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ORIGINAL ARTICLE

SHORT TERM EFFECTS OF PROSTHODONTIC REHABILITATION ON DIETARY INTAKE AND BODY MASS INDEX IN EDENTULOUS PATIENTS IN MALAYSIA

Efectos a Corto Plazo de la Rehabilitación Prostodóncica Sobre la Ingesta Dietética y el Índice de Masa Corporal en Pacientes Edéntulos en Malasia

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ABSTRACT

Background: Edentulism in the elderly population has been related to changes in food intake and nutritional deficiency, as it has a measurable impact on mastication. Providing dentures helps in enhancing the chewing ability and improving the dietary intake of the elderly, thus improving their physical status. **Aim:** The objectives of this study were to identify the preliminary changes in physical status of edentulous patients, to identify the changes in calorie intake, and to examine the association between calorie intake and the physical status of edentulous individuals before and after prosthodontic rehabilitation.

Materials and Methods: This cross-sectional study involved 39 patients. The parameters used to conduct the study for evaluating and comparing the dietary intake with physical status were clinical extra oral and intra oral examination of the patients, anthropometric records including body-mass-index (BMI) and 24-hour dietary recall method. First level of analysis was done using descriptive statistics and second level of analysis was done using Pearson's chi-square test.

Results: There was an increase in calorie intake in 51.3% of the patients after prosthodontic rehabilitation. Meanwhile, 28.2% had a decrease in calorie intake and 20.5% showed no difference in their calorie intake. For the association between calorie intake with physical status, 33.3% showed an increase in calorie intake and normal BMI. While 25.6% showed a decrease in calorie intake with normal BMI after rehabilitation, 15.4% had no changes in their calorie intake with normal BMI.

Conclusion: The majority of edentulous patients both before and after prosthodontic rehabilitation had a lower calorie intake than recommended. There was no significant difference between calorie intake and physical status of patients after prosthodontic rehabilitation.

Keywords: Mouth, edentulous; Prosthodontics; Mouth Rehabilitation; Energy Intake; Nutrition; Body mass index.

RESUMEN

Antecedentes: El edentulismo en la población de edad avanzada se ha relacionado con cambios en la ingesta de alimentos y deficiencias nutricionales, ya que tiene un impacto mensurable en la masticación. Proporcionar prótesis dentales ayuda a mejorar la capacidad de masticación y la ingesta dietética de los ancianos, mejorando así su estado físico. **Objetivo:** Los objetivos de este estudio fueron identificar los cambios preliminares en el estado físico de los pacientes edéntulos, identificar los cambios en la ingesta calórica y examinar la asociación entre la ingesta calórica y el estado físico de los individuos edéntulos antes y después de la rehabilitación protésica.

Materiales y métodos: Este estudio transversal involucró a 39 pacientes. Los parámetros utilizados para realizar el estudio para evaluar y comparar la ingesta dietética con el estado físico fueron el examen clínico extraoral e intraoral de los pacientes, los registros antropométrico incluyendo el índice de masa corporal (IMC) y el método de recordatorio dietético de 24 horas. El primer nivel de análisis se realizó utilizando estadísticas descriptivas y el segundo nivel de análisis se realizó utilizando la prueba de chi-cuadrado de Pearson.

Resultado: Hubo un aumento en la ingesta calórica en el 51,3% de los pacientes después de la rehabilitación protésica. Mientras tanto, el 28,2% tuvo una disminución en la ingesta calórica y el 20,5% no mostró diferencias en su ingesta calórica. Para la asociación entre la ingesta calórica y el estado físico, el 33,3% mostró un aumento en la ingesta calórica y el IMC normal. Mientras que el 25,6% mostró una disminución en la ingesta calórica con el IMC normal después de la rehabilitación, el 15,4% no tuvo cambios en su ingesta calórica con el IMC normal.

Conclusión: La mayoría de los pacientes edéntulos tanto antes como después de la rehabilitación protésica tuvieron una ingesta calórica menor a la recomendada. No hubo diferencias significativas entre la ingesta calórica y el estado físico de los pacientes después de la rehabilitación protésica.

Palabras Clave: Boca edéntula; Prostodoncia; Rehabilitación Bucal; Ingestión de energía; Nutrición; Índice de masa corporal.

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INTRODUCTION

According to the data from the UN World Population Prospects, by 2050 one in six people in the world will be over the age 65 (16%), up from one in 11 in 2019 (19%).[1] Whilst the aging population may stand for the progress in public health efforts, it is still accompanied by inevitable consequences of malnutrition and change in physical status of individuals as an aftermath of edentulism. This is owing to the change in dietary habits, poor dentition and quality and quantity of food consumed.[2,3]

According to a study the increase in the percentage of edentulism is directly related to the advancing age with a marked increase from the age of 45 years.[4] The condition of the teeth has a direct relation with changes in food intake and masticatory efficiency. Masticatory ability in turn is affected by presence or absence of teeth, the number of teeth which are functional and use of prosthesis. Edentulism in elderly people has been related to changes in food intake and nutritional deficiency as it has a measurable impact on mastication. Masticatory efficiency is affected by the presence of teeth, the number of functional teeth, and the use of prostheses, which influence the choice of food.[5] They will compensate for the lost teeth and alter dietary intake of the patients positively.[6]

Some studies have shown that providing dentures has a significant impact on the oral health quality of life. Thus, it helps in improving the chewing ability and and alter the dietary routine in elderly population.[7-9] The choice of food quality and quantity are influenced by physical factors such as edentulism, whether total or partial and the use of poorly adapted prostheses. This shows the importance of having a well fitted denture for masticatory purposes.[10]

Intake of fruits, vegetables, fibres and protein substantially decreases in individuals who are edentulous in comparison with fully dentate individuals thereby affecting their physical status significantly. [11] Whether or not prosthodontic rehabilitation causes improvement in dietary intake and physical status among edentulous patients in a short time is ambiguous. As the dietary intakes significantly correlate with physical status. Hence, we aim to investigate the changes in diet and physical status in edentulous individuals before and shortly after provision of prosthesis. A multidimensional parameter has been used to assess the nutritional and physical status including general information of patients, anthropometric records, clinical examination, and 24-hour dietary recall method.

MATERIALS AND METHODS

Our research framework included patients attending Lincoln University College Dental Care for prosthodontic rehabilitation. This study aims to evaluate and compare the dietary intake with physical status of edentulous patients before and after prosthodontic rehabilitation.

A cross sectional design was used in this study. This study received its approval by the Institutional Research Ethics Committee, Faculty of Dentistry, Lincoln University College in Malaysia. Target population for our study was patients attending the Lincoln University College Dental Care for prosthodontic rehabilitation.

The sample size was computed using Rao software, assuming 50 new patients will visit for prosthodontic rehabilitation during the study period. The calculated samples at a significance level of 0.05, a power of 80%, was 39.

Inclusion criteria

- 35 to 75 years old, male and female.
- Partially edentulous and completely edentulous group.
- First time denture wearers and patients who had worn dentures before.

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Exclusion criteria

- Patients with any physical disabilities that will affect oral functions such as facial palsy, parkinsonism.
- Patients with eating disorders.
- Patients with remaining teeth that are periodontally compromised

The study was done using the following parameters which were evaluated three months after prosthodontic rehabilitation.

Survey Instrument

The parameters included were:

- General information of the patients.
- Anthropometric records
- Clinical examination (Intra oral and extra oral)
- 24-hour dietary recall method

The study was conducted as follows: first, patients' information was recorded in a questionnaire consisting of name, gender, age, date of visit, occupation, whether partially or completely edentulous and whether first time denture wearers or had worn dentures before.

Then the anthropometric data to evaluate the physical status of patients was obtained; the following parameters were recorded before and re-assessed three-months after prosthodontic rehabilitation:

- Height of patients in meters
- Weight of patients in kilograms
- Body Mass Index (BMI)

This was followed by Clinical examination which consisted of checking for common physical signs of deficiency due to poor eating patterns caused by the loss of teeth.

Both extraoral and intraoral examinations were carried out. For extra oral examination, the clinical data included general appearance, skin changes, eyes, pale nails and lips. Intraoral examination consists of evaluating the condition of oral mucosa, presence of any lacerations or ulcers and angular cheilitis.

To record the calorie intake 24-hour diet diary recall method was used before and after prosthodontic rehabilitation. Patients had to fill what they ate for breakfast, teatime, lunch, dinner, and supper. Based on the diet diary, the calorie intake of patients before and after prosthodontic rehabilitation was calculated and compared using the MyFitnessPal application.

Physical status of edentulous individuals was measured by calculating their Body Mass Index (BMI). The data was acquired from the height and weight of patients that were recorded before and after three months of prosthodontic rehabilitation.

Statistical Analysis

Research Variables

Data was grouped according to demographic profile, type of edentulousness and period of edentulousness. All data obtained were entered and analyzed with the aid of computers using Microsoft Excel software and SPSS version 25 statistical software.

An extrapolation of data has been done for the calorie intake and physical status of edentulous individuals before and after prosthodontic rehabilitation. The mean, minimum and maxi-mum value for calorie intake, weight and BMI was described using descriptive statistics.

The test of association was done in order to examine the association between calorie intake and physical status of edentulous individuals before and after prosthodontic rehabilitation. The variables accounted for were calorie intake pattern (increase, decrease, no change) and BMI (underweight, normal, overweight, obese).

RESULTS

Demographic Profile of Patients

A total number of 39 patients participated in this study. Table 1 shows demographic variables recorded from the patients. Majority of patients were aged 66 to 75 years old (43.59%), followed by age group of 56 to 65 years old (25.64%), 35 to 45 years old (17.95%) and the least patients come from age group of 46 to 55 years old (12.82%). Out of a total 39 patients, 53.85% are female while 46.15% are male.

Patients participated in this study were classified into 3 groups based on the period of edentulousness, in which 30.77% belonged to group of edentulousness less than 5 years, 15.38% in group of 5 to 10 years and 53.85% of them has been edentulous for more than 10 years. Patients were categorized as partial and complete edentulism types (74.36% and 25.64% respectively). None of the patients had physical disabilities or eating disorders.

Descriptive Statistic of Variables

The Calorie Intake and Physical Status of Edentulous Individuals before and after Prosthodontic Rehabilitation. The calorie intake obtained from 39 patients before they started with prosthodontic rehabilitation was between 570 kcal to 1828 kcal.

The mean weight for patients before starting prosthodontic rehabilitation is 59.84 kg. Since their height was also recorded in the study, their BMI which represent their physical status in this study was calculated using formula

$$\frac{\text{weight (kg)}}{\text{height (m)}^2}$$

The highest BMI before denture treatment was 35.38 and 16.33 represents the lowest BMI from those patients.

Based on Table 2, the data collected after prosthodontic rehabilitation showed slight increase in the mean and maximum value of calorie intake, which was 1143 and 2000 kCal respectively. On the other hand, the minimum calorie intake for patients that had undergone denture treatment showed a slight decrease from 570 to 550 kcal. Changes in weight of these patients can be seen from the mean value that had increased to 60.53 kg while the maximum weight has decreased to 86.20 which is not a significant change. For BMI, only the minimum value had changed, which increased from 16.33 to 16.98.

As reported on Table 3, there was an increase in calorie intake for 51.3% of the patients after wearing dentures. However, 28.8% of patients showed a decrease and 20.5% had no changes at all in their calorie intake. There is a 48.8% of patients who showed an increase in both weight and BMI. Meanwhile, 25.6% showed a decrease and the remaining 25.6% had no change. There was a significant proportion 33.3% (p-value = 0.406) of patients with an increase in calorie intake who showed normal BMI after denture treatment, (Table 4).

In addition, 25.6% had a decrease in calorie intake but normal BMI after prosthodontic rehabilitation, while 15.4% remained in this category despite no changes in their calorie intake. For patients that had an overweight body mass index, 12.8% had an increase in calorie intake, while 2.6% of patients had no change in calorie intake.

Although a total of 51.3% of patients showed an increase in calorie intake with various BMI readings, there was no significant association between calorie intake and body mass index (BMI) with p-value = 0.406.

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Table 1. Demographic Profile of Patients (n = 39).

Demographic variables		n=39	%
Age groups	35-45	7	17.95
	46-55	5	12.82
	56-65	10	25.64
	66-75	17	43.59
Gender	Male	18	46.15
	Female	21	53.85
Period of edentulousness	< 5 years	12	30.77
	5-10 years	6	15.38
	> 10 years	21	53.84
Types of Edentulousness	Partial	29	74.36
	Complete	10	25.64
Had denture before	Yes	25	64.10
	No	14	35.90
Physical disabilities	Yes	0	0.00
	No	39	100
Eating disorder	Yes	0	0.00
	No	39	100

Table 2. Calorie intake and physical status before and after prosthodontics rehabilitation.

Age groups	Calorie Intake(kcal)		Weight (kg)		Body mass index	
	Before	After	Before	After	Before	After
Mean	1131	1143	59.84	60.53	22.82	22.82
Minimum	570	550	48.00	48.00	16.33	16.98
Maximum	1828	2000	86.90	86.20	35.38	35.38

Table 3. Calorie intake and physical status before and after prosthodontics rehabilitation.

Calorie Intake	Body mass index								p-value
	Underweight		Normal		Overweight		Obese		
	n	%	n	%	n	%	n	%	
Increase	1	2.6	13	33.3	5	12.8	1	2.6	0.406
Decrease	0	0	10	25.6	1	2.6	0	0	
No change	1	2.6	6	15.4	0	0	1	2.6	

DISCUSSION

Our first objective in this study was to identify the calorie intake of edentulous individuals before and after prosthodontic rehabilitation. The mean calorie intake obtained by 24-hour dietary recall method was 1131 kcal, before prosthodontic rehabilitation. The calorie intake was reassessed 3-months post prosthodontic rehabilitation, when the mean for calorie intake was 1143 kcal.

The calorie intake before prosthodontic rehabilitation was between 570 kcal and 1828 kcal. After dentures were issued, the minimum and maximum calorie intake were 550 kcal and 2000 kcal respectively.

The result showed that the amount of calorie intake of edentulous individuals before and after prosthodontic rehabilitation in this study were still lower than the recommended daily calorie intake

by the Ministry of Health of Malaysia. For adults, the recommended calorie intake is between 1500 kcal-2300 kcal (Malaysian Dietary Guideline). The result was comparable to the study conducted by Pierre *et al.,*[11] which showed that edentulous individuals had calorie intake lower than the recommended dietary intake. Besides, our results are in agreement with the study by Elizabeth et al which found that calorie-adjusted nutrient intakes decreased with progressively impaired dentition status.[10] Physical status of edentulous individuals was measured by calculating their Body Mass Index (BMI). The data was acquired from the height and weight of patients that were recorded be-fore and after three months of prosthodontic rehabilitation. According to WHO, BMI can be categorized into six categories, Table 4.

Our second objective of this research was to identify the changes in physical status among edentulous patients before and after prosthodontic rehabilitation. We compared the calorie intake and BMI of edentulous individuals before and after three months of prosthodontic rehabilitation to note whether there was any increase or decrease. After three months of wearing dentures, 51.3% of patients showed an increase in their calorie intake similarly to what has been reported earlier, who carried out a longitudinal study that examined subjects before and after denture therapy and reported that MNA scores improved after denture therapy in subjects with partial dentures.[12]

Subjects with complete edentulism also showed improved MNA scores after denture therapy. Besides, Prakash *et al.,*[13] also concluded that prosthetic rehabilitation of edentulous patients with complete dentures, along with dietary counselling had improved the nutritional status of these patients. The mean weight of patients in this study before prosthodontic rehabilitation was 59.84 kg. Average BMI before prosthodontic rehabilitation was 22.82 which indicates normal weight. Majority of the patients also had normal BMI before and after prosthodontic rehabilitation. The result was supported by a previous study that found that body composition indicators were generally within normal range, and no statistically significant difference (p>0.05) was found between individuals with conventional dentures and implant supported overdenture.[6] The mean weight of patients in this study before prosthodontic rehabilitation was 59.84 kg. Average BMI before prosthodontic rehabilitation was 22.82 which indicates normal weight, Table 2). The majority of the patients also had normal BMI before and after prosthodontic rehabilitation The result was supported by a previous study conducted by Katia *et al.*[2]

The authors of the study found out that body composition indicators were generally within normal range, and no statistically significant difference (p>0.05) was found between individuals with conventional dentures and implant supported overdenture.[6] Patients were able to chew better when wearing dentures and this led to an increase in daily nutritional intake. Good quality denture groups had significantly bet-ter masticatory performance than the medium and poor-quality denture groups as discussed by Rosemary *et al.*[14] For physical status of edentulous individuals, 48.8% of patients had an increase in both the weight and BMI. Meanwhile, 25.6% had decre-ased and the remaining 25.6% had no change in their weight and BMI. There were no significant changes in body weight and BMI of patients in our study. This was in contrast with previous research conducted by Kanehisa *et al.*[15]
They found out that six months after prosthodontic treatment, body weight changes were significantly different in subjects regardless of denture type used.

This may be due to the short follow up time for assessing weight and BMI of patients, which was three months after prosthodontic rehabilitation, while the previous study assessed changes in body weight six months after prosthodontic rehabilitation. Our results were also not aligned with the

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study carried out by Paturu *et al.,*[16] which found out that there was a significant change in body weight of individuals with complete edentulism after two months of denture delivery. The differences in the result obtained was possibly because the study conducted had emphasized that every complete denture wearer needs to be periodically counseled by a registered dietician and dentist for checkup to avoid malnutrition and disease. Meanwhile in our study, there was no specific professional counselling on tailored nutrition intake for the patients.

Thus, proper dietary intake guidance and counselling are of paramount importance for edentulous individuals. In the absence of tailored dietary advice, apparently successful prosthetic rehabilitation does not necessarily result in a satisfactory diet.[17] In our third objective, we wanted to examine the association between calorie intake and physical status of edentulous individuals before and after prosthodontic rehabilitation. A percentage of 33.3% of patients had an increase in calorie intake and normal BMI after prosthodontic rehabilitation. However, 25.6% had a decrease in calorie intake and 15.4% had no changes in their calorie intake. Both of these groups also had normal BMI.

Based on these findings, we found no association between calorie intake and the physical status of edentulous individuals before and after three-months prosthodontic rehabilitation. A previous study com-pared the BMI of patients that used conventional denture and implant supported denture after one year and reported all of the subjects had normal BMIs and there was no significant difference in BMI after one year of denture wearing.[5] Inconclusive evidence was also recorded in studies investigating the association between dental status and body mass by Kassioni.
Foods such as stringy meats, vegetables and fruits such as carrots and apples are hard to chew, but they are high in nutrients needed by the elderly. High in fat and low in fiber diets by edentulous individuals could be due to reduced mastication ability in those wearing complete dentures Allen *et al.,*[19] this may lead to involuntary weight gain. In contrast, a prospective study carried out using data from the Survey on Health, Well-being and Aging in Brazil (SABE), had shown that the risk of weight and waist circumference loss was higher among edentulous community of older adults than among dentate ones, Andrade *et al.*[20]
The National Diet and Nutrition Survey (NDNS) in independent elderly aged 65 years and older in the United Kingdom revealed that having functioning natural dentition of more than 20 teeth increased the possibility of having a normal BMI, while ha-ving few natural teeth or being edentulous was associated with a greater risk of being underweight or being obese Sheiham *et al.*[21] These discrepancies may be due to cultural or methodological variation in each study.

A study with a longer period of time and a more sensitive methodology is needed to get more accurate results. Patients should be reviewed after 6 months and 1-year post prosthodontic rehabilitation to get a proper assessment of the dietary intake and physical status. Moreover, dietary progress should be discussed during each review visit. Nutrition care should be an integral part of the overall prosthodontic treatment as discussed by Rathee *et al.*[22]
Other than that, this study has identified that in most patients there were no significant changes in BMI post prosthodontic rehabilitation. This could be because the patients were evaluated for changes in physical status after a three month period only. The changes in physical status in some patients take longer to manifest.

The findings showed that the mean value of calorie intake both before and after prosthodontic rehabilitation of the denture wearers were under that recommended by the WHO; it is important for dentists to educate patients about a healthy diet

before and after oral rehabilitation with a denture. It is crucial for clinical dental students to get exposure and obtain knowledge in educating patients about their daily calorie intake as dentists play an important role in detecting and preventing malnutrition in the elderly population.

This is especially important in this study as the majority of the patients were aged between 66 to 75 years old. The data acquired from this study has policy implications and can be used to identify patients that need dietary counselling. Since most of the patients were not ingesting enough calories per day, they all are indicated for dietary counselling sessions. With this, a holistic treatment approach can be achieved that can benefit the patients significantly. Furthermore the incorporation of the need to take note of a patient's anthropometric records such as height and weight is warranted, so that a general idea of the patient's physical health can be gained and measures can be taken to elaborate a comprehensive customized treatment plan with a focus on the patient's diet.

As the study only recruited 39 subjects, which is a small sample size, we plan to continue this research with a larger sample size, which could result in higher significance and more accurate results. Other than that, this study is recommended to be extended to all the dental faculties of the thirteen universities in Malaysia so that the overall results can be representative of the whole Malaysian population. We also propose a refinement in the methodology to get more accurate data on nutritional status and physical status of patients before and after prosthodontic rehabilitation. Methods such as Mini Nutritional Assessment (MNA), and Geriatric Oral Health Assessment Index (GOHAI) can be used.

CONCLUSION

This study helped in identifying the nutritional status among edentulous individuals that visited the LUC Dental Clinic for prosthodontic rehabilitation. Their overall physical status was obtained through Body Mass Index (BMI) and clinical examination.

This provided the general health status of edentulous patients that came to seek treatment and allowed for the assessment of their calorie intake. Since most of the edentulous patients are elderly, they are at a higher risk of malnutrition as mentioned by Mafauzy.[23] Thus, this study enabled us to identify patients who are at risk of malnutrition. There are not many studies conducted to find out the association between nutritional intake and physical status of denture wearers in Malaysia.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

ETHICS APPROVAL

This study was approved by the Institutional Research Ethics Committee, Faculty of Dentistry, Lincoln University College in Malaysia.

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AUTHORS' CONTRIBUTIONS

Ayesha Shaziya Jubapu: conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; supervision; validation; visualization; writing, original draft; writing – review and editing.

Erum Zain: Formal Analysis, Investigation, Validation.

Shahistha Parveen: Validation, Visualization.

Nancy Farghal: Conceptualization, Vali-dation, Writing-Review and Editing.

Nur Atikah: Investigation, Writing- Original Draft.

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