | 12.53 (6.63-23.69) | 16.61 (9.6-28.6) | 0.86 | 0.43 | 0.75 |
| Vitamin D* (μg) | 0.40 (0.24-0.66) | 0.37 (0.24-0.56) | 0.27 (0.1-0.55) | 0.56 | 0.97 | 0.70 |
| Vitamin E* (mg) | 2.82 (1.79-4.45) | 2.30 (1.41-3.76) | 1.97 (1.3-2.97) | 0.48 | 0.78 | 0.86 |
| Retinol* (μg) | 66.4 (45.9-96.1) | 76.62 (52.3-112.3) | 70.11 (46.2-106.3) | 0.97 | 0.84 | 0.93 |
| Carotene* (μg) | 615.8(389.22-74.4) | 302.5(165.3-53.7) | 257(166.1-395.6) | 0.03 | 0.10 | 0.88 |

Values are Mean \pm SD. P=Tukey post hoc comparison between groups. * = Values are log transformed for analysis, presented as geometric means (confidence interval).

When the dietary vitamins were compared significantly high levels were found for vitamin B₁₂ in complete denture wearers [1.77 (0.81-3.86) µg, p=0.04] versus edentulous [0.43 (0.19-0.96) µg] group, and carotenes intake in dentate [615.8 (389.22-74.4) µg, p=0.03] versus complete denture wearers [257.0 (166.1-395.6) µg]. No statistical significance was found for the rest of the parameters (Table III). In complete denture group, more mean intake of riboflavin (0.58±0.31mg), niacin (14.51±8.65mg), and biotin (12.27±7.45mg) was found. In edentulous group, mean intake of retinol [76.62 (52.3-112.3) mg] was more.

No statistical significance was found for mineral content of the diet among the three groups (Table IV). However, mean intake of most minerals were high in dentate group suggesting good quality of food. However, mean intake of calcium, phosphorous, and zinc were high among complete denture wearers when compared to edentulous.

Furthermore, the lean body mass was significantly high in dentate subjects compared to edentulous and complete denture (dentate vs complete denture) (52.7±8.8 kg vs 42.2±6.5 kg, p<0.001), (dentate vs edentulous) (52.5±8.8 kg vs 47.1±6.3 kg, p=0.04). We also found the caloric intake was more in dentate patients compared to other groups (dentate vs complete denture) (1750.9±132.9 KCal vs 1649.1±125.1 KCal, p=0.02). Oral health status showed improvement in dentate and complete denture compared to edentulous subjects respectively (33.3±1.2, 31.7±2.6, 26.5±2.6, p<0.001). Difference in rest of the parameters were non-significant.

DISCUSSION

Oral health plays an important role in the social, psychological and general wellbeing of an individual.¹¹ For general and oral health of the elderly subjects, an appropriate and adequate nutrition is of great importance. It is proven in the research studies that poor oral function due to impaired dental status can cause chewing difficulty, dietary limitations and thus resulting in impaired nutritional

status of these elderly. Masticatory efficiency is affected by the presence of teeth, the number of functional teeth, and the use of prostheses, which all influences the type and quality of food.^{12,13} The presence of five or more pairs of posterior teeth help the aged individuals to select the type of food they can easily chew and digest.^{14,15} This finding is also observed in our study that dentate individuals were taking more solid food, rich in fibers and micronutrients.¹⁴ Furthermore, the decrease in the solid food is seen in patients having no pairs of teeth, these are in accordance with the previous studies.^{9,16} The edentulous people prefer to use semi-solid and fluid food, which are low in essential nutrients.^{3,17} The preference is due to ease in chewing, swallowing, preparation, and affordability.¹⁸

Conventional complete denture is one of the most commonly used treatment modality for edentulous patients. However, with the use of complete denture, many problems such as pain, swelling, difficulty in speech/biting and chewing hard foods, can lead to denture stomatitis are reported.^{19,20} As a result, the edentulous patients with complete denture try to modify either their type of food or cooking methods.²¹ These issues can be addressed by use of implant supported dentures in place of conventional complete dentures.²² The advantage of implant supported dentures includes better support, stability and retention and better performance. However, dental implants are technique sensitive, surgical intervention is required and are costly.²³ A low level of awareness about dental implants also exists and therefore, conventional complete denture are the treatment of choice for majority of the patients living in the under developed countries.²⁴

In a study by Sahyoun NR, et al., BMI was found to increase with the decrease in number of teeth, due to decrease masticatory forces and more caloric food consumption.⁹ However, increase in BMI after denture use among edentulous people was observed.²⁵ In another study by Hossain M, et al., the differences of the BMI values were found to be statistically significant

(p<0.05) both at 3 months and 6 months follow up compared to the base line value.²⁶ No significant difference in BMI was observed in our study population. This might be because of the selection of participants in a specific age range or specific age limits.

Oral health related quality of life is good predictor of general wellbeing of an individual in a community. A number of methods have been used to measure oral health related quality of life, GOHAI being one of them.²⁷ GOHAI is very easy, simple and reliable tool to assess oral health status of elderly population as perceived by the individual.¹⁰ It was observed that oral hygiene and quality of life improved with the use of complete denture when compared with the edentulous group. These findings are supported by many previous research that use of complete denture causes improvement in oral health and social wellbeing of an individual.^{28,29}

In contrast, improvement in functionality, mastication and self-confidence was observed by Shigli K, et al.,⁷ In our study oral health showed significant improvement but the dietary intake was not significantly improved with denture use when compared to those with teeth. This might be due to the fact that even with the use of complete denture, patients face difficulty in using artificial teeth due to factors as previously described.

The health status was more related to the duration of individual becoming edentulous as was observed in this study. The individual using complete denture were edentulous for significantly high time (7.35±5.63) compared to edentulous (3.35±5.18). The longer the duration of individual without teeth the worse is the health condition. This was unexpected as with the use of denture improvement was expected as previously seen in the studies.^{7,30}

The results of the current study must be applied cautiously, as the sample size in this study is small and food intake was recorded only for one day through 24-hour dietary recall. The results would be more reliable with the use of 3 and 7 days' record.^{16,31} However, the

advantage of 24-hour dietary record is its simplicity, quick use and feasibility to mentally recall for the elderly after one day. The disadvantage being it does not give long term information about food intake.³² While in 3 and 7 days' recall methods, there is compliance and recall bias can be an issue. To overcome these problems, diet diary can be provided for dental analysis of food intake.³³

CONCLUSION

The use of complete denture in edentulous patients significantly improves their oral health status. However, it does not improve the caloric intake and anthropometric measures in these edentulous patients. These parameters are not dependent on the provision of complete dentures but rather are dependent on the duration of edentulousness.

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AUTHORS' CONTRIBUTIONS

Following authors have made substantial contributions to the manuscript as under:

SHH: Study design, analysis and interpretation of data, drafting the manuscript, final approval of the version to be published

AG: Acquisition of data, drafting the manuscript, final approval of the version to be published

MOM: Analysis and interpretation of data, critical revision, final approval of the version to be published

SRH: Conception, drafting the manuscript, critical revision, final approval of the version to be published

MAK: Acquisition of data, critical revision, final approval of the version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest

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DATA SHARING STATEMENT

Data available on request due to privacy / ethical restrictions



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