Assessment of Nutritional Status and Oral frailty among Geriatric population using different Dental prosthesis: An observational study

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ABSTRACT

Introduction: Oral frailty is increasingly recognized as an early indicator of systemic frailty and adverse health outcomes in older adults. Compromised oral function may restrict dietary intake and negatively influence nutritional status. Therefore, the present study aimed to assess the nutritional status and oral frailty among geriatric individuals rehabilitated with different types of dental prostheses.

Methods: This analytical cross-sectional study included 96 geriatric participants aged ≥60 years rehabilitated with dental prostheses for at least three months. Participants were stratified into five groups: complete denture, removable partial denture, fixed partial denture, overdenture, and full mouth rehabilitation. Oral frailty was assessed using a validated questionnaire. Nutritional status was evaluated using a multiple-pass 24-hour dietary recall method and anthropometric measurements. Nutrient intake was also assessed. Data were entered into Microsoft Excel and analyzed using SPSS version 23.

Results: No significant association was observed between prosthesis type and body mass index ($p > 0.05$). Energy and macronutrient intake were comparable across prosthetic groups. However, calcium intake differed significantly, with the lowest intake observed among full mouth rehabilitation users ($p = 0.044$). Perceived oral impact scores varied significantly between prosthetic groups ($p = 0.033$), with higher scores in the full mouth rehabilitation group. Oral frailty scores showed a highly significant difference across prosthesis types ($p = 0.002$), with the highest scores observed in full mouth rehabilitation users and the lowest in fixed partial denture users.

Conclusion: Prosthesis type influenced oral frailty and selected nutritional parameters among geriatric individuals. Comprehensive prosthodontic care should integrate functional assessment and nutritional counselling to improve geriatric health outcomes.

Keywords: Body mass index; Geriatric; Nutrition; Oral health; Oral frailty; Prostheses.

INTRODUCTION

Population aging is a global phenomenon, accompanied by a rising burden of chronic diseases, functional decline, and increased healthcare needs. Among older adults, oral health plays a pivotal yet often underestimated role in determining overall health, nutritional adequacy, and quality of life.[1,2] Age-related tooth loss, reduced salivary flow, diminished neuromuscular coordination, and compromised masticatory efficiency frequently necessitate prosthodontic rehabilitation.[1] However, restoration of missing teeth alone may not fully address the functional and systemic consequences associated with aging.

Conflict of Interest: None

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In recent years, the concept of oral frailty has gained prominence in geriatric dentistry and prosthodontics. Oral frailty represents a progressive decline in oral functions, including chewing ability, swallowing, articulation, and tongue pressure, often occurring alongside cognitive and physical deterioration.[3,4] This condition has been shown to precede general frailty and is associated with adverse health outcomes such as malnutrition, sarcopenia, reduced mobility, and increased mortality. Early identification of oral frailty is therefore crucial for preventive and rehabilitative strategies in elderly populations.[5] A previous systematic review has reported prevalence rate of 24% for oral frailty and 57% for oral pre-frailty.[4]

Nutritional status is closely interlinked with oral function. Impaired mastication and swallowing can restrict food choices, leading to reduced intake of essential macro- and micronutrients.[6] Elderly individuals with compromised oral function often prefer soft, carbohydrate-rich diets that are low in protein, calcium, and other vital nutrients, thereby increasing the risk of undernutrition.[7] Prosthodontic rehabilitation aims to restore oral function; however, the extent to which different types of dental prostheses influence oral frailty and nutritional status remains inadequately explored.

Various prosthetic modalities, such as complete dentures, removable partial dentures, fixed partial dentures, overdentures, and full mouth rehabilitation, differ substantially in their biomechanical properties, stability, and functional outcomes. While advanced prosthetic treatments are presumed to improve masticatory efficiency and dietary intake, clinical evidence suggests that functional outcomes may vary considerably among elderly patients due to adaptation difficulties, neuromuscular limitations, and pre-existing oral frailty.[8-10] Understanding these differences is essential for individualized treatment planning and comprehensive geriatric care. There is lack of adequate evidence that assessed oral frailty in geriatric population with different prostheses.

Therefore, the present study aimed to assess the nutritional status and oral frailty among geriatric individuals rehabilitated with different types of dental prostheses. The objectives were to evaluate variations in nutritional intake and anthropometric measures across prosthetic groups, to compare oral frailty scores among different prosthetic modalities, and to explore the association between prosthesis type, nutritional status, and oral frailty in the elderly population.

METHODS

This hospital-based analytical cross-sectional observational study was conducted in the Department of Prosthodontics, in collaboration with the Department of Public Health Dentistry, at a tertiary care dental institution in India. The study is approved by institutional ethical committee of JMF's ACPM Dental College, Dhule (INST/NEW/2022/2959/2024-25/012). The study protocol received prior approval from the Institutional Ethics Committee, and all procedures were performed in accordance with the Declaration of Helsinki. The study followed Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.[11]

Geriatric individuals aged 60 years and above attending the outpatient department were screened for eligibility. Participants were included if they had been rehabilitated with a dental prosthesis for a minimum duration of three months and fulfilled at least three of the six established oral frailty criteria: fewer than 20 natural teeth, reduced chewing ability, impaired articulatory oral-motor skills, reduced tongue pressure, and self-reported difficulty in eating or swallowing. Exclusion criteria included severe cognitive impairment, neurological or psychiatric disorders affecting oral function, uncontrolled systemic diseases, active malignancies, conditions independently affecting nutritional intake, and unwillingness to provide informed consent.

A stratified purposive sampling technique was employed. Eligible participants were categorized into five mutually exclusive groups based on prosthetic status: complete denture (CD), removable partial denture (RPD), fixed partial denture (FPD), overdenture, and full mouth rehabilitation (FMR). Sample size estimation was performed using G*Power software (version 3.1). Assuming an effect size of 0.35, an alpha level of 0.05, and 80% statistical power, the minimum required sample size was calculated as 96 participants. During the study period, 435 individuals were screened, of whom 96 fulfilled the inclusion criteria and were enrolled.

Data collection followed a standardized protocol comprising four sequential steps: participant screening and informed consent, clinical examination, questionnaire administration, and anthropometric assessment. All clinical assessments were performed by a single calibrated examiner to minimize inter-examiner variability. Examiner calibration demonstrated high reliability ($\kappa > 0.85$). Questionnaires were administered through face-to-face interviews by a trained investigator to reduce reporting bias. All study instruments were pilot tested prior to final use.

Oral frailty was assessed using a validated five-item oral frailty questionnaire incorporating both objective and subjective parameters.[12] These included number of remaining natural teeth, chewing difficulty, articulatory oral-motor performance, tongue pressure, and perceived difficulty in eating and swallowing. The questionnaire was translated into the local language using a forward–backward translation process to ensure semantic equivalence and cultural appropriateness. Internal consistency and content validity were confirmed before administration (Cronbach's $\alpha = 0.89$; I-CVI = 0.96; S-CVI/Ave = 0.95). Tongue pressure was measured using a hydraulic tongue pressure measuring device. Chewing ability and swallowing difficulty were assessed through standardized clinical evaluation and participant self-report. Higher cumulative scores indicated greater oral frailty.

Nutritional status was evaluated using a multiple-pass 24-hour dietary recall method. Participants reported all foods and beverages consumed in the previous 24 hours, including portion sizes and preparation methods. Standard household measures were used to improve accuracy. To ensure reliability, repeat dietary recall was conducted in a randomly selected 30% subsample. Dietary intake data were analyzed using standard Indian food composition tables and compared against the Nutrient Requirements for Indians, including Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR), as per ICMR–NIN (2020).[13] Energy, macronutrients, and selected micronutrients such as calcium, phosphorus, and iron were assessed.

Body weight and height were measured using standardized techniques. Body mass index (BMI) was calculated as weight (kg)/height^2 (m^2) and categorized according to World Health Organization criteria. Mid-arm circumference was also recorded as an additional indicator of nutritional status.

The primary outcome variable was nutritional status, assessed through dietary intake analysis and BMI. Secondary outcome variables included oral frailty score, perceived oral impact, oral health awareness, and functional parameters related to prosthesis use.

Data were entered into Microsoft Excel and analyzed using SPSS version 23. Descriptive statistics were computed for all variables.

Normality of continuous data was assessed using the Shapiro–Wilk test. Between-group comparisons were performed using one-way ANOVA or the Kruskal–Wallis test, followed by appropriate post-hoc tests. Categorical variables were analyzed using the chi-square test or Fisher's exact test. Associations between oral frailty scores and nutritional parameters were examined using Spearman's rank correlation. Multivariable linear regression analysis was conducted to identify predictors of nutritional status after adjusting for age, sex, and prosthesis type. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 96 geriatric participants meeting the eligibility criteria were included in the final analysis. The demographic and clinical characteristics of the study population are presented in Table 1. The cohort comprised 58 males (60.4%) and 38 females (39.6%). Participants were distributed across five prosthetic categories, with CD, RPD, and overdenture users each accounting for 22.9% of the sample. FMR and FPD users constituted 16.7% and 14.6% of the participants, respectively. With regard to recent weight changes, 43.8% of participants reported weight loss of 1–3 kg in the preceding three months, 39.6% reported no weight loss, 4.2% reported weight loss exceeding 3 kg, and 12.5% were uncertain of their recent weight history.

The association between prosthesis type and BMI categories is summarized in Table 2. Most participants across all prosthetic groups were classified within the normal BMI range. However, variations were observed among groups. Underweight status was most prevalent among CD users (36.4%), whereas no underweight individuals were identified in the FPD or overdenture groups. Overweight status was most frequently observed in overdenture users (27.3%), while obesity was noted only among RPD users (9.1%). Despite these trends, Fisher's exact test showed no statistically significant association between prosthesis type and BMI category (p = 0.316).

Mean daily nutrient intake across prosthetic groups is detailed in Table 3. Mean energy intake ranged from 2464.3 ± 415.4 kcal in the FMR group to 2916.4 ± 422.5 kcal in the FPD group. Mean protein intake varied between 51.7 ± 11.7 g among RPD users and 62.8 ± 5.4 g among FPD users. Mean fat and carbohydrate intake showed comparable distributions across all prosthetic categories. Statistical analysis demonstrated no significant differences among groups for energy, protein, fat, carbohydrate, phosphorus, or iron intake (p > 0.05).

In contrast, a statistically significant difference was observed in calcium intake across prosthesis groups (p = 0.044). The lowest mean calcium intake was recorded in the FMR group (589.4 ± 174.5 mg), whereas the highest intake was observed among FPD users (942.1 ± 200.5 mg). Post-hoc analysis revealed that calcium intake in the FMR group was significantly lower than that in the FPD group (p = 0.004) and the overdenture group (p = 0.004). No other pairwise comparisons reached statistical significance.

Oral health awareness scores according to prosthesis type are shown in Table 4. Median awareness scores ranged from 13.0 in the CD and FPD groups to 22.0 in the FMR group, with RPD and overdenture users demonstrating intermediate values. Although the FMR group exhibited the highest median awareness score, the overall difference among prosthetic groups did not reach statistical significance (Kruskal–Wallis test, p = 0.068).

Perceived oral impact scores are presented in Table 5. Median scores ranged from 9.0 in the FPD group to 15.0 in the FMR group. A statistically significant difference in perceived oral impact was observed among prosthesis groups (p = 0.033). Post-hoc pairwise analysis demonstrated that this difference was significant only between the FMR and FPD groups (p = 0.020), with FMR users reporting higher perceived impact scores.

Oral frailty scores across the five prosthetic categories are summarized in Table 6. Median oral frailty scores showed marked variation, with the highest score observed in the FMR group (49.5) and the lowest in the FPD group (28.0). CD, RPD, and overdenture users exhibited intermediate scores. The Kruskal–Wallis test demonstrated a statistically significant difference in oral frailty scores among prosthesis groups (p = 0.002). Post-hoc analysis confirmed that oral frailty scores in the FMR group were significantly higher than those in all other prosthetic categories (p < 0.05).

Overall, the results indicate that while BMI distribution and most nutritional parameters were comparable across prosthetic groups, significant differences were observed in calcium intake, perceived oral impact, and oral frailty scores. These differences were most pronounced among individuals who had undergone full mouth rehabilitation compared with those rehabilitated using fixed partial dentures.

Table 1: Demographic and clinical characteristics of the study participants (N=96).

Variable	Category	N (%)
Sex	Male	58 (60.4)
	Female	38 (39.6)
Denture type	Complete Denture (CD)	22 (22.9)
	Removable Partial Denture (RPD)	22 (22.9)
	Overdenture	22 (22.9)
	Full Mouth Rehabilitation (FMR)	16 (16.7)
	Fixed Partial Denture (FPD)	14 (14.6)
Weight loss (Past 3 months)	No weight loss	38 (39.6)
	Weight loss 1–3 kg	42 (43.8)
	Weight loss >3 kg	4 (4.2)
	Unknown	12 (12.5)

Values are presented in form of n (%).

Table 2: Association between type of prosthesis and body mass index (BMI) categories.

Prosthesis	N	Underweight, N (%)	Normal, N (%)	Overweight, N (%)	Obese, N (%)	*Chi stats	p-value
CD	22	8 (36.4)	10 (45.5)	4 (18.2)	0 (0.0)	1.65	0.362
FMR	16	2 (12.5)	14 (87.5)	0 (0.0)	0 (0.0)		
FPD	14	0 (0.0)	12 (85.7)	2 (14.3)	0 (0.0)		
Overdenture	22	0 (0.0)	16 (72.7)	6 (27.3)	0 (0.0)		
RPD	22	4 (18.2)	12 (54.5)	4 (18.2)	2 (9.1)		

*Fisher's Exact Test, p > 0.05: non-significant, Values are presented in form of n (%).

Table 3: Comparison of mean daily nutrient intake with respect to type of prosthesis.

Nutrient	CD (n=22)	FMR (n=16)	FPD (n=14)	Overdenture (n=22)	RPD (n=22)	F stats	p-value
Energy (kcal)	2667.4 ± 508.8	2464.3 ± 415.4	2916.4 ± 422.5	2667.5 ± 629.2	2593.5 ± 392.6	1.89	0.505
Protein (g)	56.7 ± 13.3	54.4 ± 4.9	62.8 ± 5.4	58.8 ± 9.6	51.7 ± 11.7	2.16	0.209
Fat (g)	90.5 ± 21.9	84.3 ± 21.4	89.2 ± 25.5	91.1 ± 22.7	83.5 ± 27.8	0.94	0.886
Carbohydrate (g)	458.0 ± 127.5	390.2 ± 101.8	438.9 ± 63.7	447.3 ± 100.5	444.4 ± 135.8	1.13	0.754
Calcium (mg)	727.8 ± 293.0	589.4 ± 174.5	942.1 ± 200.5	893.7 ± 284.1	852.6 ± 312.6	12.45	0.044*
Phosphorus (mg)	709.2 ± 302.5	683.9 ± 188.8	967.8 ± 267.7	867.8 ± 332.8	838.2 ± 363.5	2.04	0.286
Iron (mg)	9.8 ± 3.5	8.1 ± 1.7	12.4 ± 2.1	10.2 ± 2.6	9.8 ± 3.1	3.12	0.058

*Data are Mean ± SD, One-way ANOVA was used, *p < 0.05: significant.

Table 4: Comparison of oral health awareness score by prosthesis type.

Prosthesis	n	Median (IQR)	H	p-value
CD	22	13.0 (10.0)	8.87	0.068
FMR	16	22.0 (3.8)		
FPD	14	13.0 (1.0)		
Overdenture	22	18.0 (5.0)		
RPD	**22**	**18.0 (7.0)**		

Kruskal-Wallis Test was used, p > 0.05: non-significant, IQR: interquartile range.

Table 5: Comparison of perceived oral impact score by prosthesis type.

Prosthesis	N	Median (IQR)	H	p-value
CD	22	10.0 (8.0)	14.56	0.033*
FMR	16	15.0 (0.8)		
FPD	14	9.0 (2.0)		
Overdenture	22	10.0 (2.0)		
RPD	**22**	**10.0 (7.0)**		

Kruskal-Wallis Test was used, *p < 0.05: significant, IQR: interquartile range.

Table 6: Comparison of oral frailty score by prosthesis type.

Prosthesis	N	Median (IQR)	H	p-value
CD	22	29.0 (22.0)	32.12	0.002*
FMR	16	49.5 (4.8)		
FPD	14	28.0 (6.0)		
Overdenture	22	35.0 (8.0)		
RPD	22	32.0 (14.0)		

Kruskal-Wallis Test was used, *p < 0.05: significant, IQR: interquartile range.

DISCUSSION

The present study evaluated the association between different types of dental prostheses, nutritional status, and oral frailty among geriatric individuals. The findings highlight that while prosthodontic rehabilitation restores dental form and function, functional and nutritional outcomes vary considerably depending on the type and complexity of the prosthesis, as well as patient-related factors such as adaptation capacity and underlying oral frailty.

In the current cohort, most participants across all prosthetic groups exhibited a normal body mass index, and no statistically significant association was observed between prosthesis type and BMI. This finding is consistent with previous report suggesting that BMI alone may not be a sensitive indicator of nutritional compromise in elderly populations, particularly those with chronic oral functional limitations.[14] However, a notable proportion of complete denture users were underweight, suggesting a trend toward nutritional vulnerability in this group.[7] Reduced denture stability, compromised masticatory efficiency, and avoidance of harder, nutrient-dense foods among complete denture wearers have been widely reported and may explain this observation.[8,15]

Analysis of dietary intake revealed that overall energy and macronutrient consumption did not differ significantly across prosthetic groups. Similar findings have been reported in systematic reviews demonstrating that prosthetic replacement does not consistently result in improved dietary quality or nutrient intake.[8,16] Elderly individuals often maintain habitual dietary patterns even after prosthodontic rehabilitation, and functional improvements may not translate into meaningful dietary changes without targeted nutritional counseling.

A key finding of this study was the significant difference in calcium intake among prosthesis groups, with individuals rehabilitated with FMR exhibiting the lowest calcium intake. This result is clinically relevant, as calcium is critical for bone metabolism, particularly in older adults at risk of osteoporosis and fractures.[17] Despite receiving comprehensive prosthetic treatment, FMR patients may experience prolonged adaptation periods, occlusal discomfort, or altered chewing patterns that discourage the intake of calcium-rich foods such as dairy products and fibrous vegetables. Similar observations have been reported in studies evaluating dietary intake following extensive prosthodontic rehabilitation, where improved dental status did not necessarily correlate with improved micronutrient consumption.[8,10]

Oral health awareness scores did not differ significantly across prosthetic groups, although FMR users demonstrated higher median awareness levels. This may reflect increased exposure to dental care, prolonged treatment duration, and repeated professional interactions associated with complex rehabilitation. However, the lack of statistical significance suggests that awareness alone may not be sufficient to influence functional outcomes or nutritional behavior, reinforcing the multifactorial nature of oral health perception in geriatric patients.

Perceived oral impact scores differed significantly among prosthetic groups, with FMR users reporting the highest perceived impact and FPD users the lowest. This finding underscores an important paradox in geriatric prosthodontics: more extensive rehabilitation does not necessarily equate to better patient-reported outcomes. High expectations, increased treatment complexity, maintenance demands, and heightened self-awareness may contribute to greater perceived burden among FMR patients. In contrast, fixed partial dentures are often perceived as more natural and stable, resulting in lower subjective impact and better functional integration.[10,18]

The most striking finding of the study was the significantly higher oral frailty scores observed in the FMR group compared with all other prosthetic categories. This counterintuitive result suggests that FMR recipients may represent a subgroup with advanced baseline oral functional decline, necessitating comprehensive rehabilitation. Oral frailty is known to encompass neuromuscular deterioration, reduced tongue strength, impaired coordination, and swallowing difficulties, factors that prosthetic replacement alone cannot fully correct.[19,20] Similar findings have been reported in geriatric study indicating that oral frailty may persist or progress despite prosthodontic intervention, and is associated with mortality, and physical frailty, emphasizing the need for integrated functional rehabilitation approaches.[5,21]

From a clinical perspective, these findings highlight the importance of comprehensive pre-treatment assessment beyond dental status alone. Prosthodontic treatment planning for geriatric patients should incorporate evaluation of oral frailty, masticatory efficiency, and nutritional risk. Fixed prostheses, where feasible, may offer superior functional outcomes; however, even advanced prosthetic rehabilitation should be complemented by dietary counseling, oral motor exercises, and periodic functional reassessment. Interdisciplinary collaboration with nutritionists and geriatric healthcare providers is essential to optimize outcomes.

The study has several limitations. Its cross-sectional design precludes causal inference, and the relatively small sample size in certain prosthetic subgroups, particularly FMR and FPD, may limit generalizability. Dietary intake assessment relied on 24-hour recall, which is subject to recall bias despite standardized methodology. Additionally, pre-treatment nutritional and oral frailty status was not available, limiting evaluation of treatment-related changes over time.

Future research should adopt longitudinal designs to assess changes in nutritional status and oral frailty before and after prosthodontic rehabilitation. Larger multicenter studies incorporating objective masticatory performance tests, muscle strength assessments, and validated quality-of-life measures are recommended. Interventional studies evaluating the impact of combined prosthodontic, nutritional, and oral functional rehabilitation programs would further strengthen evidence-based geriatric dental care.

CONCLUSION

The present study demonstrated that while prosthodontic rehabilitation restores dental form, functional and nutritional outcomes vary significantly among geriatric patients depending on the type of prosthesis. Although body mass index and most macronutrient intakes were comparable across prosthetic groups, significant differences were observed in calcium intake, perceived oral impact, and oral frailty scores. Individuals rehabilitated with full mouth rehabilitation exhibited the highest oral frailty and lowest calcium intake, whereas fixed partial denture users showed more favourable functional outcomes. These findings underscore the need for comprehensive geriatric prosthodontic care incorporating oral frailty assessment, nutritional evaluation, and interdisciplinary management to optimize long-term health outcomes.

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