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ORIGINAL ARTICLE

Prevalence of temporomandibular disorders in adult obstructive sleep apnoea patients: A cross-sectional controlled study

Maria Lavinia Bartolucci[1] | Francesco Bortolotti[1] | Irene Pelligra[2] | Chiara Stipa[1] | Giovanni Sorrenti[2] | Serena Incerti-Parenti[1] | Giulio Alessandri-Bonetti[1]

[1]Section of Orthodontics and Dental Sleep Medicine, Department of Biomedical Sciences, University of Bologna, Bologna, Italy

[2]Department of Otolaryngology Head and Neck Surgery, Sant'Orsola-Malpighi Hospital – University of Bologna, Bologna, Italy

Correspondence
Giulio Alessandri-Bonetti, Section of Orthodontics, Department of Biomedical Sciences, University of Bologna, Via San Vitale, 59, 40125 Bologna, Italy.
Email: giulio.alessandri@unibo.it

Abstract

Background: Obstructive sleep apnoea (OSA) is characterised by partial or complete obstruction of the upper airways during sleep and it has been associated with temporomandibular disorders (TMDs) on the basis of several pathophysiological hypotheses.

Objectives: To assess the prevalence of TMDs in a population of patients affected by OSA compared to a control group of subjects not affected by OSA.

Methods: A cross-sectional controlled study was conducted on a group subjects studied by polygraphy (PG) at the snoring section of the ENT department, Sant'Orsola-Malpighi Hospital – University of Bologna. Patients who received a diagnosis of OSA were included in the study group and subjects with a negative PG diagnosis for Sleep Disordered Breathing and PG respiratory pattern that did not suggest the occurrence of sleep disorders were enrolled in the control group. Both the subjects included in the study group and the control group underwent an examination following the Diagnostic Criteria for Temporomandibular Disorders Axis I and II.

Results: Forty-three OSA patients (29 M, 16 F, mean age 52.26 ± 11.40) and 43 healthy controls (25 M, 18 F, mean age 49.95 ± 7.59) were included in the study. No significant differences were found between groups in demographic data. TMD prevalence and Axis II results did not differ between groups.

Conclusions: This paper does not highlight a higher prevalence of TMDs in adults with OSA compared to healthy controls. Further high-quality studies are needed to confirm the results and to give possible pathophysiological explanations, providing reliable evidence.

KEYWORDS
obstructive sleep apnoea, orofacial pain, polygraphy, temporomandibular disorders

1 | INTRODUCTION

Obstructive sleep apnoea (OSA) is characterised by partial or complete obstruction of the upper airways during sleep. In the general adult population, the prevalence of OSA estimated at the clinically relevant cut-off of ≥15 events of apnoea/hypopnea per hour (AHI) ranged from 6% to 17% reaching 49% in the advanced ages.[1] Obstructed breathing leads to brain arousal, activation of the sympathetic system and blood oxygen desaturation.[2] These events entail a series of comorbidities that involve not only daytime sleepiness,[3] cardiovascular and neuro-metabolic aspects[4–6] but also deteriorate quality of life, bringing out profiles of anxiety and depression.[7,8]

The term 'temporomandibular disorders' (TMDs) is a hypernym including a set of musculoskeletal and neuromuscular conditions involving the temporomandibular joint, the masticatory muscles and associated structures. A recent systematic review reported an overall prevalence of TMDs in the general population of approximately 31% for adults/elderly and 11% for children/adolescents,[9] pointing out that TMDs are anything but a negligible clinical issue. TMDs are recognised to have a multifactorial aetiology with many possible predisposing, exacerbating and perpetuating factors.[10]

Obstructive sleep apnoea has been associated with TMDs, especially with muscle pain, according to the pathophysiological theory that myofascial pain can affect the central control of the muscles involved in breathing, chewing and swallowing.[11] Cunali and coworkers reported a considerably higher prevalence of TMDs in a sample of OSA patients (52%) compared to the general population.[12] However, the authors did not perform the analysis with a control group of non-OSA subjects, that would have been useful to isolate the effect of the variable 'presence of OSA'.

A recent systematic review underlined that the current evidence on the relationship between TMDs and OSA is inconclusive and high-quality studies are needed to clarify this issue.[13] That would be important to add a piece in the framework of knowledge of OSA patients' characteristics, improving the clinical management of comorbidities and possible side effects during the therapy. Therefore, the aim of the present study was to assess the prevalence of TMDs in a population of patients affected by OSA compared to a control group of subjects not affected by OSA.

2 | MATERIALS AND METHODS

The present study was approved by the Ethics Committee of the Area Vasta Emilia Centro of the Emilia-Romagna Region (CE-AVEC) with the number 118/2018/OSS/AUSLBO.

A cross-sectional controlled study was conducted on a group subjects studied by polygraphy (PG) at the snoring section of the ENT department, Sant'Orsola-Malpighi Hospital – University of Bologna. The study group was formed by OSA patients that were referred to the Dental Clinic – Section of Orthodontics and Dental Sleep Medicine of the University of Bologna for a specific clinical examination to check the possibility to perform a mandibular advancement device (MAD) for OSA treatment. The control group was composed by subjects who requested a PG for snoring problems, that resulted not affected by OSA and did not have signs of sleep disorders after the PG. All participants signed an informed consent.

Inclusion criteria for the study group were AHI > 5, determined by PG study (Embletta MPR Sleep System, Embla Systems) as recommended by the American Academy of Sleep Medicine (AASM) guidelines[14] and age ≥18 years. Inclusion criteria for the control group were the absence of symptoms of sleep disorders, a negative PG diagnosis for Sleep Disordered Breathing, a PG respiratory pattern that did not suggest the occurrence of sleep disorders and age ≥18 years. Patients taking non-steroidal anti-inflammatory drugs, paracetamol and opioid analgesics in the previous 5 days, steroidal drugs in the previous 30 days, those treated with anti-depressants, membrane-stabilising drugs, and oral contraceptives,[15] subjects affected by diabetes and painful acute oral diseases (e.g. pulpitis, dental fractures), and non-self-sufficient individuals (necessitating material and psychological support due to physical problems or previous accidents) were excluded from the present study. An expert clinician performed the anamnesis to verify patients' eligibility.

The patients included were examined by two blinded, expert and calibrated operators, following the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD),[16] the most used and updated TMD diagnostic classification system, that includes a physical assessment using reliable and well-operationalised diagnostic criteria (Axis I) and an evaluation of psychological status and pain-related disability (Axis II). The patients received the Graded Chronic Pain Scale (GCPS)[17] to describe pain intensity and pain-related disability, the Jaw Functional Limitation Scale (JFLS)[18] to evaluate functional status of the masticatory system, the Patient Health Questionnaire-9 (PHQ-9)[19] to assess psychological distress due to depression, the Generalised Anxiety Disorder-7 (GAD-7),[20] the Physical symptoms questionnaire (PHQ-15)[21] and the Oral Behaviours Checklist (OBC)[22] investigating the frequency of oral parafunctional habits. Afterwards, a physical assessment (Axis I) was performed by an orofacial pain specialist. The Epworth Sleepiness Scale (ESS) was also administered to all subjects included to evaluate daytime sleepiness.[23,24]

2.1 | Statistical analysis

The literature data report that the prevalence of TMD diagnosis in OSA patients and in general population is 52% and 31% respectively.[1,12] Considering these data and the TMD diagnosis as the primary outcome of the present study, a sample size calculation was performed setting alpha error = 0.05 and beta error = 0.20. The effect size resulted 0.454 with a total minimum sample size of 63 subjects. The prevalence of TMD between groups was computed using the χ^2 test. The Axis II questionnaires scores were compared between the two groups by means of χ^2 test. Comparison of continuous data between groups (such as age, AHI score and ESS score) was

computed by means of t test for independent samples. Statistical analysis was performed with IBM SPSS statistics v. 25.0 (IBM Corp.).

3 | RESULTS

After the application of inclusion and exclusion criteria to a group of 147 subjects recruited, 86 resulted eligible and were included in the present study: 43 patients in the OSA group and 43 subjects in the control group. Sample description is reported in Table 1 and sample selection process is reported in Figure 1. In the OSA group 10 patients were mild, 24 patients were moderate and 9 patients were severe. There were no significant differences between groups in gender distribution and in mean age. OSA group had a significantly higher mean AHI and body mass index (BMI) compared with the control group. No differences were detected in the ESS score between groups.

Table 2 shows the results of the comparisons of TMDs prevalence between groups. No differences were detected in TMDs prevalence between OSA patients and controls: 46.5% of OSA patients and 44.2% of controls were affected by TMDs. Even dividing TMDs into muscle TMDs (myalgia, myofascial pain with and without referral, headache attributed to TMD) and articular TMDs (arthralgia, disc displacement with or without reduction, degenerative joint disease) no differences in prevalence were found between groups. Figure 2 shows the distribution of the TMD diagnoses in the present sample. The most frequent diagnoses were myalgia and disc displacement with reduction in both groups. No differences emerged when comparing the prevalence of specific TMD diagnoses between groups.

Concerning Axis II, the prevalence of over cut-off scores of the questionnaires did not show differences between OSA patients and controls. These results are shown in Table 3.

TABLE 1 Sample description.

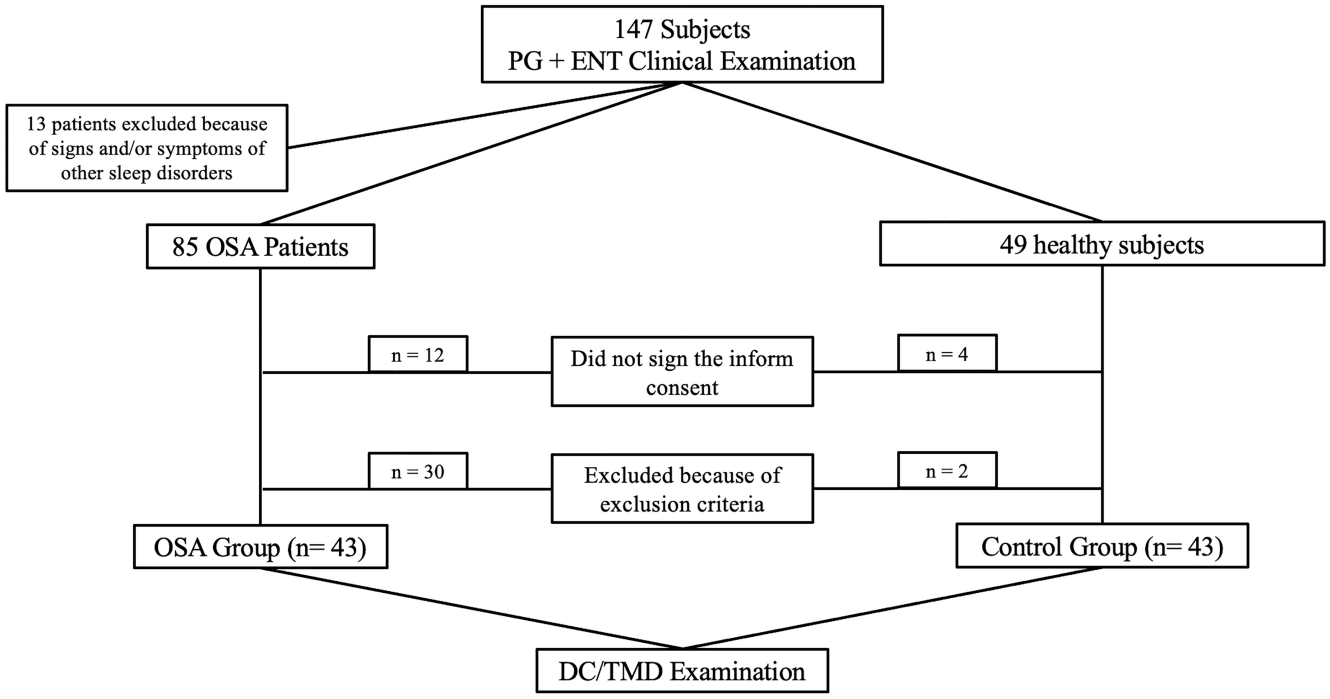
	OSA ($n = 43$)	Control ($n = 43$)	p
Age	52.26 ± 11.40	49.95 ± 7.59	.273
Gender	29 M, 14 F	25 M, 18 F	.372
AHI	22.55 ± 12.33	2.36 ± 1.54	<.001*
BMI	28.06 ± 3.60	25.42 ± 2.60	<.001*
ESS	7.90 ± 3.53	6.67 ± 4.12	.293

Note: Data are reported as mean ± standard deviations.
*Significant difference between groups.

TABLE 2 Comparison of prevalence of TMD diagnoses between groups (χ^2 test).

	OSA ($n = 43$)	Control ($n = 43$)	χ^2	p
TMD	20 (46.5%)	19 (44.2%)	0.047	.829
Muscle TMD	11 (25.6%)	11 (25.6%)	0.001	1.000
Articular TMD	18 (41.9%)	16 (37.2%)	0.195	.659

Note: Prevalence is reported as percentage and number of subjects.



PG = polygraphy; DC/TMD = diagnostic criteria for temporomandibular disorders

FIGURE 1 Flow diagram of sample selection process.

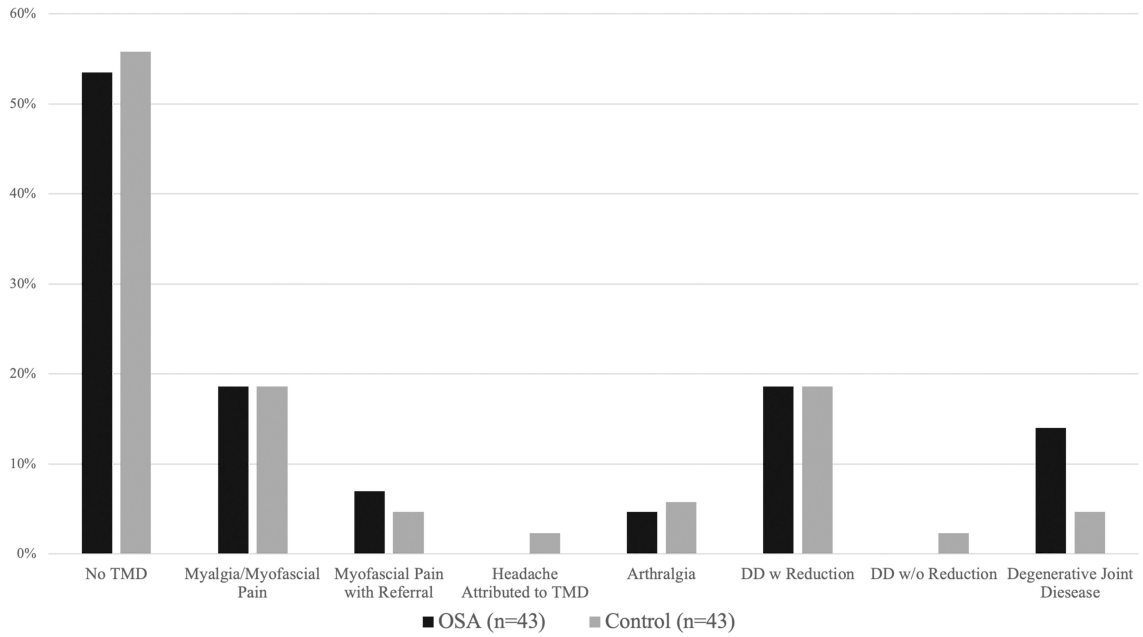


FIGURE 2 Prevalence of specific TMDs in OSA and control groups.

TABLE 3 Comparison of prevalence of over cut-off scores of the Axis II DC/TMD questionnaires between the groups (χ^2 test).

	OSA ($n = 43$)	Control ($n = 43$)	χ^2	p
GCPS 2.0 (Chronic Pain)	4 (9.3%)	6 (14.0%)	0.453	.501
JFLS-20 (Functional limitation)	2 (4.7%)	4 (9.3%)	0.717	.397
PHQ-9 (Depression)	25 (58.1%)	24 (55.8%)	0.047	.828
PHQ-15 (Physical symptoms)	22 (51.2%)	29 (67.4%)	2.361	.124
GAD-7 (Anxiety)	22 (51.2%)	22 (51.2%)	0.000	1.000
OBC (Oral parafuntions)	11 (25.6%)	18 (41.9%)	2.549	.110

Note: Prevalence is reported as percentage and number of subjects.

4 | DISCUSSION

In the present investigation the DC/TMD international protocol was used to evaluate the prevalence of TMDs in a group of adult patients who received a diagnosis of OSA and in a group of age and sex matched controls who resulted not affected by OSA and did not present signs of other sleep disorders after a PG recording.

The results point out no differences between the two groups in terms of TMDs prevalence and the OSA group did not show higher scores in Axis II questionnaires than controls.

These outcomes are at odds with previous papers that, on the contrary, reported a possible positive relationship between TMDs and OSA. The cohort of Orofacial Pain Prospective Evaluation and Risk Assessment (OPPERA) study,[25] measured the incidence of TMDs in a population of possible OSA subjects identified by means of a screening questionnaire. The findings suggested a strong correlation between the two conditions. Indeed, the subjective nature of OSA evaluation by means of questionnaires represents an important limitation, considering that the AASM guidelines, published in 2017, strongly discourage the use of questionnaires to clinically diagnose OSA without a PG assessment.[14] Cunali et al.[12] reported similar data and specifically a high prevalence of TMDs in a population of OSA patients that were diagnosed with a PG evaluation. However, the absence of a control group undermine their conclusions.[12] The investigation by Dubrovsky et al.,[11] performed on patients affected by myofascial TMD pain and on a smaller group of matched controls, found a higher frequency of respiratory effort related arousals in TMD patients but no difference in AHI index between groups. Moreover, the study was conducted on a sample of only women making it impossible to generalise the results.[11] A recent paper reports a significantly higher prevalence of TMDs in OSA patients compared with

controls.[26] The authors performed a protocol that is very similar to the present study, using the DC/TMD for the clinical evaluations.[27] However, the subjects included in the control group were recruited using the ESS and Berlin questionnaire for sleep disordered breathing[28] and not by a negative polygraphic OSA diagnoses, as AASM recommends.[14] The reliability of these questionnaires in detecting OSA patients has been questioned in literature[28,29] and the data provided by the present investigation contribute to rise doubts on this issue, since no differences in ESS scores emerged between OSA and control groups (Table 1). Therefore, the only use of questionnaires to screen OSA patients could entail the recruitment of non-representative samples, weakening the relevance of the results.

The present cross-sectional controlled study performs the evaluations by means of the gold standard tools for OSA and TMDs diagnoses both in the study and in the control groups.

The fact that the controls were recruited from a sample who had consulted the ENT department to investigate the possible presence of sleep apnoea, could be interpreted as a limitation providing selection bias. Conversely, the control subjects were referred to the ENT Unit for snoring problems. They underwent a PG evaluation to exclude the presence of concomitant sleep apnoea and other sleep disturbances. Consequently, the present control group can be considered representative of the general healthy population.

Being composed by mild, moderate and severe OSA patients, also the study group can be considered quite representative of the general OSA population. Severe OSA patients were referred to our clinic since they refused to use the CPAP or demonstrated low adherence to that therapy. Moreover, the MAD therapy was indicated not only as single treatment but also as part of a multimodal therapy. Indeed, the use of a MAD can be part of the therapeutic program for mild, moderate but even severe OSA patients, in order to improve the efficiency (which is considered as the sum of efficacy and adherence) of the treatment, together with behavioural and positional therapy, CPAP and ENT surgery. Evidence for enhanced adherence and efficacy with multimodal therapy has led to an increase in its implementation in clinical practice.[30,31]

The outcomes of the present study indicate that a higher prevalence of TMDs cannot be expected in OSA patients compared to controls. Indeed, the two groups did not show differences in the prevalence of signs and symptoms of TMD. These data are in accordance with a previous investigation on the variations of pressure pain thresholds (PPTs) of masticatory muscles in OSA patients, before and during the therapy with a MAD compared to controls.[32] At T0 the two groups did not show significant differences in PPTs, suggesting that a common predisposing pathophysiological phenotype among OSA patients is unlikely to exist.

A recent systematic review[13] supports these conclusions: despite the 'fair' to 'good' quality of the selected studies reporting a positive association between OSA and TMDs,[11,12,25,33] the evidence provided resulted limited. Several authors made hypotheses on possible pathophysiological mechanisms underlying the correlation between OSA and TMDs[34–38] but to date, an objective confirmation is still lacking. Therefore, further high-quality studies are needed to gain stronger evidence and the basic research could be of great help to unveil the physiological bases of a possible association or interaction between OSA and TMDs.

One of the treatments for OSA patients is the MAD therapy. Even if the outcomes of the present study show no difference in TMD prevalence between OSA patients and controls, the MAD stresses temporomandibular joint and masticatory muscles and TMDs can occur and fluctuate during time.[39,40] Consequently, the dentist that performs the MAD therapy should monitor the temporomandibular joint and masticatory muscles status during the follow-up[39,40] in order to avoid discontinuation of the therapy.

5 | CONCLUSIONS

No differences in TMDs prevalence emerged between the group of OSA patients and the controls.

The present paper provides a point of reflection on the necessity to perform high-quality studies with attention to the methods of sample selection but also to understand possible variables that could generate connections between the two pathologies.

AUTHOR CONTRIBUTIONS

Maria Lavinia Bartolucci: DC/TMD examination and wrote the paper. Francesco Bortolotti: DC/TMD examination. Irene Pelligra: performed ENT examination and polygraphic analysis. Chiara Stipa: performed patient recruitment. Giovanni Sorrenti: performed ENT examination and polygraphic analysis. Serena Incerti-Parenti: performed statistical analysis and revised paper. Giulio Alessandri-Bonetti: designed the study.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest and that they did not receive funds for this investigation.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Serena Incerti-Parenti https://orcid.org/0000-0002-0301-6126
Giulio Alessandri-Bonetti https://orcid.org/0000-0003-1317-1901

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