**Trukawka Kinga, Gębska Magdalena, Mikołajczyk–Kocięcka Anna, Weber–Nowakowska Katarzyna, Żyżniewska-Banszak Ewelina. Assessment of neck disability index in people with bruxism. Journal of Education, Health and Sport. 2022;12(7):217-227. eISSN 2391-8306. DOI http://dx.doi.org/10.12775/JEHS.2022.12.07.021**
**https://apcz.umk.pl/JEHS/article/view/JEHS.2022.12.07.021**
**https://zenodo.org/record/6790245**

**The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).**

**Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).**



**Received: 21.06.2022. Revised: 25.06.2022. Accepted: 02.07.2022.**

# Assessment of neck disability index in people with bruxism

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## Summary

**Aim**: Assessment of neck disability index in people with bruxism.

**Material and Methods:** The study was conducted on a group of 40 subjects of both sexes, in the age range of 18 to 38 years old, with diagnosed bruxism according to Panek (B2, B3). The control group consisted of the same number of subjects in the same age range without bruxism. The research tool was the standardized neck spine disability index (NDI). The scale consists of an examination date and a follow-up after time and 10 questions related to: pain intensity, daily activities, lifting, reading, headaches, concentration, working, driving, sleeping and recreation.

**Results:** Individuals with bruxism are more likely to have higher rates of neck disability index. The analyses conducted showed that individuals diagnosed with bruxism achieved higher levels

of pain for almost all factors on the NDI scale. The study found that significantly higher difficulty and pain intensity was present for almost all aspects among those aged 25-31 years, those with a university education, and those who were employed.

**Conclusion:** The biomechanical connections between the stomatognathic system and the cervical spine indicate the need for functional assessment of the cervical spine in individuals with bruxism.

**Keywords:** bruxism, neck pain, temporomandibular joint, parafunction.

## Introduction

Bruxism is an unconscious, repetitive masticatory muscle activity characterized by clenching or grinding of the teeth during movements that are not part of the masticatory function (speaking, breathing, chewing, swallowing). It is a major risk factor for temporomandibular disorders (TMDs) [1]. The consequences of bruxism include mechanical tooth wear (tooth abrasion), damage to the hard tissues of the tooth (enamel cracking), pain in the temporomandibular joints and masticatory muscles, headaches and cervical spine pain, earaches [2].

Until now, not all factors influencing the formation of bruxism have been recognized [3]. Currently, two theories of its formation are presented. The first theory assumes a peripheral etiology, while the second assumes a central etiology [2]. In the peripheral etiology, occlusal factors are mentioned, i.e., obstacles that occur in dental contacts and speech, such as premature dental contacts caused, for example, by improper filling of a tooth cavity. Central ethology is considered to play a greater role than occlusal etiology. In this etiology, civilization stress, which causes tonic tension of the masticatory muscles and the cervical spine due to the lack of possibility to relieve negative emotions, is mentioned as the main factor of bruxism [4]. It was originally thought that bruxism could arise through occlusal abnormalities and other morphological factors, but in the absence of any evidence supporting this thesis, it was rejected. However, it has been noted that there are factors that may increase the risk of developing bruxism. These factors include younger age, female gender, use of stimulants (cigarettes, alcohol, caffeine, drugs) among others. Certain sleep disorders such as obstructive sleep apnea may also have a significant role in the development of bruxism [5].

To diagnose the severity of bruxism, an index according to Panek is commonly used in clinical practice. This index divides bruxism into four degrees of its severity, i.e.: B1 (assumed bruxism), B2 (active bruxism with no major damage to hard tissues of teeth), B3 (‘gone through’ bruxism and fixed), B4 (active bruxism with abnormal tooth wear) [6]. Bruxism is also divided according to the time of occurrence during the day. We distinguish both daytime

bruxism, which occurs during the waking state (Daytime Bruxism), and unconscious, nocturnal bruxism, which occurs during sleep (Awake Bruxism) [7].

The symptoms of bruxism can be divided into extraoral symptoms and intraoral symptoms. Extraoral symptoms are those that occur in the masticatory muscles and the temporomandibular joint, but they also include visual and hearing disorders. Intraoral symptoms are those found in the teeth, periodontium, and oral cavity [8].

According to previous scientific data, people with bruxism are accompanied by headache, pain in the masticatory muscles and, in particular, the cervical spine [4]. This relationship is due to the biomechanical connection between the temporomandibular joints and the neck [9]. The posterior neck muscles (trapezius muscles, splenius muscles, semispinalis muscles, multifidus muscles) are involved in maintaining a stable position of the head and in gaining strength for cranial movement and are constantly working to maintain a stable position of the head. For this stability to be maintained, there must be a balance between anterior forces and posterior forces. The anterior forces are formed by the masticatory muscles, suprahyoid muscles, infrahyoid muscles, and the anterior neck muscles (sternocleidomastoid muscles, scalene muscles, and deep neck muscles). These muscle groups work together as a functional relationship [10]. Because of this functional relationship between the TMJ and cervical muscles, malposition of one can interfere the position and function of the other. Grieve found that patients with abnormal overactivity of the masticatory muscles may also have overactivity of the sternocleidomastoid muscles. This may result in abnormal elongation of the upper cervical muscles and loss of physiological cervical lordosis [11]. The numerous biomechanical connections between the temporomandibular joint and the cervical spine can lead to a situation where a dysfunction in one structure over time leads to dysfunction in the other structure.

Therefore, the authors of this study hypothesized that individuals with bruxism may have a higher rate of cervical spine disability than individuals without this parafunction.

## Objective

Assessment of neck disability index in people with bruxism.

## Material and methods

The study was conducted from February to April 2022 at the Department of Musculoskeletal Rehabilitation, Pomeranian Medical University in Szczecin. The study group (G1) consisted of 40 subjects of both sexes, aged 18 to 38 years (55% women 45% men), with bruxism diagnosed by dental examination.

Inclusion criteria in G1 were: dentist-determined B2 or B3 bruxism according to Panek; no neurological, autoimmune, endocrine, or degenerative joint disease; and consent to participate in the study. Exclusion criteria were: subjects undergoing orthodontic, prosthetic (dentures), surgical treatment, cervical spine disease, history of cervical spine trauma(s); pregnancy; taking analgesics and anti-inflammatory drugs during the study. The control group (G2) consisted of an equal number of subjects in the same age range without known bruxism.

All study participants who voluntarily consented to participate in the study were asked to complete a questionnaire.

To evaluate the subjects, a questionnaire consisting of two parts was used.

1. Metric. This part used four questions about age, gender, education, and occupation.

2. Standardized scale of neck spine disability index (NDI Neck Disability Index). The scale consists of 10 single-choice questions related to: pain intensity, self-reliance, lifting objects, reading, headaches, concentration, working, driving, sleeping and resting. Each question had 6 possible responses. Responses were scored on a scale of 0 to 5 points, where 0 points meant normal activity without pain and 5 points meant complete inability to be active, due to pain. At the end of the survey, the NDI disability index was calculated, where a score of - 4 points meant no disability, 5-15 points meant low disability, 15-24 points meant moderate disability, 25-34 points meant considerable disability, and a score of 35 points or more meant total disability.

**Group characteristics**

Analyzing the age of the respondents, almost half of them indicated the range of 18-24 years - 47.5%. In addition, 26.3% of the respondents were between 25 and 31 years old or between 32 and 38 years old (Figure 11). Analyzing the gender of the respondents, more than half (55%) of the research sample was female - 55%. Thus, the percentage of men was 45% of the total sample. Looking at the education of the respondents, more than half of them had a university degree - 57.5%. In addition, 37.5% of the respondents had secondary education at the time of the survey, while 5% had vocational education. Considering the occupation status of the respondents, the most numerous group were students - 36.3%. More than every fourth respondent was employed in a white-collar worker, while 3.8% - in a blue-collar worker. The remaining respondents admitted that their nature of work is mixed - 32.5%.

**Statistical analysis**

The data obtained will be statistically analyzed using SPSS STATISTIC software. Chi-square and Anova tests will be used for this purpose. The accepted level of statistical significance was $p<0.05$.

**Results**

The results of the neck disability index (NDI) are presented below. Respondents were asked to rate ten different aspects of life on a scale of 0 to 5, with the higher the rating, the greater the difficulty and intensity of pain.

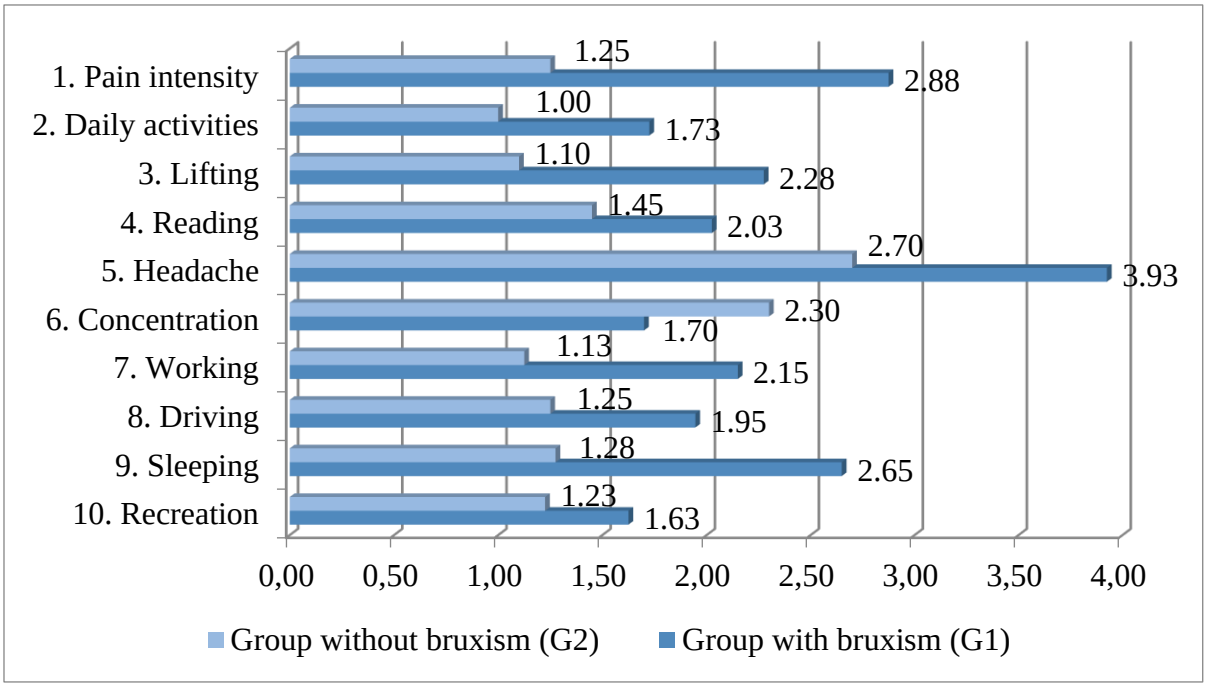


Fig. 1. Assessment of factors comprising the NDI scale in G1 and G2 based on the authors survey, N=80

*Source: Own elaboration based on the study*

The conducted analyses showed that people who were diagnosed with bruxism achieved higher pain levels for almost all factors. Only when considering concentration, greater difficulties were noted among those who are not affected by bruxism on a daily basis (Figure 1).

Tab. 1. Asessment of the factors comprising the NDI scale, and the profile of G1+G2 respondents (in %)

| Respondent profil | | N | Pain intensity | Anova | p | Daily activities | Anova | p | Lifting | Anova | p |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 18-24 years | 38 | 1.53 | 11.820 | 0.000 | 1.16 | 5.347 | 0.007 | 1.29 | 13.092 | 0.000 |
| | 25-31 years | 21 | 2.57 | | | 1.62 | | | 2.05 | | |
| | 32-38 years | 21 | 2.52 | | | 1.48 | | | 2.05 | | |
| Gender | Woman | 44 | 1.89 | 2.762 | 0.101 | 1.34 | 0.134 | 0.715 | 1.64 | 0.444 | 0.507 |
| | Man | 36 | 2.28 | | | 1.39 | | | 1.75 | | |
| Education | Secondary | 34 | 1.65 | 10.413 | 0.002 | 1.18 | 6.513 | 0.013 | 1.38 | 10.823 | 0.002 |
| | University | 46 | 2.37 | | | 1.50 | | | 1.91 | | |
| Occupation | Student | 29 | 1.45 | 18.716 | 0.000 | 1.10 | 10.162 | 0.002 | 1.24 | 19.544 | 0.000 |
| | Employee | 51 | 2.41 | | | 1.51 | | | 1.94 | | |
| Total | | 80 | 2.06 | | | 1.36 | | | 1.69 | | |

*Source: Own elaboration based on the study*

Tab. 2. Assessment of the factors comprising the NDI scale, and the profile of G1+G2 respondents (in %)

| Respondent profil | | N | Reading | Anova | p | Headach e | Anova | p | Concent ration | Anova | p |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 18-24 years | 38 | 1.55 | 2.541 | 0.085 | 2.82 | 5.961 | 0.004 | 2.16 | 0.962 | 0.387 |
| | 25-31 years | 21 | 1.86 | | | 3.76 | | | 1.86 | | |
| | 32-38 years | 21 | 1.95 | | | 3.76 | | | 1.86 | | |
| Gender | Woman | 44 | 1.75 | 0.029 | 0.866 | 3.52 | 2.616 | 0.110 | 2.25 | 7.021 | 0.010 |
| | Man | 36 | 1.72 | | | 3.06 | | | 1.69 | | |
| Education | Secondary | 34 | 1.56 | 3.718 | 0.053 | 2.88 | 6.981 | 0.010 | 2.09 | 0.488 | 0.487 |
| | University | 46 | 1.87 | | | 3.63 | | | 1.93 | | |
| Occupation | Student | 29 | 1.55 | 3.068 | 0.084 | 2.86 | 5.808 | 0.018 | 2.38 | 7.568 | 0.017 |
| | Employee | 51 | 1.84 | | | 3.57 | | | 1.78 | | |
| Total | | 80 | 1.74 | | | 3.31 | | | 2.00 | | |

*Source: Own elaboration based on the study*

Tab. 3. Assessment of the factors comprising the NDI scale, and the profile of G1+G2 respondents (in %)

| Respondent profil | | N | Praca | Anova | p | Jazda samochodem | Anova | p |
|---|---|---|---|---|---|---|---|---|
| Age | 18-24 years | 38 | 1.42 | 3.986 | 0.023 | 1.25 | 9.603 | 0.000 |
| | 25-31 lat | 21 | 1.95 | | | 2.05 | | |
| | 32-38 lat | 21 | 1.71 | | | 1.70 | | |
| Gender | Woman | 44 | 1.64 | 0.000 | 0.988 | 1.50 | 1.172 | 0.282 |
| | Man | 36 | 1.64 | | | 1.69 | | |
| Education | Secondary | 34 | 1.47 | 3.146 | 0.080 | 1.30 | 8.994 | 0.004 |
| | University | 46 | 1.76 | | | 1.80 | | |
| Occupation | Student | 29 | 1.38 | 5.995 | 0.007 | 1.21 | 12.327 | 0.001 |
| | Employee | 51 | 1.78 | | | 1.80 | | |
| Total | | 80 | 1.64 | | | 1.58 | | |

*Source: Own elaboration based on the study*

Tab. 4. Assessment of the factors comprising the NDI scale, and the profile of G1+G2 respondents (in %)

| Respondent profil | | N | Sleeping | Anova | p | Recreation | Anova | p |
|---|---|---|---|---|---|---|---|---|
| Age | 18-24 years | 38 | 1.47 | 9.868 | 0.000 | 1.32 | 1.206 | 0.035 |
| | 25-31 years | 21 | 2.38 | | | 1.48 | | |
| | 32-38 years | 21 | 2.43 | | | 1.57 | | |
| Gender | Woman | 44 | 1.93 | 0.085 | 0.772 | 1.48 | 0.666 | 0.417 |
| | Man | 36 | 2.00 | | | 1.36 | | |
| Education | Secondary | 34 | 1.65 | 0.5809 | 0.018 | 1.41 | 0.026 | 0.873 |
| | University | 46 | 2.20 | | | 1.43 | | |
| Occupation | Student | 29 | 1.34 | 20.046 | 0.000 | 1.31 | 1.507 | 0.223 |
| | Employee | 51 | 2.31 | | | 1.49 | | |
| Total | | 80 | 1.96 | | | 1.43 | | |

*Source: Own elaboration based on the study*

When intergroup comparisons are made, it can be observed that significantly greater difficulty and pain intensity were present for almost all aspects among those aged 25-31 years, those with a university education, and those who were professionally employed (Table 1-4).

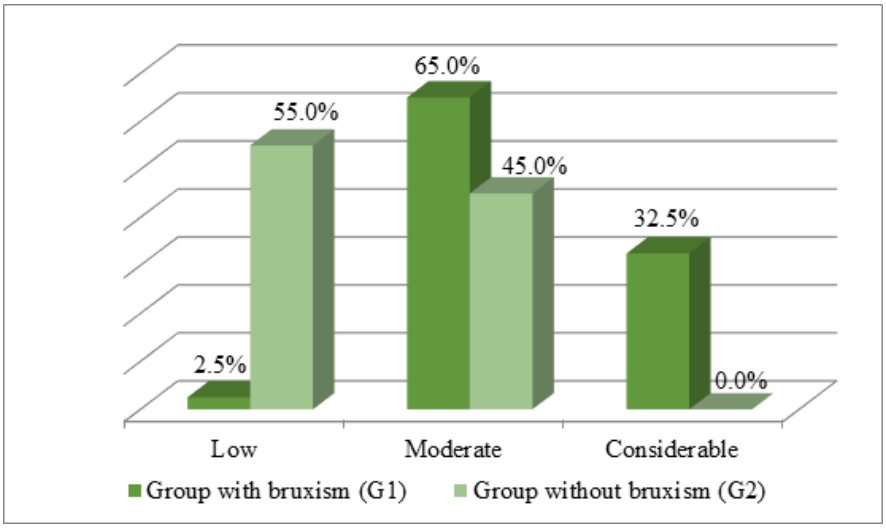


Fig. 2. Assesment of the neck spine disability score in NDI scale at G1 and G2, based on authors survey, N=80% (%)

*Source: Own elaboration based on the study*

The neck spine disability scale is summarized by determining the rate of disability present. Analyses used for this purpose showed that almost all respondents with bruxism had moderate or considerable disability, with 65 and 32.5% of respondents indicating this, respectively. On the other hand, respondents not affected by bruxism were significantly more likely to have a score indicating low or moderate disability with 55 and 45% of indications, respectively (Fig.2).

Tab 5. Assesment of the neck spine disability score in NDI scale, and G1+G2 respondent profile (%)

| Respondent profil | | N | Low | Moderate | Considerable | Chi-kwadrat | p |
|---|---|---|---|---|---|---|---|
| Age | 18-24 years | 38 | 44.7 | 55.3 | 0.0 | 18.387 | 0.001 |
| | 25-31 years | 21 | 14.3 | 52.4 | 33.3 | | |
| | 32-38 years | 21 | 14.3 | 57.1 | 28.6 | | |
| Gender | Woman | 44 | 29.5 | 50.0 | 20.5 | 1.530 | 0.456 |
| | Man | 36 | 27.8 | 61.1 | 11.1 | | |
| Education | Secondary | 34 | 35.3 | 64.7 | 0,0 | 11.502 | 0.003 |
| | University | 46 | 23.9 | 47.8 | 28.3 | | |
| Occupation | Student | 29 | 44.8 | 55.2 | 0.0 | 11.482 | 0.003 |
| | Employee | 51 | 19.6 | 54.9 | 25.5 | | |
| Total | | 80 | 28.8 | 55.0 | 16.3 | | |

*Source: Own elaboration based on the study*

By correlating the NDI index with the profile of the respondents, it can be observed that considerable disability was significantly more prevalent among those aged 25-31 years with higher education (Tab.5).

## Discussion

Performing biomechanical analysis of the stomatognathic system and the cervical spine, it can be observed that they form a closed biokinematic chain. This means that all elements functionally can interact with each other in a direct manner. Increased tension in the masticatory muscles may be the cause of pain in the craniofacial region, temporomandibular joints, supra- and infra-hyoid region and the cervical spine.

Analyzing the results of the study, the authors observed that bruxism is significantly more common in people aged 25 to 31 years with university education and employed ($p<0.05$). The obtained results partly agree with the data from the literature, where it is reported that bruxism affects people aged 18 to 29 years to the greatest extent [12]. And its main etiological factors are psycho-emotional overload, including chronic stress and environmental demands on the individual [13].

Analyzing the results of a study conducted by the authors, it was noted that individuals struggling with bruxism had higher neck disability than those without this parafunction. In people with bruxism, this disability is moderate or considerable - 65% and 32.5% of indications, respectively. Those without bruxism had low to moderate disability - 55% and 45%, respectively. According to a study by Tuncer et al., the probability of NDI was significantly increased by 3.4 times in individuals with nocturnal bruxism compared to individuals without this parafunction [14].

Due to the direct connection between the SS structures and the cervical spine, numerous research papers have shown the impact of bruxism on cervical spine function [15, 16, 17, 18]. In their study, Piekartz et al. found that bruxism was significantly correlated with higher rates of neck disability, as well as the presence of TMDs. They showed that cervical dysfunction is one of the risk factors for bruxism. [16]. Gouw et al. noted the high coherence of neck muscles and jaw muscles. They emphasize the importance of looking at the entire head-neck system as one functional unit, rather than separating them into individual segments [15]. The same relationship between the cervical and facial muscles was noted by Giannakopoulos et al [18]. Herpich et al. observed that the cervical angle in subjects with bruxism differed from the cervical angle in subjects without bruxism. The more the severity of TMDs symptoms increased in patients with bruxism, the greater the cervical angle [17]. Winocur et al. found that the most common symptom associated with bruxism was cervical pain (46.6%) [19]. More frequent cervical pain problems in patients with nocturnal bruxism were also observed by Tuncer et al [14]. Santamato et al. studied the effect of botulinum toxin in a patient with nocturnal bruxism on cervical pain. In the study, the toxin was injected into the masseter and temporal muscles, and the result was a reduction in cervical pain. However, this study must take into account the uncertainty regarding bruxism as a cause of cervical spine pain and the fact that the reduction

in cervical spine pain may have been due to other treatments used by the patient [20]. In a study, Walczynska-Dragon et al. examined the effect of occlusal splinting in TMDs on cervical spine pain. During a 3-month study, they found an improvement in pain and increased cervical mobility [21]. In a 2003 study of a 6-year-old female patient with bruxism complaining of cervical pain, vector manipulation of the upper cervical spine was used. The treatments used resulted in a reduction in pain [22].

The authors study was designed to assess the cervical spine disability index and the prevalence of temporomandibular joint disorder (TMDs) symptoms in individuals with bruxism. The results of this study significantly confirmed previous scientific reports indicating a functional relationship between the TMJ and the cervical spine. As the biomechanical analysis of the SS shows, a disorders in one structure affects other structures. The above data are particularly important for the medical team conducting diagnosis and therapy of patients with disorders of the stomatognathic system. With an interdisciplinary team including a dentist (e.g., prosthodontist) and a dental physiotherapist, it is possible to holistically treat patients with TMDs toward improving function and relieving pain from the SS structures.

## Conclusion

1. Individuals with bruxism have higher levels of neck pain compared to the group without parafunction.

2. A higher rate of neck disability is significantly correlated with the presence of bruxism, and attention should be paid to this when diagnosing and treating a patient with masticatory parafunction.

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