

# Problems of sleep, depression, quality of life in adolescents with TMD diagnosis

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## Highlights

Adolescents with TMD are at a greater risk of developing depression and they suffer a greater impact of these on their quality of life.

The quality of life can be affected by an inappropriate level of sleep, which might cause social withdrawal, anxiety and low self-esteem.

More attention should be given to this patient group by preventing and controlling the progression of dysfunction as well as providing more comprehensive treatment and multidisciplinary interaction.

## Abstract

**Aim:** To verify the relationship between temporal-mandibular dysfunction (TMD) with depression, sleep, sleepiness and quality of life in adolescents aged 13 to 18 years old. **Methods:** Thirty-eight adolescents being seen at the UFAL Dental Clinic (Federal University of Alagoas), for TMD, and qualifying according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC / TMD), participated in the study. Two instruments were used to investigate sleep quality: the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS); the Oral Health Impact Profile (OHIP-14) for quality-of-life assessment; and the Beck Depression Inventory (BDI-II) for depression assessment. Pearson's correlation coefficient was used for the relationship of numerical variables. For the means tests, the Student *t* test was applied (using, when necessary, the Welch correction). For the analyses, the Bonferroni correction was considered. **Results:** After calculation,  $\alpha$ Bonferroni correction was applied equal to 0,0005. Of the total number of participants (56% female and 44% male), with a mean age of 14.7). In all comparisons between groups (with and without TMD), there were statistically significant indices for adolescents with TMD in relation to: depression ( $p=5.6 \cdot 10^{-11}$ ), quality of life ( $p=4.3 \cdot 10^{-12}$ ), sleep quality ( $p=5.0 \cdot 10^{-10}$ ), and somnolence ( $p=0.0002$ ). From the correlation matrix, it was observed that all correlations were significantly positive and moderate. **Conclusions:** Adolescents with a diagnosis of TMD presented an increase of depression and somnolence, as well as impairment of sleep quality and quality of life, and these same variables can influence on the onset of TMD.

**Keywords:** Adulthood; Temporomandibular Dysfunction; Temporomandibular Joint

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## INTRODUCTION

Adolescence is the transitional period between childhood and adulthood, in which changes, discoveries, and the construction of identity takes place. During this period, physical changes and body alterations affecting the mouth and teeth often occur. These have the potential to compromise the well-being and quality of life of these individuals and reproduce a process of detachment and changes in behavior patterns.

The temporomandibular joint (TMJ) is formed by muscles and bone structures, which connect the mandible to the skull, the set of dysfunctions that affect it is known as temporomandibular dysfunction (TMD).<sup>1,2</sup>

Its frequency can vary from 6% to 68%,<sup>3</sup> 4.5% to 62%<sup>4</sup> and 34.9%.<sup>5</sup> This difference is related to the studied populations, diagnostic criteria applied, and the variations in the data related to the practice of the tests.

Although a cause or pathophysiology of the condition have not been identified, its etiology is believed to be multifactorial and biopsychosocial (wherein emotional conditions are intimately linked with a severe somatic state of stress and anxiety, consisting of initiating, predisposing, and perpetuating factors).<sup>6</sup> Psychological variables and female gender are important risk indicators related to the incidence of TMD, even in adolescents.<sup>7</sup> There is a correlation between depression and functional impairment in the origins of TMDs.<sup>8</sup> The association between the presence of psychological factors, especially depression, in patients with TMD has been demonstrated by several authors.<sup>8,9,10</sup>

Adolescents with TMD are at a greater risk of developing depression and they suffer a greater impact of these factors on their quality of life.<sup>10,11</sup> Its signs and symptoms can substantially affect their functional, emotional, and psychological functioning, generating a negative impact and affecting the quality of life of children and pre-adolescents. They are affected mainly by pain and

its severity, which has the potential to affect the physical as well as the psychological, causing both discomfort, limitations and reduced quality of life.<sup>12,13,14</sup>

The quality of life can be affected by an inappropriate level of sleep, which might cause social withdrawal, anxiety, and low self-esteem. Quality of life, health, and longevity may require quiet, sleepy nights of sleep so that, during sleep, proteins are synthesized and maintain neural networks linked to memory and learning. Low self-esteem and greater impairment of psychological well-being, symptoms of anxiety, depression and unhappiness can compromise quality of life.<sup>14,15</sup>

The chronic sleep loss may influence other diseases, and its short duration often can be brought to the adult life.<sup>16</sup> When adolescents sleep later, they can suffer from a decrease in the quality of nocturnal sleep; they often report increased daytime drowsiness.<sup>17,18</sup>

Sleep patterns undergo important changes during adolescence, and may have implications for the immune system, which is regulated by the sleep-wake cycle.<sup>19,20</sup>

Myofascial pain can impair sleep quality, affecting daily life. Two-way interactions occur between the experience of pain and the sleep process: pain interferes with the ability to sleep and interrupted sleep contributes to increasing the perception of pain. There is a possibility that interrupted sleep may serve as a risk factor for inadequate pain inhibition processing and suggest that efforts to treat early-onset sleep disorder may be beneficial in reducing the severity or impact of pain.<sup>20,21</sup>

Although several factors interfere with the onset of TMD, a better knowledge regarding sleep problems, quality of life and depression are of great importance in preventing its onset, development and installation and, as well, preventing further damage in the future. As dental surgeons understand better the causes of TMD, it

will be easier to diagnose the disease and make a plan in order to enrich the living of the patients with this particular disorder. The objective of this study was to evaluate adolescents between the ages of 13 and 18, with and without TMD, and to correlate with depression, quality of life and sleep, and to correlate these variables with each other.

## METHODS

### Study design

This research was approved by the Ethics and Research Committee of the São Leopoldo Mandic SS Dental Research Center (opinion 2.270.675/2017). Informed consent were obtained from all participants. All the adolescent participants were interviewed and evaluated by the researcher for the diagnosis of TMD. They also completed instruments for assessment of depression, quality of life and sleep (by another examiner integral to the dental clinic of UFAL and blinded to this study). The administrator of the questionnaires was not aware of the diagnosis and, therefore, did not know to which group the participant belonged.

This was an observational, cross-sectional, descriptive, and analytical study about male and female adolescents aged 13 to 18 years-old who were diagnosed with temporomandibular dysfunction (TMD). These participants were compared to adolescents without TMD in the areas of depressive symptoms, quality of life, and sleep-related issues.

### Sample size

A pilot study was conducted with 16 patients from the Dental Clinic of the Federal University of Alagoas, to estimate the sample number. In this study, it was found that approximately 25% of patients had TMD. From this finding, and using a confidence level of 95%, the minimum sample size for a robust proportion of a known population was calculated. Knowing that in the Dental Clinic of the Federal University of Alagoas

the demand is spontaneous, a survey was carried out during the period from January to March of 2017 (in which 45 examinations took place). From this information, it was determined that the sample size of patients with TMD should be 69. The control group, it was found, should consist of a number of equal size, thus arriving at a total of 138 patients.

### Clinical examination

The researcher (KACPC) was properly trained to perform the diagnosis of TMD through the theoretical capitulation by observation of the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), reading and memorizing the specifications for the respective examination and trained by a TMD specialist on the classification diagnosis of RDC/TMD. The researcher applied the RDC/TMD to 16 individuals to perform the pilot study and then reapplied for the expertise, thus obtaining the diagnosis. A reevaluation occurred after 15 days, by the same examiner. Participants with an intra-examiner kappa index above 90% were considered for evaluation

The criteria for inclusion of the research were those adolescents who agreed to participate, were authorized to do so by their legal guardians, and who signed the Free and Informed Consent Form. It was explained to each that the procedures were simple, with no risk to the participants and preserved the names of them. At the end, cognitive orientations were given to those diagnosed with TMD and referred to the UFAL orofacial pain clinic.

Participants with mental disability, orofacial deformities, using antidepressant medications or any other medication that interfered with improvement in depression, quality of life and/or sleep were not included in the study, as were any who could not adequately answer the examination questions and/or the questionnaire or expressed, at any time, the desire not to participate in the research.

## TMD diagnosis

For the diagnosis of TMD, the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD),<sup>22</sup> Portuguese version,<sup>23</sup> multiaxial, was used. Axis I assess TMD clinical conditions and offers a better diagnostic classification for researches, in that it covers the possible physical aspects of temporomandibular muscle dysfunction (myofascial pain and myofascial pain with aperture limitation). The diagnosis is related to the examination items, specified in detail, and to the presence of the signs and symptoms.

## Evaluation of the quality of sleep and sleepiness

The Pittsburgh Sleep Quality Index (PSQI), which is a questionnaire that assesses sleep quality over a period of one month, was performed using two instruments. The translated and validated version into Brazilian Portuguese proposed by Bertolazi. et al.<sup>24</sup> was used. It consists of 19 self-rated questions and 5 questions to answered by bedfellows or roommates. The 19 questions are classified into 7 components, with a score from 0 to 3. The PSQI components are as follows: subjective sleep quality (C1), sleep latency (C2), sleep duration (C3), habitual sleep (C4), sleep disturbances (C5), use of medication to sleep (C6), and diurnal dysfunction (C7). The sum of scores for these 7 components provides a global score, ranging from 0 to 21, where the highest score indicates poorer sleep quality. And the Epworth Sleepiness Scale (ESS), for the evaluation of daytime sleepiness, in its Portuguese version, was developed by John.<sup>25</sup> This tool evaluates the degree of sleepiness through the possibility of dozing in 8 daily situations. It was used the translated version to Portuguese, developed by Bertolazi, A. et al.<sup>26</sup> To assess the possibility of dozing in a given setting, the individual uses a scale of 0 (corresponding to none) to a maximum of 3 (great possibility of dozing). A total score >10 is used as the cut-off

point. Scores greater than 16 indicate severe somnolence.

## Evaluation of depression

The Beck Depression Inventory (BDI-II)<sup>27</sup> was used to assess depression problems. It is one of the most popular scales for assessing the severity of depression in adolescents as well as in adults. It consists of a questionnaire with 21 items. The instrument was validated for Portuguese by Gorenstein and Andrade.<sup>28</sup> The scale measures the severity of episodes of depression. It consists of several items related to depressive feelings (such as hopelessness, irritability, guilt, and a sense of being punished), as well as physical symptoms (such as weakness, weight loss, and decreased libido). Each response receives a value of 0–3. The categories used were drawn from the original: 0–13 minimal depression, 14–19 mild depression, 20–28 moderate depression and 29–63 severe depression. Higher values indicate a greater severity of depressive symptoms.

## Quality of life assessment

To evaluate the quality of life, the Oral Health Impact Profile (OHIP-14) was used. It was developed by Slade,<sup>29</sup> and its already translated and validated form to Brazilian Portuguese was used by Oliveira and Nadanovsky.<sup>30</sup> The OHIP-14 consists of 7 dimensions, represented by the following issues: functional limitations: issues 1 and 2 of the form; physical pain: issues 3 and 4 of the form; Psychological discomfort: issues 5 and 6; physical incapacity: issues 7 and 8; psychological incapacity: issues 9 and 10; social incapacity: issues 11 and 12; disability: issues 13 and 14. To calculate the impact of orofacial pain on patients' quality of life, the standard method of calculation of the OHIP-14 was used, using the specific weight for each question. The following scores were assigned to each response: never - 0, rarely - 1, sometimes - 2, often - 3, always - 4, do

not know - exclusion (of any form). As proposed by Slade, the value attributed to each question was multiplied by its specific weight, resulting in a maximum value variation for each question from 1.36 to 2.64 points. When adding the final score of all the questions, there can be a variation from 0 to 28 points. The higher the score presented, the greater the repercussion on the quality of life.

### Statistical analysis

The data were initially entered into a Microsoft Office Excel worksheet. Subsequently, the variables were grouped by instruments and organized into tables and graphs.

Pearson's correlation was used to analyze the relationship of numerical variables. For the means tests, the Student *t* test was used (applying, when necessary, the Welch correction for different variances). The tests were two-tailed. For the criterion of rejecting the null hypotheses, the 5% level (that is,  $p$ -value  $< .05$ ) was considered for the whole of the tests using the Bonferroni correction to avoid the inflation of the error rate of the family [ $TEF = 1 - (1-0.05) 10$ ]. Data were analyzed using statistical software R for Windows, version 3.5.0.

## RESULTS

After calculating the family error rate, it was observed that in only one of any of the results of the 10 tests (using a 5% significance level), there was a 40% risk of a type I error (due to having some of these results due to chance, based on the null hypothesis). Thus, the value of  $\alpha$  was corrected in  $\alpha_{\text{Bonferroni}} = 0.0005$ .

### Demographic data

The sample consisted of 138 adolescents, of whom 56% were female and 44% were male. The mean age of adolescents was 14.7 years, and three-quarters of the sample were between 13 and 16 years of age.

### Depression assessment

The  $p$ -value found, equal to  $5,6 \cdot 10^{-11}$ , lies well below the threshold established by the Bonferroni correction. That is, it was observed that there was a significant difference between the means of the total BDI-II scores in relation to the control and TMD groups, with averages of 7.4 (minimum depression) and 20.5 (moderate depression), respectively. Categorically considering, the BDI-II score stratified by the group, where it can be seen that the predominance of the "DTM" group for the depression categories above "minimum", in this category the "Control" group is more frequent (Table 1).

Table 1. Analysis of the BDI-II scores versus control and TMD groups

Depression†	Groups		Total
	Control	TMD	
Minimum	58	22	80
Light	7	12	19
Moderate	3	15	18
Severe	1	20	21
<b>Total</b>	<b>69</b>	<b>69</b>	<b>138</b>
Minimum	0.0	0.0	0.0
First Quartile	2.0	10.0	4.0
Median	5.0	20.0	10.0
Average&	7.4	20.5	14.0
Third Quartile	10.0	30.0	21.0
Maximum	46.0	52.0	52.0

† Categories according to Beck Depression Inventory (BDI-II); & Student *t* test with Welch correction. Total BDI-II versus Group

### Sleepiness assessment

In this case, as the p-value equal to .0002 was lower than the threshold calculated for the number of multiple comparisons (Bonferroni correction) and always with the optics to avoid the inflation of type I errors for the test family, the hypothesis null was rejected. It was observed that there was a significant difference between the means of the total ESS-BR scores in relation to the control and TMD groups, with a mean of 7.8 (little drowsiness) and 10.8 (moderate drowsiness), respectively. Regarding the level of somnolence, little sleepiness was predominant for the majority of adolescents in the control group and the higher frequency of moderate and severe sleepiness in the TMD group (Table 2).

Table 2. Analysis of ESS-BR scores, control vs. TMD groups

Somnolence†	Groups		Total
	Control	TMD	
Little	51	33	84
Moderate	15	25	40
High	3	11	14
<b>Total</b>	<b>69</b>	<b>69</b>	<b>138</b>
Minimum	1.0	0.0	0.0
First Quartile	4.0	8.0	6.0
Median	7.0	11.0	9.0
Average&	7.8	10.8	9.3
Third Quartile	11.0	15.0	13.0
Maximum	22.0	20.0	22.0

† Drowsiness: (low  $\leq 9$ ); (10  $\leq$  moderate  $\leq 15$ ); (16  $\leq$  strong  $\leq 24$ ). & Student t test with Welch correction. Total score ESS versus Groups produced the  $t = -3.8$  statistic, with 134.1 degrees of freedom (d.f.); and p value = .0002.

### Sleep quality assessment

The p-value found (equal to  $5.0 \cdot 10^{-10}$ ) is well below the threshold established by the Bonferroni correction. That is, it was observed that there is a significant difference between the means of the total Pittsburgh Sleep Quality Index (PSQI-BR) scores in relation to the control and TMD groups, with averages of 5.3 and 9.8, respectively. From the “medians” perspective, the difference between the control and TMD groups was better, with medians 4.0 (good sleepers) and 10 (poor sleepers), respectively. The analysis showed that 87% of the adolescents in the TMD group were poor sleepers; in the control group, 59% of adolescents had normal sleep quality. A comparison of the results, especially when looking at the control group mean, shows that although the group mean is above the cut-off point of five, comparing both groups as having sleep difficulties, the contingency table is perfectly seen in a way that most subjects in the “control” group have total scores lower than five while the situation reverts to the TMD group. (Table 3).

Table 3. Analysis of PSQI-BR scores versus control and TMD groups

Sleep quality†	Groups		Total
	Control	TMD	
Good	41	9	50
Bad	28	60	88
<b>Total</b>	<b>69</b>	<b>69</b>	<b>138</b>
Minimum	2.0	3.0	2.0
First Quartile	3.0	7.0	4.0
Median	4.0	10.0	7.0
Average&	5.3	9.8	7.6
Third Quartile	7.0	12.0	11.0
Maximum	15.0	19.0	19.0

† Sleep quality: (Good  $\leq 4$ ); (5  $\leq$  Poor  $\leq 21$ ). & Student t test with Welch correction. Total score PSQI versus Groups yields the statistic  $t = -6.9$ , with 97.24 degrees of freedom (d.f.); and p value =  $5.0 \cdot 10^{-10}$ .

### Quality of life assessment

Some of the participants answered one or more questions in the OHIP-14 questionnaire with the response "I do not know" or left the answer blank (totaling 116 cases, 65 in the control group and 50 in the TMD group).

The p-value found equal to  $4.3 \cdot 10^{-12}$ , lies well below the threshold established by the Bonferroni correction. That is, it was observed that there is a significant difference between the means of the total OHIP-14 scores in relation to the control and TMD groups, with averages of 10.5 (mean impact) and 17.1 (mean impact), respectively. Otherwise put, the majority of the respondents were classified as having a "medium" impact, 58% of adolescents for the OHIP-14 total score. Cases classified as having a "high" impact were only in the TMD group, while the majority of cases with " "Is in the" Control "group, with only one" TMD "case with this impact (Table 4).

Table 4. OHIP-14 impact analysis versus control and TMD groups

Impact†	Groups		
	Control	TMD	Total
Weak	28	1	29
Medium	38	29	67
Strong	0	20	20
<b>Total</b>	<b>66</b>	<b>50</b>	<b>116</b>
Minimum	7.0	7.1	7.0
First Quartile	8.0	11.8	9.3
Median	9.9	17.1	12,0
Average&	10.5	17.1	13.4
Third Quartile	12.8	22.1	16.2
Maximum	16.3	25.1	25.1

† Impact: (weak < 9.33); ( $9.33 \leq \text{mean} < 18.66$ ); ( $18.66 \leq \text{strong} \leq 28$ ) & Student *t* test with Welch correction. Total score OHIP-14 versus Groups yields the statistic  $t = -8.3$ , with 71.87 degrees of freedom (d.f.); and p-value =  $4.3 \cdot 10^{-12}$ .

### Correlations between instrument scores

For all the analyses that follow in this subsection, only the 116 cases whose values of the OHIP-14 questionnaire could be imputed are part of the tests and evaluations presented. The correlation coefficients and their respective p-values are summarized in Table 5.

Table 5. Correlation coefficient matrix and p-values – Oral Health Impact Profile (OHIP-14), Beck Depression Inventory (BDI-II), Epworth Sleepiness Scale (ESS) and Pittsburgh Sleep Quality Index (PSQI)

X	OHIP	BDI	ESS	PSQI
<b>OHIP</b>	–	0.59	0.42	0.48
<b>BDI</b>	$2.27 \cdot 10^{-12}$	–	0.46	0.67
<b>ESS</b>	$2.34 \cdot 10^{-06}$	$2.44 \cdot 10^{-07}$	–	0.40
<b>PSQI</b>	$5.03 \cdot 10^{-08}$	$2.22 \cdot 10^{-16}$	$9.71 \cdot 10^{-06}$	–

\*The upper triangular matrix contains the Pearson correlation coefficients and lower the p-values of the correlations.

In order to analyze the hypothesis of correlations, between the scores of the various instruments, six correlations were made between 4 variables whose results are presented in Table 5. For the number of cases under analysis, the value of the critical correlation coefficient (in module) was 0,18 for each individual correlation (the so-called comparative error rate). With the results obtained for the correlations, all the instruments are correlated with each other with statistical significance (p-value < 0.001), that is, a level of 0.1%. Thus, all correlations between the 4 instruments were statistically significant, even considering the Bonferroni correction for the p-values. It was found that all correlations were positive and moderate, that is, as one of the scores increased, the other also increased. The analysis of its dimensions in the correlation matrix indicated that all the variables correlated well against each other in this research.

Highlighting the lowest explained variance was found in the correlation between the PSQI and ESS (16%), and the highest between the BDI and PSQI (with 45% of the variance explained). It was demonstrated that the lowest relationship was found between sleep quality indexes and sleepiness and the highest between depression and sleep quality.

## DISCUSSION

As in any disease, the knowledge of TMD risk factors support the practitioner's ability to establish strategies in an attempt to avoid or postpone the onset of adverse clinical conditions. Based on the premise of health promotion of the individual, the need to understand the different situations that appear associated with this dysfunction precedes the knowledge of the early identification of signs and symptoms. It is important to note at this point that the presence of signs and symptoms, as may emerge apart from TMD, may not represent the developing disease. The clinical use of the knowledge of the risk factors is very important to understand the development of the TMD. The relevant literature still does not document satisfactorily the influences these factors may exert on children and adolescents in their various stages of growth; as a result, many inferences from adult research still need to be made.<sup>31</sup>

The prevalence of TMD in Brazilian adolescents is significantly more common in females.<sup>8,31,32</sup> Previous findings are consistent with the present study, where the proportion of female participants is higher than the males in the TMD group. Hormones such as estrogen are known to interfere with pain sensitivity; this may result in disease processes in the TMJ region, including inflammation. However, no single process can fully explain the predilection for TMD in females, suggesting that other dependent mechanisms are also involved.<sup>32,33</sup>

The etiology of TMD involves predisposing, precipitating, and perpetuating factors that contribute to its development.<sup>34</sup> Psychological variables are important risk indicators related to the incidence of TMD, even in adolescents.<sup>27</sup> The higher prevalence of depression and somatization during pubertal growth may contribute to more reports of symptoms in individuals with TMD, and the increase in pain level may cause emotional responses to some degree, the adequacy to stress may develop a factor in the appearance of this dysfunction.<sup>35</sup> These data corroborate our results, where it was observed that the majority of adolescents with TMD presented with moderate to severe depression.

There is a significant correlation between TMD, anxiety, and depression.<sup>8,36,37</sup> Signs and symptoms of TMD can substantially affect the functional, emotional, and psychological well-being of the youngster, generating negative impact and affecting the quality of life of both children and pre-adolescents.<sup>12,38</sup> The results of the current study confirm that depressive signs can have an extensive impact on the quality of life of adolescents; moreover, correlations have been found between the variables of depression and quality of life, the evaluation of the quality of life appears as a relevant outcome, because of its many dimensions, they have the capacity to identify the importance and involvement with depression.

Orofacial pain seems to have some impact on the quality of life of patients with TMD.<sup>13,39</sup> their clinical involvement is associated with the increased disease activity and the commitment of quality-of-life impairment.<sup>40</sup> In assessing data related to TMD OHIP-14, higher values were found in patients with TMD compared to asymptomatic individuals.

Sleep and emotion are intimately linked: sleep deprivation is associated with a decreased ability to recognize emotions. It thus has a direct influence on social interactions, leading to

emotional irritability, insomnia, and sleep abstinence.<sup>10,41</sup> A longitudinal study of 6504 adolescents and young adults showed a relationship between sleep disturbance and depression, on the one hand, and suicidal thoughts and attempts, on the other.<sup>42</sup> It was observed in the present study that adolescents with depression presented with alterations in the quality of their sleep. The majority of the control group, in contrast, presented with a good quality of sleep. From the same point of view, Lei J et al.<sup>43</sup> evaluated subjects with TMD and associated them with disturbed sleep and greater psychological distress than those subjects without symptoms of sleep dysfunction, they reported in their study results that sleep disorders, as well as the negative emotional states of depression, anxiety, and stress, are associated with TMD.

Studies have shown a negative influence on sleep quality of adolescents with TMD.<sup>21,44</sup> Sitar et al.<sup>45</sup> reported bi-directional interactions between TMD and sleep in their studies, with pain interfering with sleep capacity and interrupted sleep contributing to increased pain perception. In the study, the majority of adolescents with TMD were found to be poor sleepers. The same occurred with regard to drowsiness, in which the majority presented with moderate to severe drowsiness.

Changes in the quality of nocturnal sleep, such as insomnia and sleep-disordered breathing, may contribute to increased episodes of daytime sleepiness in adolescents.<sup>45,46</sup> Insomnia and daytime sleepiness, time and sleep variation (in the form of short and interrupted sleep patterns) have become increasingly frequent in the lives of the juvenile population, thus influencing their healthy development.<sup>46,47</sup> Quality of life is directly affected by inadequate sleep and increased daytime sleepiness.<sup>48</sup> Through the present work, correlations among these variables were demonstrated.

Symptoms of TMD, stress, anxiety, and depression increase the rate of sleepiness.<sup>49</sup> In

addition, poor sleep quality may contribute to drowsiness and deteriorate quality of life.<sup>50</sup> The severity of TMD can have an influence on quality of life, emotional state and, as well, quality of sleep.<sup>51</sup> Interactions confirmed in the present study, in which sleepiness, sleep quality, depression, and quality of life were correlated with each other, and then compared with each other. In this study, it is worth highlighting that the highest values for these variables were significantly present in adolescents with TMD.

The literature shows that TMD and important factors such as quality of life, sleep quality, drowsiness, and depression influence one another and can lead to changes in the physical and psychological state of adolescents. More attention should be given to this patient group by preventing and controlling the progression of dysfunction as well as providing more comprehensive treatment and multidisciplinary interaction among different professionals.

## CONCLUSIONS

According to the results it can be concluded that there are correlations amongst TMD, depression, quality of life, quality of sleep, and drowsiness. The participants with TMD had higher levels of these variables, when compared to those without symptoms. The findings of this research may be equally important in stimulating and encouraging researchers to do more work involving the subject.

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