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Review of self-reported instruments that measure sleep dysfunction in patients suffering from temporomandibular disorders and/or orofacial pain

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Abstract: Patients with temporomandibular disorders (TMD) and/or orofacial pain (OFP) frequently experience poor sleep quality or suffer from comorbid sleep disorders. Study results suggest that in chronic pain patients, an improvement in sleep quality critically influences the outcomes of interventions on mood and pain. Yet, only a few studies have systematically sought to evaluate the sleep quality of TMD/OFP patients. Standardized and validated self-reported instruments designed for screening sleep disturbances or for the evaluation of treatment outcomes in this population would therefore enhance evidence and improve treatment options. The objectives of the present study were: (1) to review the self-reported instruments that measure sleep dysfunction in studies on TMD/OFP patients, by conducting a systematic literature search; (2) to evaluate their clinimetric evidence; and (3) to provide guidance for future research using such instruments. A total of 26 papers, using eight different instruments, were identified. The most frequently used questionnaires and the only ones with good clinimetric properties were the Insomnia Severity Index followed by the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale. They were most reliable, valid and time-effective for measuring sleep dysfunctions in patients with TMD/OFP, with only a few practical constraints. Yet, in future studies, an assessment of the relationship between sleep disturbances and chronic pain will have to include instruments measuring the effect of mediator variables such as cognitive or emotional arousal. Research is required to clarify if existing self-reported questionnaires measuring these aspects will promote further insights or if there is a need for new instruments. This future research direction would blend into the overall biopsychosocial concept of TMD/OFP diagnoses and treatment.

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Table 1: Summary of instruments used for measuring sleep dysfunctions in TMD/OFP patients

Measure	Type of instrument	Type/symptoms of sleep dysfunction	No. of studies using this instrument	References
Pittsburgh Sleep Quality Index (PSQI)	Questionnaire	sleep quality; distinction of poor vs. good sleepers	15	[2,3,9,12,41,55,56,57, 80,82,88,91,106,114,116]
Epworth Sleepiness Scale (ESS)	Questionnaire	EDS	5	[1,23,24,79,106]
Sleep Assessment Questionnaire (SAQ)	Questionnaire	sleep quality	4	[37,85,92,96]
Insomnia Severity Index (ISI)	Questionnaire	insomnia severity; daytime symptoms	3	[81,106,108]
Douglass Sleep Disorders Questionnaire (SDQ)	Questionnaire	SAS diagnostic	1	[23]
Fletcher and Lockett sleep questionnaire	Questionnaire	EDS and SAS symptoms	1	[24]
Jenkins Sleep Problems Scale (JSPS)	Questionnaire	sleep disturbance scores	1	[5]
Structured Interview for Sleep Disorders (DSM-III-R) (SIS-D)	Interview	sleep disorder diagnostics	1	[106]

EDS = excessive daytime sleepiness; SAS = sleep apnea syndrome

Table 2: Description of instruments primarily focusing on aspects of sleep quality and insomnia

		Pittsburgh Sleep Quality Index (PSQI)	Sleep Assessment Questionnaire (SAQ)	Insomnia Severity Index (ISI)	Jenkins Sleep Problems Scale (JPSP)	Structured Interview for Sleep Disorders (SIS-D)
General Description	Type of measure	questionnaire	questionnaire	questionnaire	questionnaire	interview
	Number of items	18 + 5 additional questions rated by roommate or bedpartner (not scored)	17	7	4	not available
	Number of scales	7 subscales	6 factors	no subscales	no subscales	no subscales
	Purpose	a) ¹ assessment of overall sleep quality b) discrimination between good and poor sleepers c) assessment of multiple sleep disturbances d) not designed to provide clinical diagnoses	a) ⁵ sleep evaluation b) screening for sleep apnea, psychophysiologic/idiopathic insomnia, RLS/PLMS, narcoleptic/idiopathic hypersomnia c) assessment of treatment response d) assessment of overall sleep quality	a) ⁵ cognitive-behavioral b) insomnia screening c) assessment of treatment response	a) ⁵ epidemiology b) evaluation of frequency and intensity of sleep difficulties	a) ⁵ epidemiology b) structured clinical interview that can be used by experienced psychiatric interviewers for screening of patients with sleep disorders and for sleep research. Allows diagnostic assessment according to DSM-III-R.
	Content	1) subjective sleep quality 2) sleep onset latency 3) sleep duration 4) sleep efficiency 5) sleep disturbances 6) use of sleeping medication 7) daytime dysfunction	1) insomnia/hypersomnia, 2) non-restorative sleep, 3) sleep schedule disorder, 4) excessive daytime somnolence, 5) sleep apnea, 6) restlessness	a) severity of sleep-onset, b) sleep maintenance, c) early morning awakening problems, d) satisfaction with current sleep, e) interference with daily functioning, f) impairment attributed to the sleep problem, g) level of distress caused by sleep problem	1) trouble falling asleep 2) awakenings 3) trouble staying asleep 4) daytime impairment	primary sleep disorders (dyssomnias: insomnias, hypersomnias, sleep-wake schedule disorders, other dyssomnias; parasomnias: dream anxiety disorder, sleep terror disorder, sleepwalking disorder, other parasomnias); secondary sleep disorders (axis III diagnosis)
Clinimetric properties	Reliability	Cronbach's alpha: 0.83; item-total correlations: 0.20-0.66; test-retest reliability: 0.85, p<0.001 (for global score)	no data available	Cronbach's alpha: 0.74 - 0.78; item-total correlations: 0.36 - 0.67, mean 0.54; test-retest-reliability: no data	Cronbach's alpha: 0.63;-0.79; item-total correlations: 0.69-0.79; test-retest reliability: 0.59, p<0.001	Cronbach's alpha: not available item-total correlations: not available test-retest-reliability: high level attained with respect to current (4-

¹ according to the conceptual framework of sleep dysfunction [72]

						week) diagnoses. acceptably high for lifetime diagnoses.
	Validity	<i>content</i> : no informations available <i>criterion</i> : good, distinguishes good from poor sleepers	no data available	<i>content</i> : good face validity <i>criterion</i> : significant correlations with relevant PSG data before and after treatment	preliminary evidence for construct validity	<i>content</i> : good, meets DSM-III-R criteria. <i>criterion</i> : good concordance between diagnoses and PSG data
	Sensitivity/ Specificity	cutoff score >5 distinguished patients from normal control with sensitivity = 89.6%, specificity = 86.5%	sensitivities between 79-100% and specificities between 68-96% depending on factor	cutoff score 14 distinguished patients from normal controls with sensitivity = 94%, specificity = 94%	not established	not established
	Sensitivity to change ²	yes, although not designed as treatment outcome measure	no data available	yes	yes	not established
Instrument development	Sample characteristics	patients with major depression and patients with sleep disorders, including control group of good sleepers	patients with obstructive sleep apnea, fibromyalgia, chronic fatigue syndrome	adults (ages 17-84) with insomnia complaints (primary and secondary to medical, psychiatric, or other sleep disorders)	air traffic controllers, aged 25-49 years and patients admitted for coronary bypass or cardiac valve surgery, aged 25-69 years	patients with major complaints of sleep disturbances (57% were referred to a sleep laboratory for further examinations, 33% were psychiatric inpatients with sleep disturbances as major symptoms)
	Other uses	war veterans, elderly people, sleep apnea, fibromyalgia, and others	patients with psychophysiological or idiopathic insomnia, RLS/PLMS, narcoleptic/idiopathic hypersomnia	young adults (mean age 20 y) and older adults (mean age 65 y) with primary insomnia	no	no
Instrument characteristics	Administration	self; paper and pencil; 5-10 min to complete	self; no further information available	self: paper and pencil; max. 5 min to complete	interview or self; paper and pencil; 2-5 min to complete	20-30 min for trained interviewers
	Response options	Items 1-4: free entry; Items 5-18: 4-point Likert-scale (0 = not during the past month, 3 = three or more times a week); Item 19: 4-point Likert-scale (0 = very good, 3 = very bad sleep quality); Global score range: 0-21	5 point Likert scale (1 = never; 5 = always); global score range: 0-68	5-point Likert-scale (0 = not at all, 4 = extremely); global score range: 0-28	6-point Likert scale (0 = not at all, 5 = 22-31 days)	
	Reference period	past 4 weeks	no data available	past 2 weeks	past month	past 4 weeks or lifetime (only for axis I diagnoses)

	Simple scoring	no, assignment of ordinal values to quantitative and qualitative items. The 7 component scores are summed to a Global Score. Scoring instructions are provided in the original publication	no information available for screening use; summary score for assessment of overall sleep quality	yes, summary score	yes	no, knowledge on sleep disorders is needed
	Accessible interpretation	yes; higher global scores indicate poorer sleep quality	yes; higher global scores indicate poorer sleep quality	yes, suggested guidelines: 0-7 = no clinically significant insomnia 8-14 = subthreshold insomnia 15-21 = moderate clinical insomnia 21-28 = severe clinical insomnia	yes; higher scores indicate more acute sleep difficulties	yes
	Cutoff score	yes, global score >5 = severe difficulties in at least 2 domains, or moderate difficulties in more than 3 domains, distinguishes good from poor sleepers.	no data available	yes, 14.	no	no
	Norm reference	no	no data available	no	no	no
Versions	Other forms	no	no data available	clinician-administered, significant other and French language versions available	no	modified version to reflect DSM-IV revisions (see: Original use with TMD, above)
	Validated translations ³	German, French, Italian, Japanese, Taiwanese, Korean, Persian, Brazilian, Greek, Hebrew	no	Spanish, Hindi, Arabic	no	no

³ Pubmed search containing „validation“ AND „version“ AND fullname of the measure

Table 3: Description of instruments primarily focusing on aspects of excessive daytime sleepiness (EDS) and sleep apnea syndrome (SAS)

		Epworth Sleepiness Scale (ESS)	Douglass Sleep Disorders Questionnaire (SDQ)	Fletcher and Luckett sleep questionnaire
General Description	Type of measure	questionnaire	questionnaire	questionnaire
	Number of items	8	45	25
	Number of scales	no subscales	4 subscales: SA sleep apnea scale; PLM periodic limb movement disorder scale; PSY psychiatric sleep disorder scale; NAR narcolepsy scale	no subscales
	Purpose	a) ⁴ screening of overall daytime sleepiness b) use in research	a) ⁶ sleep evaluation b) screening for major sleep disorders	a) ⁶ epidemiology b) screening for sleep disturbances (at night- and daytime)
	Content	likelihood to fall asleep in 8 different situations	questions about various symptoms often associated with a) sleep apnea, b) periodic limb movement disorder, c) narcolepsy, d) psychiatric sleep disorders	1) excessive daytime sleepiness, 2) parasomnias, 3) obstructive sleep apnea syndrome, 4) daytime impairments
Climimetric properties	Reliability	Cronbach's alpha: 0.75-0.83; item-total correlations: 0.41-0.64; test-retest reliability: 0.85, p<0.001 (for global score)	Cronbach's alpha: 0.85; item-total correlations: 0.19 - 0.71; mean ?; test-retest-reliability: SA 0.84, NAR 0.75, PSY 0.84, PLM 0.81, all p<0.0001	no data available
	Validity	<i>content</i> : no informations available <i>criterion</i> : good, distinguishes normal controls from patients with different types of hypersomnia; convergent and discriminant validity were established	<i>content</i> : good face validity <i>criterion</i> : significant correlations with relevant PSG data before and after treatment	no data available
	Sensitivity/ Specificity	cutoff score > 10 distinguishes between normal and excessive daytime sleepiness with sensitivity = 93.5%, specificity = 100%	only provisional data available	no data available
	Sensitivity to change	yes	no data available	no data available
Instrument development	Sample characteristics	patients with various sleep disorders and controls with history of normal sleep habits without snoring, ages ranging from 18-78 years	n=435 clinical sleep-disorder patients in 4 groups: n=158 sleep apnea, n=73 narcolepsy, n=108 psychiatric inpatients, n=96 nocturnal myoclonus/PLMD and n=84 normal controls	n=9 OSA patients with stable nCPAP therapy for 6 months to 2 years; age 59.6 ± 6.1 n=7 OSA patients, new nCPAP user; age 51.6 ± 12.8
	Other uses	obstetric population	no data available	no data available
Instrument characteristics	Administration	self; paper and pencil; 2-5 min to complete	no data available	self; no further information available
	Response options	scale of 0-3 (0 = "would never doze", 3 = "high chance of dozing"); global score range: 0-24	5-point Likert-scale	4 point Likert scale (0 = never, 1 = rarely, 2 = occasionally, 3 = often)
	Reference period	recent times	no data available	no data available
	Simple scoring	yes, summary score	no data available	yes, summary score, divided by 25 to determine the level of symptoms

⁴ according to the conceptual framework of sleep dysfunction [72]

	Accessible interpretation	yes; higher global scores indicate higher daytime sleepiness	no data available	no; higher summary scores indicate higher levels of undefined sleep disturbances
	Cutoff score	yes, global score > 10 for identifying daytime sleepiness at a potentially clinical level	yes, but only provisional data available	no data available
	Norm reference	no	no	no data available
Versions	Other forms	no	no data available	no data available
	Validated translations ⁵	German, French, Urdu, Arabic, Iranian, Croatian, Serbian, Chinese, Thai, Korean...	no data available	no data available

EDS = excessive daytime sleepiness; SAS = sleep apnea syndrome

⁵ Pubmed search containing „validation“ AND „version“ AND fullname of the measure

Table 4: Summary and appreciation of the clinimetric soundness of the instruments found in this study

Instruments	Clinimetric properties				Critical appraisal	References
	Reliability	Validity	Sensitivity/ specificity	Sensitivity to change		
Pittsburgh Sleep Quality Index (PSQI)	good	good	good	information available	good	[6,13]
Insomnia Severity Index (ISI)	good	good	excellent	information available	good	[71,98]
Epworth Sleepiness Scale (ESS)	good	good	excellent	information available	good	[21,35,48,105]
Dougllass Sleep Disorders Questionnaire (SDQ)	good	good	provisional data available	no information available	good	[27]
Structured Interview for Sleep Disorders (SIS-D)	good	good	no information available	no information available	intermediate	[94,104]
Sleep Assessment Questionnaire (SAQ)	no information available	no information available	good to excellent	no information available	insufficient	[64,66,109]
Jenkins Sleep Problems Scale (JPSP)	preliminary evidence	preliminary evidence	no information available	information available	insufficient	[46]
Fletcher and Luckett sleep questionnaire	no information available	no information available	no information available	no information available	insufficient	[32]

Evaluation criteria for the critical appraisal

Reliability:

good = Cronbach's alpha and/or test-retest reliability and/or item-total correlation > 0.8

Validity:

good = High correlation between the test and a criterion variable (or a gold standard) taken as representative of the construct.

Sensitivity/Specificity:

excellent = sensitivity and specificity as close to 100% as possible and cut-off score published

good = sensitivity and specificity as close to 100% as possible, no cut-off score published

Sensitivity to change:

Sensitivity to change is unclearly defined. Two of the mostly used definitions are "the capacity of a measure to detect change in patients' status over time" or "the clinical meaningfulness of changes in scores" [107].

good = information available, independent of the definition chosen

Final appraisal:

good = Report of the results of validation was published and all criteria appraised as good

intermediate = Report of the results of validation incompletely published, but good reliability and validity

insufficient = Report to the results of validation incompletely published or unpublished