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Investigation of Factors Affecting Temporomandibular Joint Disorders: Sampling of The Faculty of Dentistry of Kırıkkale University

Temporomandibular Eklem Rahatsızlıklarına Etki Eden Faktörlerin Araştırılması: Kırıkkale Üniversitesi Diş Hekimliği Fakültesi Öğrencileri Örneklemi

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Abstract: Objective: In this study, factors affecting temporomandibular joint disorders (TMDs) among Kırıkkale University Faculty of Dentistry students were investigated by confirmatory factor analysis. Data were obtained using the Fonseca Anamnestic Index (FAI). Methods: The FAI scale and its factor structure were first analysed using the scree plot, Kaiser-Meyer-Olkin statistics, Bartlett's Test of Sphericity, Cronbach's Alpha and Guttman's Lamda6 coefficients. Subsequently, confirmatory factor analysis was conducted to verify the proposed factor structure. Results: All scale items appear to have a significant effect on FAI ($p<0.01$). The item in the "F1-Function-comorbidity" sub-factor of the FAI scale that has the greatest impact is Item I1, which is related to difficulty in opening the mouth wide. The variance explained by the latent factor is 77.9%. The variable with the second highest impact on this F1 factor was Item I6, which was about whether earache or jaw pain was present. The variance explained by the latent factor is 65.9%. In addition, the variable with the highest impact in the "F2-Occlusion-parafunction-psychology " sub-factor is Item I8, which is about the habit of clenching or grinding teeth. The variance explained by the latent factor is 45.6%. Conclusions: According to the results obtained, the reliability and consistency of the FAI scale was ensured. Considering all the fit criteria, it turned out that the proposed model was valid for the sample. The results of the confirmatory factor analysis indicated that the data provided a good fit to the proposed model, as evidenced by the RMSEA, SRMR, GFI, AGFI, CFI, NFI, NNFI, TLI, CR, and AVE indices. It is thought that the application of different physiotherapy techniques can reduce the problems caused by TMD in patients, make it easier to open the mouth wide, and be effective in controlling teeth clenching and jaw pain.
Keywords: Confirmatory factor analysis, Dentistry students, Exploratory factor analysis, Fonseca anamnestic index (FAI), Temporomandibular joint disorders.

Öz: Amaç: Bu çalışmada, Kırıkkale Üniversitesi Diş Hekimliği Fakültesi öğrencileri arasında temporomandibular eklem rahatsızlıklarına (TMDs) etki eden faktörler doğrulayıcı faktör analizi ile araştırılmıştır. Fonseca Anamnestik (FAI) anketi kullanılarak veriler elde edilmiştir. Gereç ve Yöntem: FAI ölçeği ve faktör yapısı öncelikle yamaç grafiği, Kaiser-Meyer-Olkin istatistikleri, Bartlett Küresellik Testi, Cronbach's Alpha ve Guttman's Lamda6 katsayıları kullanılarak analiz edildi. Daha sonra önerilen faktör yapısını doğrulamak için doğrulayıcı faktör analizi yapılmıştır. Bulgular: Tüm ölçek maddelerin FAI üzerinde anlamlı bir etkiye sahip olduğu görülmektedir ($p<0,01$). FAI ölçeğinin "F1-Fonksiyon-Eşlik Eden Hastalık" alt faktöründe yer alan ve en büyük etkiye sahip olan madde, ağzı geniş açmakta zorlanma ile ilgili olan Madde I1'dir. Gizli faktör tarafından açıklanan varyans %77,9'dur. Bu F1 alt faktörü üzerinde ikinci en yüksek etkiye sahip değişken, kulak ağrısı veya çene ağrısının olup olmadığı hakkında olan Madde I6'dır. Gizil faktör tarafından açıklanan varyansı %65,9'dur. Ayrıca "F2-Oklüzyon-parafonksiyon-psikoloji "alt faktöründe en yüksek etkiye sahip değişken dişleri sıkma veya gıcırdatma alışkanlığı hakkında olan Madde I8'dir. Gizil faktör tarafından açıklanan varyansı %45,6'dır. Sonuç: Elde edilen sonuçlara göre FAI ölçeğinin ölçeğin güvenirlik ve tutarlılığı sağlanmıştır. Tüm uyum kriterleri göz önünde bulundurulduğunda, önerilen modelin örneklem için geçerli olduğu ortaya çıkmıştır. Doğrulayıcı faktör analizi

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sonuçları, RMSEA, SRMR, GFI, AGFI, CFI, NFI, NNFI, TLI, CR ve AVE indeksleri ile kanıtlandığı üzere, verilerin önerilen modele iyi bir uyum sağladığını göstermiştir. Farklı fizyoterapi tekniklerinin uygulanmasının hastalarda TMD'nin yol açtığı problemleri indirgeyebileceği, ağzı geniş açmakta kolaylık sağlayabileceği, diş sıkma ve çene ağrısını kontrol etmede etkili olabileceği düşünülmektedir.
Anahtar Kelimeler: Açıklayıcı faktör analizi, Doğrulayıcı faktör analizi, Diş hekimliği öğrencileri, Fonseca Anamnestik (FAI) Anketi, Temporomandibular eklem bozuklukları.

Introduction

Temporomandibular joint disorder (TMD) is a comprehensive term that encompasses various neuromuscular and musculoskeletal disorders involving the temporomandibular joint (TMJ), chewing muscles, and/or associated anatomical structures (Valesan et al., 2021). The etiology of TMD is complex and multifactorial with the influence of trauma, occlusion, parafunctional habits, systemic diseases, psychological, hormonal and genetic factors (Molina-Torres et al., 2016; Mori et al., 2010). Defining overloading as the first stage of TMD, Nitzan et al. (2004) stated that overloading on the joint at this stage causes degenerative changes and if this loading becomes continuous, it may cause damage to the joint ligaments, capsule, cartilage and disc. Symptoms of TMD are categorized into three groups in terms of affected structures: jaw joint, teeth and muscles (Okeson, 2019). The presence of sound during jaw movement, restriction in mouth opening and local pain in the face and in front of the ear are the most common findings of TMD (LeResche, 1997).

Epidemiological studies indicate that TMD are more common in individuals aged between 20 and 40 years, while complaints of this nature are rarely reported in individuals aged 60 and above (Greene, 1994; Ow et al., 1995). Scientific research suggests that signs indicative of TMD are present in about one out of every four individuals in the population. Furthermore, it has been observed that symptoms requiring treatment are severe in only about 10% of those with these findings (Epker & Gatchel, 2000; Magnusson et al., 2002).

TMD is analyzed in two main categories as conservative and surgical, with conservative treatments, having a success rate ranging between 75% and 90%, generally preferred, encompassing strategies like reducing parafunctional habits, splint therapy, patient education, medical treatment, and physiotherapy, while surgical intervention may be considered for TMD patients experiencing painful or painless mandibular locking, unresponsiveness to conservative measures, and the presence of intracapsular pathologies such as adhesions, osteoarthritis, and synovitis (Kalamir et al., 2012; Okeson, 2019).

Campos et al. (2014) used the FAI scale to model TMD severity in Brazilian women and proposed it as a valid and reliable tool. Additionally, Dos Santos Berni et al. (2015) also stated

that FAI is an effective method for identifying myogenic TMD in female populations. Resende et al. (2013) conducted a study correlating minor psychiatric disorders and quality of life with TMD in patients diagnosed with different classifications of TMD and at different levels of severity. They used the FAI for initial screening and found associations between minor psychiatric disorders and TMD severity, other than stress.

The FAI was originally created in Portuguese and subsequently translated into English. In order to address the needs of Turkish-speaking populations, Arıkan et al. (2023) have translated the scale into Turkish and evaluated its reliability and validity, which is an important step towards ensuring cultural relevance and accessibility for this population.

In this study, the names of the sub-factors were used as determined by Arıkan et al (2023). Factor1 (F1), "Function-comorbidity" means that conditions such as TMD are associated with impaired jaw function. For example, if a person experiences pain or restriction in jaw movements, it may affect chewing function, which in turn may affect eating habits or ability to chew. There is also a relationship between jaw conditions such as TMD and psychological factors such as stress or anxiety. This indicates that psychological factors affecting jaw functions may play a role in the development or exacerbation of comorbid conditions such as TMD. Factor2 (F2) "Occlusion-parafunction-psychology" amalgamates terms used in both dentistry and psychology. Primarily, "occlusion" refers to the biting and chewing functions of teeth, whereas "parafunction" delineates abnormal dental activities, particularly those that occur frequently and are harmful. The association of these terms with psychology suggests that emotional factors such as stress, anxiety, or other psychological elements can influence an individual's dental functions, leading to parafunctional habits.

Psychological factors, especially stress or anxiety, may play a significant role in the emergence of parafunctional activities like bruxism. Therefore, the phrase "Occlusion-parafunction-psychology" elucidates the relationship between dental structure and function and psychological factors, underscoring the importance of comprehending this relationship in dental practice and treatment. The expression "function-comorbidity" emphasizes the relationship between TMJ functions and other existing health problems. TMD are characterized by symptoms such as pain, restriction, or discomfort in jaw movements. This disorder can affect daily functions such as chewing, speaking and swallowing. Understanding these relationships plays an important role in the treatment and management of patients.

The aim of this study was to investigate the factors affecting TMD with data obtained from dental students at Kırıkkale University. For this purpose, the construct validity of the two-factor FAI structural model proposed by Arıkan et al. (2023) was examined by confirmatory factor analysis (CFA). The results obtained are compared with similar studies in the literature and then suggestions for future research are presented.

Methods

Statistical Methods

The study was conducted with the approval of the Kırıkkale University Non-Interventional Ethics Committee (Decision No: 2023.10.15). The prevalence and severity of TMD among students of the Kırıkkale University Faculty of Dentistry were assessed through a cross-sectional questionnaire study. The test's significance level was set at 0.05, the effect size was 0.3, and the sample size of n=220 was determined to be sufficient for 95% power, based on the power analysis. These findings indicate the confidence and expertise of the researchers in conducting a well-designed study. The study included 240 volunteer students from Kırıkkale University Faculty of Dentistry, consisting of 160 females and 80 males aged between 20 and 33 years. The FAI form was adapted into Turkish by Arıkan et al. (2023) and designed by Fonseca (1994). It was created online using Google Forms and sent via email to students registered in the faculty database. Volunteer students were requested to complete the questionnaire. The FAI consists of ten multiple-choice questions that allow participants to assess the frequency and severity of symptoms related to the TMJ. The available responses to these questions are 'yes', 'sometimes', and 'no' (Table 1) (Arikan et al., 2023).

The participants were not restricted by any time limits when answering the questions. They were asked to choose one of the following options: 'yes' (10 points), 'sometimes' (5 points), or 'no' (0 points). The data analysis was performed using both SPSS 27.0 (IBM Corp., Armonk, NY, USA) and R software (R Core Team, Vienna, Austria).

Exploratory Factor Analysis (EFA)

EFA is a statistical technique that is used to identify latent factors that explain the correlations among observed variables. Its purpose is to determine whether a smaller number of factors can explain the variance in a larger set of variables. EFA aids in the development of theoretical models and the creation of more parsimonious measurement instruments by reducing the dimensionality of the data and identifying common patterns. EFA provides a systematic approach to investigating complex datasets and revealing hidden relationships among variables.

Table 1: Distribution of Participants Based on Their Responses to Each Question of Fonseca's Anamnestic Index (AFI)

Items	Mean	Standard Deviation	Median	Skewness	Kurtosis
I1. Ağzınızı geniş açmada zorluk yaşıyor musunuz? (Do you have difficulty opening your mouth wide?)	1.229	2.597	0	2.017	3.179
I2. Çenenizi yanlara doğru hareket ettirmede zorluk yaşıyor musunuz? (Do you have difficulty moving your jaw to the sides?)	1.313	2.937	0	2.091	3.054
I3. Çiğnerken yorgunluk veya kas ağrısı hissediyor musunuz? (Do you feel fatigue or muscle pain when you chew?)	4.021	4.088	5	0.371	-1.415
I4. Sıkça baş ağrınız oluyor mu? (Do you have frequent headaches?)	4.292	4.207	5	0.27	-1.542
I5. Boyun ağrınız ya da tutulmanız var mı? (Do you have neck pain or stiff neck?)	5.792	4.29	5	-0.307	-1.579
I6. Kulak ağrılarınız ya da çene ekleminde ağrınız var mı? (Do you have ear aches or pain in that area (temporomandibular joint)?)	2.604	3.77	0	1.037	-0.477
I7. Çiğnerken veya ağzınızı açarken çene ekleminizde herhangi bir ses fark ettiniz mi? (Have you ever noticed any noise in your temporomandibular joint while chewing or opening your mouth?)	4.875	4.549	5	0.049	-1.795
I8. Dişlerinizi sıkma veya gıcırdatma gibi bir alışkanlığınız var mı? (Do you have any habits such as clenching or grinding your teeth?)	4.208	4.363	5	0.31	-1.622
I9. Dişlerinizin iyi bir şekilde oturmadığını hissediyor musunuz? (Do you feel that your teeth do not come together well?)	4.167	4.566	0	0.332	-1.723
I10. Kendinizi gergin (sinirli) biri olarak düşünüyor musunuz? (Do you consider yourself a tense (nervous) person?)	4.875	3.852	5	0.042	-1.321

Various methods, such as principal components (PC), least squares (LS), generalized least squares (GLS), and maximum likelihood estimation (MLE), are utilized to estimate parameters in EFA models. The choice of method depends on factors such as the data distribution and variable structure. EFA requires the use of Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity to assess the validity of the analysis and the suitability of the dataset.

The KMO measure is a statistical tool used in EFA to evaluate dataset suitability by assessing the extent of common variance among variables, indicating the potential for factor extraction. The KMO statistic is a measure of sampling adequacy that ranges from 0 to 1. Higher values indicate better suitability for factor analysis, with a value approaching 1 suggesting high

interrelation among variables. A KMO value above 0.6 is typically deemed acceptable, with higher values preferred. Another statistical technique used in EFA is Bartlett's Test of Sphericity, which assesses dataset suitability by examining correlations among variables. The purpose of this test is to evaluate whether observed variables exhibit significant correlations, which is a prerequisite for factor analysis. The test assumes no correlations among variables and computes a chi-square statistic. A significant chi-square statistic (e.g., $p < 0.05$) indicates sufficient inter-variable correlations, supporting factor analysis suitability. Rejecting the null hypothesis suggests dataset suitability for reliable factor extraction. Bartlett's Test of Sphericity thus plays a pivotal role in determining dataset structure for EFA.

Confirmatory Factor Analysis (CFA)

This chapter investigates the factors that affect TMD among students at Kırıkkale University Faculty of Dentistry, using CFA. The fit of data collected from dentist students with the FAI to the structural model created by Arikan et al. (2023) was examined.

CFA is crucial in identifying latent variables within existing measurement models. CFA, which is particularly useful in evaluates challenging structures such as mood, confirms established theories in various fields. Unlike EFA, CFA begins with a pre-defined model that aligns observed variables with latent structures. CFA was conducted to evaluate TMD among dental students. FAI score was used as a latent variable and FAI scale questions (I1-I10) were used as measurement variables. Before CFA, the assumption of multivariate normal distribution had been tested on the data set. To examine the multivariate normal distribution assumption, the approach proposed by was used Korkmaz et al. (2014). In cases where the data do not comply with the multivariate normal distribution, it is appropriate to use robust techniques for parameter estimation.

Weighted Least Squares Mean and Variance adjusted (WLSMV) estimation method in CFA, which integrates weighted least squares and accommodates adjustments for both mean and variance in the test statistic, using robust maximum likelihood estimation. This technique is particularly effective in handling non-normal or categorical data (Öncel & Erdugan, 2023). The goodness of fit indices of this model were calculated using the Lavaan Package in the R program.

The Root Mean Square Error of Approximation (RMSEA) fit index evaluates how well variables fit into the covariance matrix. Confidence in the goodness of fit of the model increases as this value decreases below 0.1 (Byrne, 2016; Schermelleh-Engel et al., 2003). The Standardized Root Mean Square Residual (SRMR) fit index is calculated by transforming the

sample variance-covariance matrix and model variance-covariance matrices into a correlation matrix. A lower SRMR fit index indicates a better fit of the model to the data (Kline, 2011). Model fit is considered excellent if the RMSEA and/or SRMR values are below 0.05. Values between 0.05 and 0.10 indicate an acceptable model fit. Other fit criteria typically range from 0 to 1, with values closer to 1 indicate superior model fit. Model fit can be assessed by using various fit criteria.

Other fit indices include GFI (Goodness-of-Fit Index), AGFI (Adjusted GFI), CFI (Comparative Fit Index), NFI (Normed Fit Index), NNFI (Non-Normed Fit Index), and TLI (Tucker–Lewis Index). The closer these indices are to 1, the better the fit. To ensure the goodness of harmony in CFA, the model should have a χ^2/df value less than 3, RMSEA between 0.00-0.10, NFI between 0.90-1.00, CFI between 0.95-1.00, and GFI and AGFI between 0.90-1.00. According to Schermelleh-Engel et al. (2003), if the model values fall within these ranges, the model can be considered acceptable or good. In order to ensure the distinction of factors and to measure a different feature of each factor, the covariance between the factors is desirable to be less than 0.7.

When analyzing models to determine if the variables effectively explain the latent variable, it is important to evaluate the composite reliability (CR) criterion along with variance measures. In CFA, reliability and consistency assessments typically use benchmarks such as CR≥0.70, Cronbach alpha coefficients ≥0.70, and AVE (average variance extracted) values ≥0.50. Hair (1998) suggested that to establish scale reliability, variance measurement estimates should exceed 0.50, indicating that the construct explains at least 50% of the variance of its indicators on average. However, Fornell and Larcker (1981) argued that AVE values below 0.5 remain acceptable if CR values surpass 0.6, signifying adequate structural reliability (Huang et al., 2013).

To assess the effectiveness of measurement instruments in research, it is necessary to thoroughly examine their reliability and validity. This can be achieved through various coefficients, each with its own advantages and disadvantages. Cronbach's alpha is a widely used metric for evaluating the internal consistency reliability of a measurement scale, which measures the degree of interrelatedness among its items. The output of this measure ranges from 0 to 1, indicating higher internal consistency reliability. Values above 0.7 are generally considered satisfactory. Another relevant coefficient in this field is Guttman's Lambda6, which also yields values between 0 and 1. Values above 0.7 usually indicate acceptability.

Results

The study involved 240 volunteer students, 160 of whom were female (66.7%) and 80 were male (33.3%). There were 120 students from the 4th and 5th grades. The students' ages ranged between 20 and 33, and they were studying at Kırıkkale University Faculty of Dentistry. The age distribution of the participants was as follows: 33 (13.8%) were 20 years old, 65 (27.1%) were 21 years old, 85 (35.4%) were 22 years old, 35 (14.6%) were 23 years old, and 22 (9.2%) were between the ages of 24 and 33. Table 2 presents the frequency (f) and percentage (%) of students according to these variables.

Table 2: Frequencies of Variables

Variables	Sociodemographic Profile	Frequency	%
Gender	Female	160	66.7
	Male	80	33.3
Class	4	120	50.0
	5	120	50.0
Age	20	33	13.8
	21	65	27.1
	22	85	35.4
	23	35	14.6
	24-33	22	9.2

The study determined the mean and standard deviation (SD) values for the ages of the participants and their FAI scores. It was found that the mean age of the participants was 22.01 (SD=1.902) and the mean FAI score was 37.31 (SD=21.748). The data suggests that the mean FAI value for 5th grade students (Mean=38, SD=24) is higher than that of 4th grade students (Mean=36, SD=19). It is worth noting that the highest FAI score (Max=100) was observed in the 5th grade.

Explanatory Factor Analysis Results

Primarily, EFA was performed on items of FAI. The factor number of FAI was stated as 2 by Arikan et al. (2023). Figure 1 shows the graph commonly used to determine the number of factors in EFA. The plot displays the variance associated with different numbers of factors. Initially, there is a rapid increase in variance as the number of factors increases. However, beyond a certain point, there is a diminishing return in the increase of variance with additional factors, resulting in a noticeable 'elbow' or inflection point in the graph. This inflection point indicates the point at which the increase in variance explained by adding more factors decreases significantly. Generally, factors beyond this point do not contribute significantly to improving the explanatory power of the model and may only add unnecessary complexity. Thus, the scree

plot is a useful tool for selecting the appropriate number of factors and assisting researchers in determining the most parsimonious model that adequately captures the underlying structure of the data.

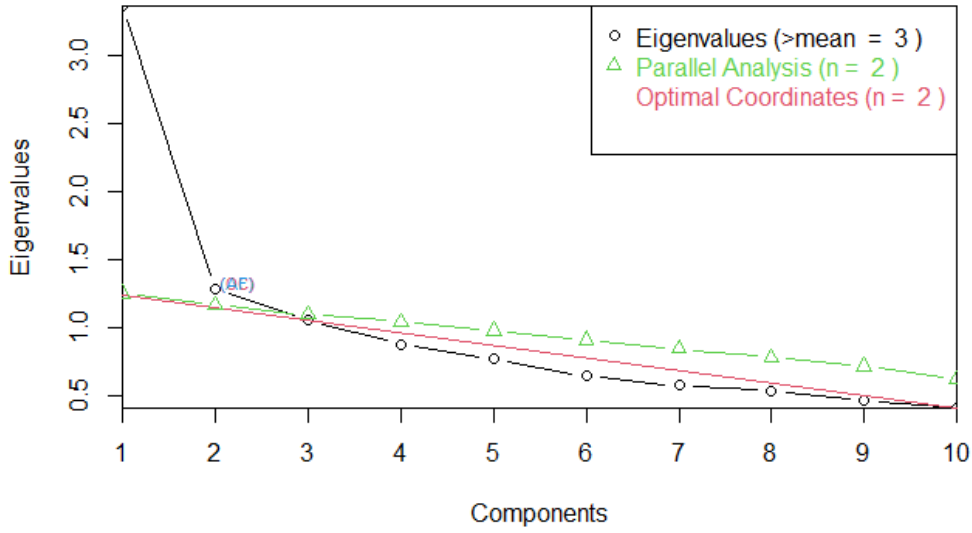

Figure 1. View of the Number of the Factor

Factor number decisions obtained based on eigenvalue analysis results are located in the upper right part of the Figure 1. Accordingly, it appears that used FAI data has a two-factor structure. The estimation method selected was unweighted least squares, and the rotation method chosen was Varimax in EFA. When KMO test is examined, it can be observed that the sample is sufficient for EFA (KMO= 0.829 >0.70). Additionally, Bartlett's sphericity test was significant (Chi-Square test value=492.977, p<0.000) therefore Bartlett test analysis results are suitable for CFA analysis of the relationships between variables. As a result of EFA, it was seen that the 2-factor structure explained 50.19% of the total variance. This implies that the construct is well measured, as the total variance is greater than 50%. Internal consistency was achieved with Cronbach's-α value of 0.739, Guttman's Lambda (λ6) of 0.748.

Confirmatory Factor Analysis Results

It can be concluded that the sample size of the present study was appropriate since the FAI included 10 items. The sample size of n=240 was considered sufficient for CFA, as reported in Malikov et al. (2024). The Mardia skewness value of the FAI was calculated as 630.169 (p<0.001), and the Mardia kurtosis value was 1.966 (p<0.001). Based on these results, it appears that the dataset does not follow a multivariate normal distribution.

The model produced a value of $\chi^2 = 62.364$ (df=34, p=0.002<0.01), resulting in a χ^2/df ratio of 1.834, indicating a perfect model fit as it falls between 0 and 3 (Hair, 1998; Schermelleh-Engel et al., 2003; Shook et al., 2004). The model's fit measures were calculated as follows: RMSEA=0.059, SRMR=0.088, GFI=0.972, GFI=0.946, CFI=0.978, NFI=0.953, NNFI=0.971, and TLI=0.971. It is seen that the model fits the data well. In addition, the model fits the data well, as indicated by the CR value of 0.870 and AVE values of 0.5 for F1 factor and 0.243 for F2 factor.

Table 3 presents non-standardised factor loadings, which are estimates of the path coefficients, in the 'est' columns. The 'std.err' column indicates the standard error associated with these non-standardised factor loadings. The 'z-value' and 'p-value' provide insight into the level of significance of the estimated parameters. A z-value greater than 1.96 indicates significance at the 0.05 level. Similarly, a p-value below 0.05 indicates the significance of the latent factor in explaining the corresponding item. The column 'std.lv' contains only standardized factor loadings for latent variables. The R^2 value indicates the proportion of variance in each item that is explained by the latent structure.

A higher R^2 value indicates a stronger impact of the item on the factor. The names of the latent factors are named as a "F1-Function-comorbidity", "F2-Occlusion-parafunction-psychology " by Arikan et al. (2023). The results of the CFA model for FAI data obtained from Kkkale University dental students are given in Table 3.

Table 3: Factor Loadings of the CFA Model

Factor	Items	est	std.err	z-value	p value	std.lv	R^2
F1	**I1**	**1**	**-**	**-**	0.000	**0.882**	**0.779**
F1	I2	0.853	0.089	9.614	0.000	0.753	0.567
F1	I3	0.859	0.061	14.174	0.000	0.758	0.574
F1	I4	0.671	0.069	9.706	0.000	0.592	0.350
F1	I5	0.633	0.073	8.627	0.000	0.558	0.312
F1	**I6**	**0.920**	**0.061**	**15.034**	**0.000**	**0.812**	**0.659**
F1	I7	0.574	0.073	7.911	0.000	0.507	0.257
F2	**I8**	**1**	**-**	**-**	**0.000**	**0.675**	**0.456**
F2	I9	0.303	0.143	2.128	0.000	0.205	0.042
F2	I10	0.710	0.143	4.955	0.033	0.479	0.230
Cov(F1, F2)		0.476	0.062	7.652	0.000	0.799	

est, non-standardized factor loadings, estimates of the path coefficients; std.err, the standard error value of the non-standardized factor loading; z-value, "est" value divided by the "std.err" value; p-values based on z-test and p < 0.05 significant; std.lv, standardized factor loadings; R^2, the proportion of variance in each item that is explained by the latent structure.

According to Table 3, all items significantly affect FAI ($p<0.01$). The variable that affects F1 the most is item I1, and the variance explained by the latent factor is $R^2=0.779$ ($p<0.01$). This means that a 1 unit increase in FAI score will increase I1 by 1 unit. Item I6 is the second variable that affects F1 the most, and the variance explained by the latent factor is $R^2=0.659$ ($p<0.01$). This means that a 1 unit increase in FAI score will increase T9 by 0.920 units. The variable with the highest impact on F2 is item I8, which is related to the habit of clenching or grinding teeth. The variance explained by the latent factor is 45.6%. In addition, it was observed that the variable that had the least effect on n F2 was I9 and its variance explained by the latent factor was $R^2=0.042$ ($p<0.01$).

In the path graph in Figure 2, standardized factor loadings (std.lv values) are shown on the lines.

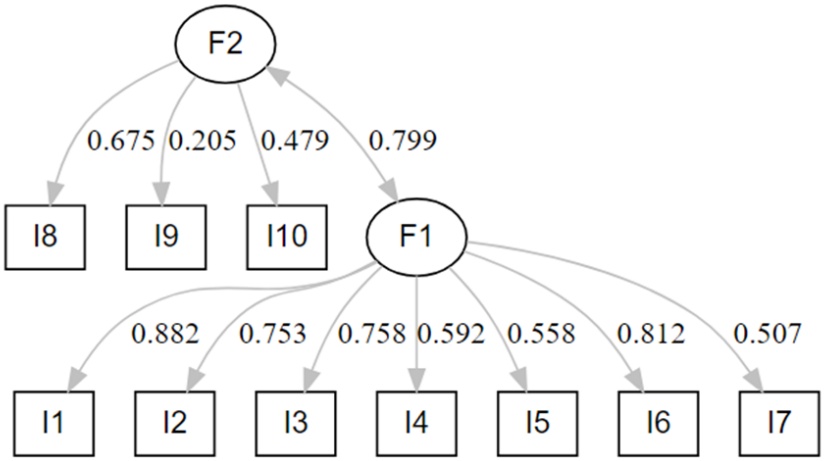

Figure 2. Confirmatory Factor Analysis Path Diagram

Discussion

TMD is a common health issue in society. This research aims to investigate the factors that influence TMD among students in Dental Faculties in Turkey using CFA. The study also examines the negative impact of these disorders on students' quality of life and academic performance. Therefore, investigating the factors that affect TMD is crucial for both student and public health. Such investigations can potentially lead to the development of improved treatment and prevention strategies.

TMD is a prevalent condition in dentistry, affecting 20% to 40% of the population. Its etiology is multifactorial, and psychological factors are known to play crucial roles in its onset, progression, and prognosis. Because of its complex nature, TMD is commonly considered a

psychosomatic disorder. Activated stress mechanisms are associated with between 75% and 90% of major human diseases (Nicholson et al., 2000). Studies have shown that stress and anxiety may cause myoelectric activity to be elevated, leading to parafunctions such as tooth clenching. Through physical reflexes, psychological factors can regulate the occlusal status and the masticatory activity. A negative mental or emotional state can lead to an increase in passive intra-articular pressure. This can damage the cartilaginous matrix of the condyles if the damage exceeds the repair mechanisms (Pallegama et al., 2005).

FAI is a particularly advantageous tool due to its ease of use, cost-effectiveness, and efficiency in gathering data to assess TMD severity and prevalence. FAI has been widely used by researchers to evaluate TMD severity and prevalence.

Bevilaqua-Grossi (2006) used the FAI scale to describe and characterize TMD symptoms and clinical signs and stated that pain during chewing, neck pain, headache, difficulty opening the mouth, and lateral deviation are good indicators of TMD severity. Additionally, they suggested that difficulty opening the mouth and pain in the jaw joint are good indicators of the severity and treatment of TMD. Özdinç et al. (2020) demonstrated that sleep quality and stress level are significant risk factors for the presence of TMD and proposed a comprehensive approach that evaluates both mechanical and psychosocial factors in the prevention and treatment of TMD.

Yaman et al. (2021) evaluated the presence and severity of TMD using the FAI. It was stated that TMD pain was positively associated with bruxism, clicking, headache and emotional stress. Cebi et al. (2021) found that elderly patients with TMD pathology had significantly higher levels of depression and anxiety and emphasized the importance of evaluating the relationship between TMD and the patient's undiagnosed psychological state. The findings obtained from this study are compatible with this literature information.

González-Sánchez et al. (2023) suggested that the application of different physiotherapy techniques, both alone and in combination, is effective in controlling the primary symptoms of TMD in patients. Prior research indicates an escalating prevalence of TMD, particularly among young adults and university students (Ayalı & Ramoğlu, 2015; Gulzar et al., 2022; Türken et al., 2020). Stress appears to be a significant factor in both the onset and aggravation of TMD, among university students (Ayalı & Ramoğlu, 2015). Furthermore, research by Ayalı & Ramoğlu (2015) and Nomura et al. (2007) consistently shows a higher prevalence of TMD in women than in men. Additionally, Malikov et al. (2024) found that female dentistry students in the 4th and 5th grades have a 1.909 times greater risk of TMD compared to male students.

The main difference of this study from other studies in the literature is that the severity of TMD among Turkish dental students was modelled in relation to the items in the FAI. The study aimed to determine the most effective variables explaining the change in TMD severity based on the questionnaire. CFA was applied to the data and a good fit between the observed data and the model was shown by various fit indices.

In the sub-factor 'F1-Function-comorbidity' of the FAI scale, Item I1 is the most influential, particularly regarding challenges related to widening the mouth. The latent factor explains 77.9% of the variance. Following closely, Item I6, which addresses the presence of earache or jaw pain, is the second most impactful variable on this F1 factor, accounting for 65.9% of the explained variance. Furthermore, in the 'F2-Occlusion-parafunction-psychology' sub-factor, Item I8 is the most influential variable, focusing on the habit of teeth clenching or grinding. The latent factor accounts for 45.6% of the variance. These findings have the potential to reveal risk factors and effective treatment methods for TMD. Managing symptoms, such as restricted mouth opening and ear or jaw pain, can significantly contribute to TMD treatment. Additionally, various physiotherapy exercise regimens and manual therapies targeting the facial, neck, ear, and jaw regions can further aid in alleviating TMD symptoms.

In this study, taking only 4th and 5th grade students from Kırıkkale University Faculty of Dentistry as a sample limits the study's ability to be generalizable enough. If a sample consisting of students studying in different departments of the university was considered, different parameter estimates could be obtained. In future studies, people of different ages and professions can be included in the sample and new models can be established with different variables thought to be related to TMD such as anxiety, bruxism, parafunctional habit, malocclusion.

Conclusion

This study explores the factors influencing TMD in students of Kırıkkale University Faculty of Dentistry, utilizing CFA. The data was collected through the FAI questionnaire. TMD, sleep disturbances, and physical and psychological stress are common conditions in modern societies. Some studies suggest that between 40% and 60% of the general population have some form of TMD, although many patients do not have symptoms associated with TMD. More recent studies have suggested that the prevalence of TMD is between 2% and 5% .

The reliability and consistency of the FAI scale have been confirmed by the results obtained, and the proposed model has been deemed valid for the sample based on all fit criteria.

The fit index values demonstrate that the data fits the established model well, and all scale items significantly impact FAI in this study. According to the model obtained in this study, the variables that should be primarily evaluated in the diagnosis and treatment of TMD were determined as: difficulty in opening the mouth wide, earache or jaw pain, and the habit of clenching or grinding the teeth. Dentists are advised to consider these variables as a priority in the diagnosis and treatment of TMD. Various physiotherapy techniques can effectively alleviate TMD-related problems in patients, facilitate wider mouth opening and manage teeth clenching and jaw pain.

Ethical Statement: This study was conducted with the approval of the Kırıkkale University Non-Interventional Ethics Committee (Decision No: 2023/10.15).

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