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# Evaluation of Occupational Variables Affecting Dentists Using Hierarchical Cluster Analysis

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**Abstract**

**Objective:** This study aimed to examine the occupational variables affecting dentists. The relationship between variables was discovered by the dendrogram, using hierarchical cluster analysis.

**Methods:** The study was a cross-sectional survey that includes 124 dentists in İstanbul (mean age ± S; 34.21 ± 7.35 years; occupation year 11.05 ± 6.78 years; 73 married, 51 single; 61 men, 63 women). Some assessments (sleep, depression, anxiety, pain, functionality, physical activity, and quality of life) were applied to the participants. Hierarchical Cluster Analysis of Multivariate Statistical Methods was used to determine the clustering tendency of the variables and see how these clusters can converge.

**Results:** Two main clusters were obtained by using Hierarchical Cluster Analysis. Main Cluster I contains two sub-clusters: Sub-Cluster I: Age, Occupation year, Stress, Neck disability index; Sub-Cluster II: Depression, Anxiety, Pittsburg, BMI, Oswestry disability index. Main Cluster II: Quality of life, Physical activity, Chronic disease, Smoking, Family situation, and Gender variables were obtained.

**Discussion and Conclusion:** As a result of our research, it is seen that the relations between the variables in the clusters we obtained are related to the literature. In this sense, the visual results and clusters obtained with the dendrogram enabled the variables to be presented regularly and systematically. Hierarchical cluster analysis draws attention as a modern method in terms of evaluating the physical and psychosocial variables that occur in dentistry, an important profession for society.

**Keywords:** Dentists; Occupational variables; Cluster Analysis; Dendrogram

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# Diş Hekimlerini Etkileyen Mesleki Değişkenlerin Hiyerarşik Kümeleme Analizi ile Değerlendirilmesi

**Öz**

**Amaç:** Bu çalışmada diş hekimlerini etkileyen mesleki değişkenlerin incelenmesi amaçlanmıştır. Değişkenler arasındaki ilişki, hiyerarşik cluster analizi kullanılarak oluşturulan dendrogram ile belirlendi.

**Yöntemler:** Araştırma, İstanbul'da 124 diş hekimini (ortalama yaş ± S; 34,21 ± 7,35 yıl; meslek yılı 11,05 ± 6,78 yıl; 73 evli, 51 bekar; 61 erkek, 63 kadın) kapsayan kesitsel bir anket çalışmasıdır. Araştırma kapsamında katılımcılara bazı değerlendirmeler (uyku, depresyon, anksiyete, ağrı, işlevsellik, fiziksel aktivite ve yaşam kalitesi) uygulandı. Değişkenlerin kümelenme eğilimlerini belirlemek ve bu kümelerin nasıl yakınsadığını gözlemlemek için Çok Değişkenli İstatistiksel Yöntemlerden 'Hiyerarşik Kümeleme Analizi' kullanıldı.

**Bulgular:** Hiyerarşik Kümeleme Analizi kullanılarak iki ana küme elde edilmiştir. Ana Küme I iki alt küme içerir: Alt Küme I: Yaş, Meslek yılı, Stres, Boyun özürlülük indeksi; Alt Küme II: Depresyon, Anksiyete, Pittsburg uyku anketi, BMI, Oswestry bel özürlülük indeksi. Ana Küme II: Yaşam kalitesi, Fiziksel aktivite, Kronik hastalık, Sigara, Aile durumu ve Cinsiyet değişkenleri içermiştir.

**Tartışma:** Araştırmamız sonucunda elde ettiğimiz kümelerdeki değişkenler arasındaki ilişkilerin literatürle uyumlu olduğu görülmüştür. Bu anlamda dendrogram ile elde edilen görsel sonuçlar ve kümeler, değişkenlerin düzenli ve sistematik olarak sunulmasını sağlamıştır. Hiyerarşik küme analizi, toplum sağlığı açısından önemli bir meslek olan diş hekimliğinde meydana gelen fiziksel ve psikososyal değişkenlerin değerlendirilmesi açısından modern bir yöntem olarak dikkat çekmektedir.

**Anahtar kelimeler:** Diş Hekimleri; Mesleki Değişkenler; Cluster Analizi; Dendrogram.

## INTRODUCTION

Dentists, like other healthcare professionals, experienced occupational health problems in their careers. They are prone to physical and psychological stressors depending on the working environment. Dental treatment leads to an abnormal posture that can cause musculoskeletal disorders in long term. These problems mainly occur in the form of neck and low back pain[1].

Repetitive hand grips, bending and twisting of the neck, abduction of the arm, and loads applied to the muscles and joints can cause postural misalignment. In addition, poor physical activity level as a common cause of morbidity is closely associated with musculoskeletal symptoms[2].

Dentistry is also a difficult profession from a psychological point of view. Many researchers have suggested that dentistry is stressful due to the nature of dental treatments and working conditions. Some studies show the relationship between dentistry and cardiovascular disease, smoking, divorce, and high suicide rates[3].

Many situations arising from working conditions may be a source of stress for dentists. The dental procedures assume a strained posture while working which causes abnormal forces on the body and extremities. This situation negatively affects the locomotor and nervous systems. Cervical and lumbar pain syndromes due to bad working posture are caused by spinal degeneration in different stages[4].

General examples of work conditions that may cause work-related musculoskeletal disorders (WMSDs) include: Daily exposure to vibrating devices, overhead work, having the neck in a constantly fixed position, or repetitive powerful tasks. Furthermore, psychosocial factors, such as quality of life, stress, level of support, and balance between work and leisure life have also been reported to be associated with WMSDs[5].

Dentists can experience increased professional burnout, which can cause sleep disturbances, a decrease in quality of life, and emotional problems like depression and anxiety[6,7].

This study aimed to examine the musculoskeletal and psychosocial variables affecting dentists. The relationship between variables was discovered by dendrogram, using hierarchical cluster analysis. These statistical results from the refined clusters provide new perspectives for researchers.

## METHOD

The design of the study was a cross-sectional survey that includes 124 dentists in Istanbul (mean age ± S; 34.21 ± 7.35 years; occupation year 11.05 ± 6.78 years; 73 married, 51 single; 61 men, 63 women).

The required sample size was calculated using the R program, taking into account the correlation between BMI and physical activity level, with alpha = 0.05, power = 0.90, and correlation coefficient 0.048[8]. The sample consisted of 124 people.

Inclusion criteria: Being active in dentistry for at least 1 year, residing in Istanbul.

Exclusion criteria: Dentists who have taken a break from their professional life for more than 6 months and not taking patients regularly. The current research was approved by the Ethics Committee of the Biruni University on 26/08/2018 with the number 2018/13-19.

The initial sample included in the study was 157 participants, 22 of them were excluded from the research because they didn't meet the inclusion criteria. And 11 participants were not included in the statistics due to incompleted evaluation documents. The data collection of the study was completed between October-December 2021.

First demographic features of the participants (age, gender, BMI, Occupation year, Family situation, Smoking, Chronic disease) were recorded.

### Instruments

In the second stage, some assessments were applied to the participants.

The Pittsburg Sleep Questionnaire Index (PSQI) is a valid questionnaire that assess sleep quality over the last month. It consists of seven component scores (subscale score range: 0–3): sleep quality, sleep disorders, sleep duration, sleep latency, habitual sleep efficiency, sleeping pill use, and daytime dysfunction. A total score was obtained by summing the subscale scores of all components (range: 0–21). Higher PSQI scores reflect fewer sleep quality. Sleep duration was calculated using responses from the questionnaire[9].

The Beck Depression Inventory (BDI) is a valid and self-report depression questionnaire, containing 21 items rated on a 4-point scale between 0 and[3]. Depressive symptoms were classified as; no symptoms (0-4 points), mild symptoms (5-7 points), moderate symptoms (8-15 points), and severe symptoms (16-39 points)[6].

The Beck Anxiety Inventory (BAI) is a 21-item instrument used to determine the anxiety level of participants. The questions are about the physical, emotional, and cognitive dimensions of the subject's anxiety and fear of losing control in the previous week. Each item was rated on a four-point Likert scale ranging from 0 (not at all) to 3 (severe). The total score ranged from 0 to 63. It was classified as 0-7 normal/minimum anxiety, 8-15 mild anxiety, 16-25 moderate anxiety, and 26-63 severe anxiety[10].

Neck Disability Index (NDI) was designed to provide information about how neck pain affects everyday life. There are 10 questions and the possible total score of each question is from zero to five. Each of the 10 items is scored between 0-5. Therefore, the maximum score is 50. The resulting score was multiplied by 2 to get a percentage point. Higher percentage scores were associated with worse disability[11].

The Perceived Stress Scale (PSS) is the most widely used psychological tool to assess the perception of stress. The questions in this survey are about feelings and thoughts in the last month. Participants were asked how often they feel stressful on a five-point scale from "never" to "very often". To obtain a total PSS score, responses to the four positively denoted items (items 4, 5, 7 and 8) first needed to be reversed. Then, the PSS score was calculated by summing all the items. Higher scores indicated higher levels of perceived stress[12].

The Oswestry Disability Index (ODI) is an extremely important and 'gold standard' tool that researchers and clinicians use to evaluate permanent functional disability. Each question was scored between 0-5 with the first statement being zero and showing the least amount of disability, and the last statement was scored with 5 points indicating the most severe disability. The scores of all answered questions were summed, then multiplied by two to get the total score (0-100)[13].

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used to determine physical activity levels. The IPAQ-SF consists of 7 items, estimating time spent being physically active in the past 7 days and measuring time spent in vigorous activities, moderate-intensity activities, walking, and sitting. These activity categories were multiplied by their estimated intensities in metabolic equivalents (METs) and pooled to obtain an overall estimate of physical activity at one week. The MET intensities used to score IPAQ in this study were vigorous, moderate, and walking. After the calculation of the total score, the participants were categorized as inactive, minimal active and active[14].

The Short Form (36) Health Questionnaire is a 36-item questionnaire on quality of life. The SF-36 consists of eight scaled scores, which are the weighted sums of the questions in their division. Each scale is converted directly to a 0-100 scale, assuming that each question carries equal weight. The lower the score, the greater the disability. The higher the score, the fewer influence[15].

## Statistical Analysis

Hierarchical Cluster Analysis (CA) is one of the current multivariate statistical methods. It was used to find the clustering tendency of the variables in our study. The relationships between the variables were presented as a dendrogram revealing the proximity of the similar objects. The dendrogram of the variables was obtained using the Common Linkage and Ward's Hierarchical Clustering Model. The model decided upon should be the best according to the data structure and should minimize the variability within clusters and maximize the variability between clusters. So, this method offers stronger conclusions than the univariate methods. It provides the investigator with a stronger display.

## RESULTS

A total of 124 dentists participated in this study. Demographic features of the participants were recorded (Table 1).

**Table I:**Demographic features of the participants

| | **Mean** | **SD** | **Percent** |
|---|---|---|---|
| **Age** | 34,21 | 7,35 | |
| **Occupationyear** | 11,05 | 6,78 | |
| **Married** | | | 58.8 |
| **Chronic disease** | | | 30 |
| **Smoking** | | | 52.4 |

In addition, the percentile results of the applied scales were calculated (Table 2). These percentage values were created according to the categorization of the results obtained from the scales. When the percentile values of NDI, ADI and BAI were examined, it was observed that dentists had significant percentile effects

on anxiety, neck and low back parameters. It was seen that the IPAQ and BMI ratios of the dentists included in the study were at critical values in terms of physical activity and weight.

**Table II:** Percentages of the Evaluations

| Evaluations | Level | Percent |
|---|---|---|
| NDI | Normal | 24 |
| | Mild | 27 |
| | Moderate | 40 |
| | Vigorous | 9 |
| ODI | Minimal | 47 |
| | Moderate | 53 |
| PSS | Low | 64 |
| | Moderate | 36 |
| BD | Minimal | 41 |
| | Mild | 53 |
| | Moderate | 6 |
| BAI | Mild | 8,8 |
| | Moderate | 27,4 |
| | Vigorous | 63,8 |
| BMI | Normal | 45 |
| | Obese/overweight | 55 |
| IPAQ | Inactive | 19 |
| | Minimal active | 66 |
| | Active | 15 |

**Neck Disability Index (NDI)*
**Oswestry Disability Index (ODI)*
**Perceived Stress Scale (PSS)*
**Beck Depression Scale (BDS)*
**Beck Anxiety Index (BAI)*
**Body Mass Index (BMI)*
**International Physical Activity Questionnaire (IPAQ)*

As a result of the Hierarchical Cluster Analysis two main clusters and two subclusters were obtained.

### Main Cluster I contains two sub-clusters:

Sub-Cluster I: Age, Occupation year, Stress, Neck disability

Sub-Cluster II: Depression, Anxiety, Pittsburg, BMI, Oswestry

Main Cluster II: Quality of life, Physical activity, Chronic disease, Smoking, Family situation, and Gender (Figure 1).

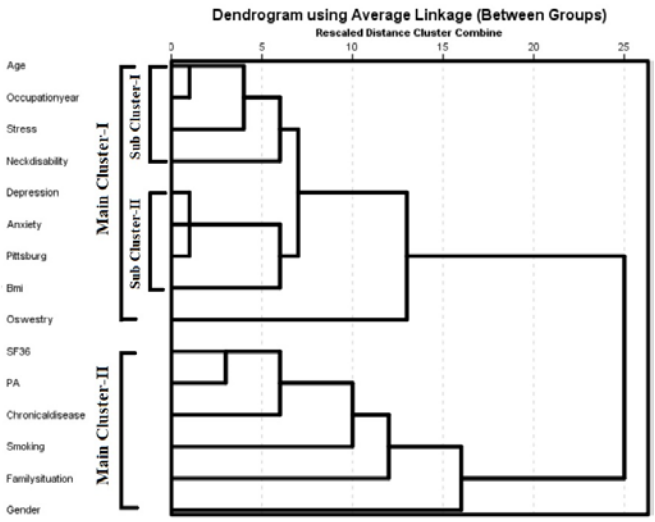



**Figure 1.** Dendrogram of the variables

Finally, interpretations were made via dendrogram representations of the clustering tendency of the variables in order to see how these clusters can converge by using Hierarchical Cluster Analysis of Multivariate Statistical Methods.

## DISCUSSION

Dentists are affected in different degrees both physically and psychosocially due to the professional difficulties they involve. Systemic analysis of a large number of variables affecting dentists will provide both a clearer visual display of the relationships between the data and a clearer interpretation. In our study the relationship between variables was discovered by the dendrogram, using hierarchical cluster analysis.

As a result of our research, two main and two subclusters were obtained in the statistical analysis. The relationships between the variables in these clusters are important in terms of systematically examining the musculoskeletal and psychosocial effects of the dentistry profession.

Variables such as the decrease in the amount of physical activity with aging, obesity, and smoking affect the quality of life of dentists

negatively like other people. The sedentary lifestyle of dentists causes them to be prone to chronic diseases. Studies show that regular physical activity reduces morbidity. It was revealed that male and single dentists are more physically active by Srilatha et al.[7,15]. In Main Cluster II, the quality of life, physical activity, smoking habit, chronic disease, family status, and gender variables were included. It is an important indicator that only 15% of the dentists included in our study are physically active and 30% have chronic diseases.

In another research, most of the dentists faced at least one musculoskeletal complaint (62%) and chronic systemic complaints (30%) like our study. Relationship between age, occupation year, and neck pain. This relationship is seen in Subcluster I (1). It was observed that 64% of dentists performed some type of regular exercise at least 4-5 days a week. Kierklo et al. found that 10% of the dentists exercise regularly to get relief from pain, 68% of them performed exercises frequently, and 23% don't do any exercises at all[16,17]. In our study, 19% of dentists were classified as inactive, 66% as minimally active, and 15% as very active.

Obesity, another important factor, exacerbates pain in most areas of the body by causing increased mechanical strain and joint damage. One-third of dentists are obese and 60% have low back pain. Sixty percent stated that they were tense, tense, or depressed, and 48.6% had difficulty sleeping[18]. In another study conducted in Brazil, it was concluded that the incidence of low back pain in dentists is higher than the general population[3]. There is also a strong correlation between depression and pain and there are relationships[19,20] like subcluster II of our study (clustering of anxiety, depression, Pittsburg; back pain, BMI, and depression).

From the point of view of musculoskeletal pain 81.4% of the dentists experienced musculoskeletal disorders, mostly in the cervical and lumbar regions. In another study it was found that 76.2% of male dentists experienced symptoms in the lower back and neck. Among Polish dentists, 60.1% had painful symptoms in their low back and 56.3% in the neck. In a similar study with dentists in Denmark, lumbar pain was also the most frequently reported type[21,22]. Alexandre et al. reported that the most affected area of Brazilian dentists was the neck (57.5%), while the prevalence in the waist was relatively low (21.1%) 19. In another study, the prevalence of MSD in the last 12 months among dentists was 58.3%. The body region most frequently affected by musculoskeletal disorders was the neck with 66.7%, followed by the lumbar region with 52.9%. In a study conducted in Spain, it was determined that the neck region is the most affected area in terms of skeletal musculature in dentists[22]. Similarly, 76% of the dentists included in our study had neck disabilities and 53% had low back pain problems.

In a study conducted on dentists in Australia in 2015, it was observed that musculoskeletal problems increased with stress[23]. The same correlation was found in another study[15]. In our study, it is clearly observed that there is an increase in these two parameters as occupation year increases, together with the relationship between stress and neck disability in subcluster I.

## CONCLUSION

As a result of our research, it is seen that the relations between the variables in the clusters we obtained are related to the literature. In this sense, the visual results and clusters obtained with the dendrogram enabled the variables to be presented regularly and systematically. Hierarchical cluster analysis draws attention as a modern method in terms of evaluating the physical and psychosocial variables that occur in dentistry, an important profession for society.

## Limitations

Although we did not include movement and posture analysis in our research due to the pandemic, we obtained the findings we needed about waist and neck health from valid scales.

**Ethics Committee Approval:**The current research, was approved by the Ethics Committee of the Biruni University on 26/08/2018 with the number 2018/13-19.

**Conflict of Interest:** The author declares no conflict of interest.

**Financial Disclosure:** The authors declared that this study has received no financial support.

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