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RESEARCH ARTICLE

PREVALENCE OF SIGNS OF TEMPOROMANDIBULAR DISORDERS IN HEALTHY ASYMPTOMATIC COMPLETELY EDENTULOUS INDIVIDUALS AND THE EFFECT OF DENTURE ON TEMPOROMANDIBULAR DISORDERS

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Abstract



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Background and objectives: Temporomandibular disorders (TMD) are a multifactorial issue characterized by signs and symptoms that eventually restrict or may impede an edentulous patient's physiological activity. The current study aimed to ascertain the prevalence of TMD among edentulous individuals, and their association with risk factors such as gender, age, educational level, habitual Khat chewing, economical status, duration of edentulousness, the age, and vertical dimension of occlusion (OVD) of the present dentures.

Materials and Methods: This study involved a thorough evaluation of 400 edentulous Yemeni patients who were undergoing prosthetic treatment at the Faculty of Dentistry Sana'a University and the University of Sciences and Technology, 114 with denture and 286 without denture. This evaluation of TMD signs and symptoms was performed using the Helkimo index. The outcomes were analyzed by correlating the research variables and the prevalence of signs and symptoms of TMD using chi-squared tests.

Results: The study's findings showed that signs and symptoms of TMD were 82.5% and 55.3% among complete denture wearers and 80.4% and 49.0% among non-denture wearers, respectively. Furthermore, the most frequent sign and symptom was the joint sounds. This study revealed a statistically significant association between the prevalence of TMD symptoms and patient gender and between TMD signs and symptoms and OVD in denture wearers.

Conclusion: The current study supports the need to evaluate the potential impact of TMD on completely edentulous individuals and to take caution while receiving dental therapy and prosthetic rehabilitation.

Keywords: Denture wearers, prevalence, signs, symptoms, Temporomandibular disorders, TMD, Yemen.

INTRODUCTION

The signs and symptoms of Temporomandibular disorders (TMD) can influence a patient's physical function and emotional well-being as well as their health-related quality of life. Because of the large number of persons affected, TMD is becoming a major health concern¹. TMD refers to a set of musculoskeletal and neuromuscular diseases that affect the

Temporomandibular joint (TMJ), the masticatory muscles, and surrounding tissues². Numerous risks factors, including teeth loss, aging, gender, para-functional habits, a defective prosthesis (incorrect centric relation and vertical dimension), psychological factors, and traumatic injury to TMJ, and even, can affect the joint function in completely edentulous individuals^{3,4}. TMD can cause several different signs and symptoms including headache, pain around the

joint, pain that worsen with mouth opening, muscles tenderness, difficulties in mouth opening, and joint sounds (crepitus and clicking)⁵. In developing countries, completely losing teeth in the elderly is common⁶. Many edentulous patients who do not report experiencing TMJ problems may exhibit one or more signs upon random examination⁴. The relationship between tooth loss and TMD in most literature surveys is still in for discussion. However, numerous studies have revealed a direct association between them⁷. There are many studies in the literature surveys showed a frequent prevalence of TMD in general populations⁸, and in the edentulous population^{3,9-11}. Edentulous individuals do not exhibit symptoms to the same degree as those who have natural dentition; however, few studies revealed that TMD symptoms were more common in denture wearers than in the population with natural teeth¹². According to Choy and Smith, people with dentition exhibit more TMD symptoms than individuals with completely missing teeth¹³.

As the number of complete dentures (CD) wearers increases, a dental professional must be aware of the effect of denture status on the anatomical and functional integration of the TMJ. The denture quality and denture-wearing habits correlated to the TMD's signs and symptoms¹⁴. Additionally, it asserted that the most common causes of TMD were improper vertical dimension (VD) and centric relation (CR)¹⁴. There have been an increasing number of publications in recent years concerning the need to examine individuals with edentulism who require prosthodontic rehabilitation and to look for the presence of TMD¹⁵.

This study aims to assess the prevalence of signs and symptoms of TMD in a sample of completely edentulous Yemeni patients who visit the Prosthodontics Department, Faculty of Dentistry, Sana'a University and University of Sciences and Technology, Sana'a City.

MATERIALS AND METHODS

Sample Size: The equation shown below was used to calculate the sample size:

$$n = z^2 \cdot P(1-p)/e^2$$

Where; n=desired sample size, p=estimated proportion of the outcome in the target population.

Unfortunately, no previous study was conducted to evaluate the TMD among Yemeni edentulous individuals. So, the sample size was estimated by using results of a previous study in Saudi Arabia³ in which the frequency of TMD in completely edentulous individual was 60.5%.

e=maximum size of standard error. It will be set as 5%
z=number of standard deviations=1.96 for 95% confidence level (CI).

$$n = (1.96)^2 \times (0.605) \times (1 - 0.605) / (0.05)^2 = 367 \approx 400$$

Sampling Method: A sample of 400 completely edentulous Yemeni patients (314 males and 86 females) Aged between 30 and 90 years presented to the dental clinic for the Prosthodontic Department at the Faculty of Dentistry, Sana'a University, and the Faculty of Dentistry, University of Sciences and

Technology were evaluated using the fish bowl sampling method.

Inclusion Criteria: All Completely edentulous Yemeni patients requiring prosthetic rehabilitation. The sample participants aged between 30 and 90 years.

Exclusion Criteria: Patients with a single CD with opposing natural teeth or partially edentulous arches. Patients who had been already diagnosed and treated as symptomatic TMD patients. The completely edentulous patients should have no history of any symptoms of TMD before teeth loss. Patients with a history of trauma or degenerative arthritis or surgical treatment in the craniofacial region.

Clinical examination, Data Collection and Analysis:

An interview and clinical examination were used to obtain the data through the Helkimo Anamnestic index (Ai) and Clinical Dysfunction index (Di). The oral interview was utilized instead of a questionnaire because it could confirm the identity of interviewed patients and determine whether the questions were understood. Tenderness, clicking, crepitus of the TMJ, musculatures, the maximum mouth opening, and pathway of mandibular opening were determined. The examiner underwent adequate training and calibration exercise before collecting data to aid in proper diagnosis, thus to avoid selection bias. Weekly training session over a 6-month period was undertaken by the examiner. The training comprised oral presentation, discussion, and clinical evaluation of patients under the supervision and guidance of experienced staff of oral diagnosis.

Statistical analysis: The results obtained were analyzed using Statistical Package for Social Sciences. Software (SPSS version 20.0, SPSS IBM, New York, NY). Statistical analyses were performed using Chi-square test. Statistical significance was set at $p < 0.05$.

Ethical Consideration: Ethical approval for this study, No: 37 dated January 23, 2021 were obtained from the Medical Ethics and Research Committee of the Faculty of Dentistry, Sana'a University. All procedures were according to the ethical guidelines of the review committee.

RESULTS

The study included 400 patients, 78.5% males and 21.5% females, 114 denture wearers and 286 non-denture wearers. Considering the incidence of TMJ symptoms among denture-non-wearers (NDW) and denture-wearing (DW) patients; TMJ sounds were the most common symptom in NDW patients (39.9%) and in DW patients (43.9%) with an associated odds ratio in DW equal to 3.1, $p < 0.001$. The second most frequent symptom was pain in the Temporomandibular joint or masticatory muscles which amounted to 12.9% in NDW versus 9.6% in DW but the difference between the two group was not significant ($p = 0.36$). The second most frequent symptom was pain on movement, 9.1% in NDW versus 7.9% in DW, but the difference between the two groups was not significant ($p = 0.7$). Other symptoms were less frequent as stiffness (0.7% in NDW vs. 1.8% in DW), fatigue

(3.8% NDW vs. 5.3% in DW), and difficulty opening the mouth (1.4% NDW vs. 2.6% in DW), locking (2.1% in DW vs. 5.3% in DW) and dislocation (luxation) (0.7% NDW vs. 0.0% in DW) (Table 2). Considering the association of clinical signs of TMD in dentures patients and patients without dentures according to the Clinical Dysfunction Index (Di), open range of motion was impaired in 5.6% of NDW patients versus 11.4% in DW with OR equal to 2.1, $p=0.04$ in DW patients; TMJ dysfunction occurred in 75.9% of NDW versus 78.1% in DW patients. Myalgia (muscle pain tenderness) occurred in 18.9% of NDW versus 13.2% in DW patients, TMJ pain tenderness occurred in 6.6% of NDW VS 3.5% in DW patients, pain on movement of the mandible occurred in 9.1% of NDW versus 4% in DW patients (Table 3). In DW patients 55.3% showed Ai I and Ai II mild and severe Temporomandibular disorder (Table 4).

Table 1: Characteristics of the study sample, (n=400).

Characteristics		Frequency (%)
Gender	Males	314 (78.5)
	Females	86 (21.5)
Education level	No education	287 (71.8)
	Primary school	52 (13)
	Secondary school	28 (7.0)
	University	33 (8.2)
Socioeconomic level	Low	321 (80.2)
	Middle	76 (19)
	High	3 (0.8)
Khat chewing	Yes	283 (70.8)
	No	117 (29.2)
Denture	Yes	114 (28.5)
	No	286 (71.5)

Table 2: Association of symptoms of TMD in study sample according to Ai in denture and non-denture patients.

Symptom	Non-denture wearers n (%)	Denture wearers n (%)	OR	p
Stiffness	2 (0.7)	2 (1.8)	2.5	0.33
Fatigue	11 (3.8)	6 (5.3)	1.3	0.5
Difficult mouth opening	4 (1.4)	3 (2.6)	1.9	0.39
Locking	6 (2.1)	6 (5.3)	2.6	0.09
TMJ sounds	114 (39.9)	50 (43.9)	3.1	<0.001
Pain in the TMJ or masticatory muscles	37 (12.9)	11 (9.6)	0.7	0.36
Pain on movement	26 (9.1)	9 (7.9)	0.87	0.7
Luxation	2 (0.7)	0 (0)	un	0.3

Un=undefined, The Helkimo Anamnestic index (Ai)

Table 3: Association of clinical signs of TMD in denture and non-denture patients according to clinical Dysfunction index (Di).

		Non-denture wearer N (%)	Denture wearer N (%)	OR	p
Range of opening movement	Normal range	270 (94.4)	101 (88.6)	0.46	0.04
	Impaired	16 (5.6)	13 (11.4)	2.1	0.04
TMJ function	Normal TMJ function	69 (24.1)	25 (21.9)	0.89	0.64
	TMJ dysfunction	217 (75.9)	89 (78.1)	1.1	0.64
Muscle pain	No tenderness	232 (81.1)	99 (86.8)	1.5	0.17
	Tenderness	54 (18.9)	15 (13.2)	0.51	0.24
TMJ pain	No tenderness	267 (93.4)	110 (96.5)	2.7	0.05
	Tenderness	19 (6.6)	4 (3.5)	0.36	0.05
Pain on movement of the mandible	No pain	260 (90.9)	110 (96.5)	0.7	0.29
	Pain on movements	26 (9.1)	4 (4)	0.36	0.05

Clinical Dysfunction index (Di).

In DW patients 82.5% showed Di I, Di II, Di III mild to severe Temporomandibular dysfunction according to clinical dysfunction index (Table 5). Total 47.3% of male patients in NDW showed Ai I and Ai II (mild to severe Temporomandibular disorder), while female patients showed a slightly higher rate (54.5%). 50% of the male patients on DW showed Ai I and Ai II (mild and severe Temporomandibular disorder), while the female patients showed a very high rate of 80% with an associated odds ratio of 4 times compared to male patients ($p=0.01$) (Table 6). In male patients from NDW 79.5% of patients showed Di I, Di II and Di III (mild to severe temporomandibular dysfunction) while

female patients had a higher incidence of Di I, Di II and Di III (83.3%) with an odds ratio concomitant equal to 1.2 but the outcome was not significant ($p=0.49$) (Table 7). In male DW patients 80.9% of patients showed Di I, Di II and Di III while female patients had a higher incidence of Di I, Di II and Di III (90%) with an associated odds ratio equal to 2.1 for females but the result was not statistically significant ($p=0.32$) (Table 7). In NDW age group patients the temporomandibular disorders Ai I and Ai II ranged from 47.7% to 54.5% and these differences between age groups were not statistically significant (Table 8).

Table 4: Distribution of TMD symptoms according to Ai among denture wearer patients.

		Denture wearers	Non-Denture wearers
		N (%)	N (%)
Anamnesis Index	Ai 0	51 (44.7)	146 (51.0)
	Ai I, Ai II	63 (55.3)	140 (49)
	Total	114 (100)	286 (100)

Ai I+ TMJ sounds, Fatigue in the jaws, Stiffness in the jaws on awakening or on movement of the lower jaw.

Ai II=Difficulties in opening mouth wide, Locking, Luxations, Pain on movement of the mandible Pain in the region of the TMJ or masticatory muscles.

Table 5: Distribution of TMD clinical signs according to Di in denture wearer patients.

		Denture wearing	
		Denture wearers	Non-Denture wearers
		N (%)	N (%)
Clinical Dysfunction Index	Di 0	20 (17.5)	56 (19.6)
	Di I, Di II, Di III	94 (82.5)	230 (80.4)
	Total	114 (100)	286 (100)

Clinical dysfunction index based on clinical examination (DI). Di 0= Clinically symptom-free, Di I=Mild dysfunction, Di II=Moderate dysfunction, Di III=Severe dysfunction.

Whereas in patients of the DW age group temporomandibular disorder Ai I and Ai II were very high in the age group 46-60 years the rate was 60% with the associated *odds ratio* equal to 3.1 times and $p=0.003$ (Table 8). In the age groups of NDW patients, the ranges for Di I, Di II, and Di III ranged from 79.1%

to 85.7% with outcome differences being non-significant as p -values greater than 0.05 (Table 9). In DW 76-90 years a higher rate of Di I, Di II, Di III (90.9%) was recorded with an associated odds ratio of 2.3 for this age group but the result was not statistically significant because p was 0.43 (Table 9).

Table 6: Association between TMD symptoms (based on Ai) and gender of the patients.

		Helkimo Anamnestic index		OR	p
		Ai 0	Ai I, Ai II		
		N (%)	N (%)		
Non-denture wearer	Males	116 (52.7)	104 (47.3)	0.7	0.29
	Females	30 (45.5)	36 (54.5)	1.3	0.29
Denture wearer	Males	47 (50.0)	47 (50.0)	0.2	0.01
	Females	4 (20.0)	16 (80.0)	4	0.01

Ai I+TMJ sounds, Fatigue in the jaws, Stiffness in the jaws on awakening or on movement of the lower jaw.

Ai II=Difficulties in opening mouth wide, Locking, Luxations, Pain on movement of the mandible Pain in the region of the TMJ or masticatory muscles

Table 7: Association between TMD signs (based on Di) and gender of the patients.

		Clinical Dysfunction Index		OR	p
		Di 0	Di I, Di II, Di III		
		N (%)	N (%)		
Non-denture wearer	Males	45 (20.5)	175 (79.5)	0.77	0.49
	Females	11 (16.7)	55 (83.3)	1.2	0.49
Denture wearer	Males	18 (19.1)	76 (80.9)	0.48	0.34
	Females	2 (10.0)	18 (90.0)	2.1	0.32

Clinical dysfunction index based on clinical examination (DI). Di 0=Clinically symptom-free, Di I=Mild dysfunction, Di II=Moderate dysfunction, Di III=Severe dysfunction.

DISCUSSION

Based on the findings of Ai in the present study, the prevalence of TMD symptoms in denture wearers was 55.3% (Table 4) and in non-denture wearers was 49.0% (Table 4). Moreover, based on the findings of Di, the prevalence of TMD signs was 82.5% of denture wearers, and 80.4% of non-denture wearers (Table 5). TMD prevalence was high in edentulous people in this study because they frequently have para-functional habits, unstable prosthesis, impaired masticatory function¹⁶, and increasing in emotional stress brought on by a loss of natural teeth is considered a contributing factor in the development of TMD¹⁷. The Yemeni population is not interested in seeking

treatment unless symptoms are present, which may explain the variations between the prevalence of signs and symptoms in both denture wearers and non-denture wearers. It was found that these results agreed with the results from previous studies of different populations^{3,9} which reported that more than 50% of edentulous individuals had TMD related problems. When compared with the findings obtained by Al-Shumailan and Almonaser¹⁸ (14.3%), Shi and Wang¹⁹ (43.2%), Divaris *et al.*,²⁰ (11%) and Jandial *et al.*,⁹ (14.3%), the findings did not agree with the current study result. These differences in findings were explained by Carlsson, who found that older people exhibited a higher incidence of osteoarthritis. Individuals, who suffer from osteoarthritis, have been shown in the

literature to have a high prevalence of TMD²¹. Along with aging and tooth loss, psychological and emotional variables also play a role^{18,22}. Also, variations in TMD prevalence between studies may be brought about by using distinct study methods, various populations, and variable sample sizes. According to the present study, the most prevalent sign and symptom in denture wearers (43.9%) and non-denture wearers (39.9%) is

TMJ sounds (Table 2). This result agreed with the findings from previous studies^{19,23}. Shi and Wang¹⁹ reported that the prevalence of joint sounds among 352 edentulous subjects was 34.1% which was the most predominant sign. Joint clicking (61.0%) was also more prevalent than TMJ pain (50.0%) in a study by Zaki et al.,¹⁰.

Table 8: Association between TMD symptoms (based on Ai) and age of the patients.

	Age	Helkimo anamnestic index		OR	p
		Ai 0	Ai I, Ai II		
		N (%)	N (%)		
Non-denture wearer	30-45 years	10 (45.5)	12 (54.5)	1.2	0.92
	46-60 years	68 (50.7)	66 (49.3)	1.0	0.92
	61-75 years	57 (52.3)	52 (47.7)	0.92	0.74
	76-90 years	11 (52.4)	10 (47.6)	0.9	0.89
Denture wearer	30-45 years	5 (50.0)	5 (50.0)	1.3	0.72
	46-60 years	20 (40.0)	30 (60.0)	3.1	0.003
	61-75 years	21 (48.8)	22 (51.2)	1.5	0.28
	76-90 years	5 (45.5)	6 (54.5)	1.5	0.49

Ai I+ TMJ sounds, Fatigue in the jaws, Stiffness in the jaws on awakening or on movement of the lower jaw.

Ai II= Difficulties in opening mouth wide, Locking, Luxations, Pain on movement of the mandible Pain in the region of the TMJ or masticatory muscles.

This study differed from several previous ones^{3,9,11} in which joint noises were not the most frequent finding in patients with complete dentures. In addition, the anomalous condylar surface is linked to joint sounds in completely edentulous patients²⁴ due to its association with degenerative disease of the articular surfaces, which is increased by aging. Anxiety in dentulous and edentulous is a common element that should be considered. Jaw clenching, which results in overuse and exhaustion of the masticatory muscles, can be

brought on by tension and stressful conditions. These situations are likely the cause of TMD in denture wearers. In 47.3% of male patients in NDW (Non-denture wearers) showed Ai I and Ai II, while female patients showed a slightly higher rate (54.5%); also 50% of the male patients on DW (denture wearers) showed Ai I and Ai II, while the female patients showed a very high rate of 80% with an associated odds ratio of 4 times compared to male patients ($p=0.01$) (Table 6).

Table 9: Association between TMD signs (based on Di) and age the patients.

	Age	Clinical Dysfunction Index		OR	p
		Di0	Di I, Di II, Di III		
		N (%)	N (%)		
Non-denture wearer	30-45 years	4 (18.2)	18 (81.8)	1.1	0.86
	46-60 years	28 (20.9)	106 (79.1)	0.8	0.59
	61-75 years	21 (19.3)	88 (80.7)	1.29	0.55
	76-90 years	3 (14.3)	18 (85.7)	1.3	0.16
Denture wearer	30-45 years	2 (20.0)	8 (80.0)	0.83	0.83
	46-60 years	10 (20.0)	40 (80.0)	0.74	0.54
	61-75 years	7 (16.3)	36 (83.7)	1.2	0.78
	76-90 years	1(9.1)	10 (90.9)	2.3	0.43

Clinical dysfunction index based on clinical examination (DI). Di 0= Clinically symptom-free, Di I=Mild dysfunction, Di II=Moderate dysfunction, Di III=Severe dysfunction.

Obtained demographic data findings showed a difference in gender (314 males versus 36 females), and this difference was attributed to the general habits of females who tend to pay more attention to their health²⁰. Also, in male patients from NDW 79.5% of patients showed Di I, Di II and Di III (mild to severe temporomandibular dysfunction) while female patients had a higher incidence of Di I, Di II and Di III (83.3%) with an odds ratio concomitant equal to 1.2 but the outcome was not significant ($p=0.49$) (Table 7). In male DW patients 80.9% of patients showed Di I, Di II and Di III while female patients had a higher incidence of Di I, Di II and Di III (90%) with an associated odds ratio equal to 2.1 for females but the result was not

statistically significant ($p=0.32$) (Table 7). Gender had a significant effect on signs and symptoms of TMD among non-denture wearers and symptoms of denture wearers. These results were in agreement with several previous studies^{10,19,23} however, they were not in agreement with other previous studies by Dallanora et al., AlZ area, and Samara and Singh^{3,11,25} in which equal rate in both sexes were occurred. TMD are most likely to develop in patients who are depressed²⁶. To understand the epidemiological behavior of TMD, it is essential to examine the prevalence of TMD over a range of age groups. In the current study, in NDW age group patients the temporomandibular disorders Ai I and Ai II ranged from 47.7% to 54.5% and these

differences between age groups were not statistically significant (Table 8). Whereas in patients of the DW age group temporomandibular disorder Ai I and Ai II were very high in the age group 46-60 years the rate was 60% with the associated odds ratio equal to 3.1 times and $p=0.003$ (Table 8). The results are consistent with the findings of previous studies showing TMD risk rise with age^{18,22,27}. Meanwhile, the results of the current study showed that the prevalence of TMD symptoms decreases in non-denture wearers with increased age which agreed with Zakir *et al.*,¹⁰ study that found a high prevalence of TMJ problems in the age group 41-50 years (29.0%) whereas least prevalent (3.0%) in the age group 81-90 years¹⁰. Regarding the association between age and the signs of TMD, the current investigation did not find any conclusive evidence of such an association. A similar finding was reported by Samra and Singh¹¹.

Limitations of the study

There has been an increasing number of publications in recent years in Yemen regarding dental problems as well as the study of oral microorganisms and their sensitivity towards antibiotics, etc²⁸⁻⁴⁵ but the need to screen individuals with irregular teeth who need prosthodontic rehabilitation and to look for the presence of TMJ disorders has been limited or non-existent. So, further investigations with calculation of sample size and using diagnostic research criteria to assess prevalence and severity of TMD among Yemeni population are needed before a final conclusion can be drawn.

CONCLUSIONS

TMD serve as a noteworthy reason for non-odontogenic pain in the orofacial location and are thought to be a subclass of musculoskeletal dysfunctions including tissue damage secondary generation of disproportionate force or pressure. The present study showed a high prevalence of signs of TMD in healthy asymptomatic completely edentulous individuals. The gender and age differences were statistically significant. The most common finding was limitation on mouth opening and the common finding was joint noises (crepitus and clicking). The current study supports the need to evaluate the potential impact of TMD on completely edentulous individuals and to take caution while receiving dental therapy and prosthetic rehabilitation.

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CONFLICT OF INTEREST

No conflict of interest associated with this work.

AUTHOR'S CONTRIBUTIONS

This research is part of a master's degree in the Prosthodontics Department, Faculty of Dentistry,

Sana'a University, Yemen. **Al-Khorasani MAM:** writing original draft, methodology. **Al-Kebsi AM:** investigation, formal analysis, conceptualization. **Al-Hammadi S:** editing, methodology. **Al-hamzi AHY:** formal analysis, conceptualization. **Al-Sanabani NF:** writing, review. **AL-Haddad KA:** editing, methodology. **Al-Najhi MMA:** methodology, investigation. **Al-Kibsi TAM:** formal analysis. Final manuscript was read and approved by all authors.

DATA AVAILABILITY

Data will be made available on reasonable request.

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