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Sleep quality in patients with dental anxiety

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Background: Psychological distress is associated with sleep disturbances; however there is little research on sleep quality in dental anxiety (DA) patients.
Objectives: To measure the sleep quality in patients with DA compared to patients with an exacerbated gag reflex (GAG) and controls and to analyze its association with various demographic and behavioral parameters.
Methods: 67 DA patients, 54 GAG patients and 100 controls with no history of DA or GAG participated in the study. Data regarding: demographic details, smoking habits, the Pittsburgh Sleep Quality Index (PSQI), Numeric Rating Scale (NRS) for pain assessment, Corah's dental anxiety scale (DAS) and Oral Health Impact Profile-14 (OHIP-14), plaque index (PI) and Decay, Missing and Filled Teeth (DMFT) scores were collected.
Results: 49.3% of the DA group and 38.9% of the GAG group were poor sleepers (mean PSQI score > 5), compared to 29.0% of the controls (PSQI mean scores: 5.8 ± 3.4, DA group; 5.2 ± 3.6 GAG group vs. 4.5 ± 2.7, control group; $p = 0.029$). Compared to controls, DA and GAG patients exhibited poorer scores in the sleep disturbances PSQI component ($p = 0.001$). DA patients exhibited poorer scores in the sleep duration PSQI component compared to the control ($p = 0.002$) and GAG groups ($p = 0.033$). Female gender ($p = 0.039$), higher current ($p = 0.046$) and maximal NRS ($p = 0.019$), higher DAS ($p < 0.001$) and OHIP-14 ($p < 0.001$) scores and more missing teeth ($p = 0.003$) were positively associated with higher PSQI scores.
Conclusions: DA patients suffered more from impaired sleep than controls and GAGs. Impaired sleep in DA patients is multidimensional phenomenon influenced by the specific diagnosis, gender, pain, dental anxiety levels, dental experience and oral health related quality of life.

1. Introduction

Sleep is vital to health and poor sleep is associated with adverse health consequences (Adamo et al., 2013; Hoevenaar-Blom et al., 2014; Kripke et al., 2002; Owens, 2014; Parish, 2009; von Ruesten et al., 2012). Impaired sleep has a negative effect on mood and daytime functioning (Adamo et al., 2013; Morin et al., 2006, 1998; Sanders et al., 2013). Therefore, assessing sleep quality assists in understanding the impact of medical and psychiatric problems upon wellbeing. Studies suggest that sleep disturbances and anxiety disorders are positively related (Marcks et al., 2010; Papadimitriou and Linkowski, 2005; Ramsawh et al., 2009), for example anxiety disorders are often associated with difficulties in initiating and maintaining sleep (Papadimitriou and Linkowski, 2005). The prevalence of insomnia is 40% higher among individuals with mood and anxiety disorders than healthy people (Soehner and Harvey, 2012; Tkachenko et al., 2014). In those with mood disorders, sleep problems are associated with lower rates of

Abbreviations used: DA, Dental anxiety; GAG, Exacerbated gag reflex; PSQI, Pittsburgh Sleep Quality Index; NRS, Numerical Rating Scales; DAS, Dental Anxiety Scale; OHIP-14, Oral Health Impact Profile 14.

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remission and response to treatment, and may be considered a risk factor for certain forms of psychopathology (Tkachenko et al., 2014).

Dental anxiety (DA) is defined as an unreasonable fear of dental procedures, objects or the context of treatment, usually associated with a strong emotional experience and physiological arousal (Humphris et al., 1995; Lin, 2013). Epidemiological surveys have shown that 5–20% of adults suffer from dental anxiety, ranging from a mild feeling of apprehension to extreme anxiety and dental phobia (Kent, 1987; Levin et al., 2006, 2007; Maggirias and Locker, 2002; Ng et al., 2005; Skaret et al., 1998; Smith and Heaton, 2003). DA is not classified in the DSM 5, however its severe expression, dental phobia is classified under blood-injury phobias in DSM 5 (American Psychiatric Association, 2013). DA is an important public health problem, not only due to its prevalence, but also because DA has a significant psychosocial impact (Schierz et al., 2008). Avoidance of dental treatment in DA patients due to fear can lead to a deterioration in dental health, which in turn may cause feelings of guilt and shame, depression, social isolation, lower general well-being, contentment, vitality and a lower quality of life (Crofts-Barnes et al., 2010; Schierz et al., 2008). Therefore, this population is of public health importance for clinicians and health-care authorities, both in medical care and in dental care.

Specific differences in sleep characteristics and the effects of sleep disruption between anxiety disorders have been demonstrated (Marcks et al., 2010; Papadimitriou and Linkowski, 2005; Ramsawh et al., 2009). However, despite the fact that DA has been studied extensively since the late 1960s, and that taking a sedative medication orally the night before a scheduled dental treatment is a common practice (Luyk et al., 1988), sleep quality in DA patients is poorly documented (Cohen et al., 2000; Crofts-Barnes et al., 2010). Crofts-Barnes et al., reported lower general vitality and sleep quality among 21 patients with DA (Crofts-Barnes et al., 2010). Cohen et al. explored 20 DA patients and reported that they suffered from sleep disturbances such as an inability to sleep (Cohen et al., 2000). However, these studies were not quantitative, had small samples and no controls. To the best of our knowledge, studies evaluating sleep quality and disturbances among DA compared to controls have not been published in the English language literature.

In order to shed light on this subject it is reasonable to compare the sleep quality of DA patients to dental patients with an exacerbated gag reflex (GAG) and dental patients with no history of DA or GAG.

The gag reflex is a protective somatic response that prevents foreign bodies entering the trachea, pharynx or larynx (Bassi et al., 2004; Kumar et al., 2011). Excessive gagging during dental treatment is caused by tactile stimuli as well as non-tactile sensations such as visual, auditory, olfactory or psychic stimuli (Scarborough et al., 2008). Gagging may be caused by and worsened by anxiety and could indicate dental anxiety in individuals reluctant to admit to being anxious about dental care (Bassi et al., 2004; Hotta, 2012; Winocur et al., 2011). However, there are other reasons for gagging, including local and systemic disorders, anatomic and iatrogenic factors (Bassi et al., 2004). To the best of our knowledge, studies evaluating sleep quality and disturbances among GAG patients have not published, and certainly not in comparison with sleep quality in DA patients.

The overall prevalence of sleep disturbances is higher in aging populations than in younger individuals (ranging from 51% to 75%) and in patients with advanced illnesses (Adamo et al., 2013; Emami et al., 2013; Foley et al., 1999; Neikrug and Ancoli-Israel, 2010; Stiefel and Stagno, 2004; Wilson et al., 2002). Therefore, exploring sleep disturbances among young individuals with DA, GAG and controls eliminates confounders such as aging and illness on sleep, allowing identification of the effects of DA, GAG and other demographic and habitual parameters on sleep.

The aims of the study were:

1. To measure sleep quality and disturbances in young patients with DA compared to those with GAG and to young individuals undergoing conservative dental treatment with no known history of DA or GAG (Control) by means of PSQI.
2. To investigate the effects of specific diagnosis, demographics, smoking habits, pain scores, dental anxiety levels and Oral health related quality of life (OHRQoL) on sleep quality by means of PSQI.

2. Subjects and methods

2.1. Study groups

During the period between May 1st, 2011 and January 31st, 2013, consecutive patients with DA (70 patients) and GAG (60 patients) referred to the Department of Oral Medicine, Oral and Maxillofacial Medical Center, Tel-Hashomer, Israel, were enrolled in the study. This Department is a secondary Oral Medicine referral center which manages dental treatment of patients with DA or GAG using Nitrous Oxide inhalation sedation and various behavioral techniques. The demographic characteristics of these patients have been thoroughly analyzed in a previous study (Almoznino et al., 2014).

The control group consisted of 100 consecutive individuals attending elective conservative dental treatment with no known history of DA or GAG.

Utilization of human subject data followed the approved protocol and requirements of the Institutional Review Board and informed consent was obtained from all participants.

2.2. Inclusion and exclusion criteria

Inclusion criterion was age 18–50 years. Exclusion criteria were: mental, psychiatric or physical disabilities; presence of drug abuse; a comorbid malignant disease or significant medical condition; for women, not being pregnant or lactating.

The inclusion criterion for DA group was referred by a general dental practitioner from a primary dental clinic to the Department of Oral Medicine, Oral and Maxillofacial Medical Center, due to dental anxiety during a previous dental treatment which prevented further treatment without conscious sedation/behavioral techniques/anti-anxiety medication, and without gagging problems.

The inclusion criteria for GAG group were: referral by a general dental practitioner from a primary dental clinic to the Department of Oral Medicine, Oral and Maxillofacial Medical Center, due to a positive history of a gagging, or almost vomiting during a previous dental treatment. The exclusion criteria were other conditions that may engage the gag reflex such as anatomic and iatrogenic factors, local and systemic disorders (e.g. sinusitis, gastrointestinal diseases, nasal polyps, mucous in the upper respiratory tract) and use of medications that may cause nausea.

In addition, inclusion criteria for the DA or GAG were: patients referred for conscious sedation in the Oral and Maxillofacial specialists Medical Center in Tel Hashomer due to the inability to undergo dental treatment on a previous occasion because of DA or GAG.

Inclusion criteria for the control group were consecutive patients with no history of DA or GAG.

2.3. Data collection

The study was based on a questionnaire which consisted of several parts: (1) Demographic details (2) smoking habits (3) sleep quality, measured using the validated Hebrew version of the PSQI (4) current and maximal numerical rating scale (NRS) for assessment of dental pain (5) Corah's Dental Anxiety Scale (DAS) (6) Oral Health Impact Profile 14 (OHIP-14). All questionnaires were filled in during a face-to-face interview at the initial visit before dental treatment and before any medications were prescribed. All subjects were scheduled for a single session in late morning or early afternoon (9:00 A.M-15:00 P.M) to minimize affects of time of day on the gag reflex (Bassi et al., 2004) or the impact of the circadian system (Morris et al., 2012).

2.4. Demographic data collection

Demographic parameters with variables defined as follows were collected: age; gender: female, male; education: ≤12 years of education (i.e. completion of high school), and >12 years of education (i.e. technicians, engineers and academic graduates); country of birth; country of origin of parents; smoking: yes, no (Table 1).

2.5. Pittsburgh Sleep Quality Index (PSQI)

The survey included the validated Hebrew version of Pittsburgh Sleep Quality Index PSQI (Shochat et al., 2007). The PSQI is a valid and reliable instrument used to measure sleep quality and disturbances over a 1-month period (Buysse et al., 1989). It has been translated into 56 languages, and has been used in a wide range of population-based and clinical studies (http://www.sleep.pitt.edu/content.asp?id=1484&subid=2316). The PSQI includes 19 items which generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (scores ranging from 0 to 3) (Buysse et al., 1989). The sum of the scores from the 7 components yields the global PSQI score (ranging from 0 to 21). A higher global score represents a decline in sleep quality. A global PSQI score >5 indicates poor sleepers. PSQI global score and its 7 components were compared between patients with DA, GAG and control groups.

2.6. Pain evaluation

Patients rated their average dental pain intensity with a 0–10 Numeric Rating Scale (NRS) where 0 represents "no pain" and 10 represents "the worst pain possible," (11 integers including 0) (Breivik et al., 2000; dos Santos Calderon et al., 2012). 'Current NRS' representing current pain and 'maximal NRS' representing maximal pain in the last month (Scott and Huskisson, 1976) were recorded. The NRS correlates with other pain assessment scales and is a reliable, valid and easy to use tool in clinical dental practice (dos Santos Calderon et al., 2012).

2.7. Corah's dental anxiety scale (DAS)

The survey included the dental anxiety scale (DAS) developed by Corah (Corah, 1969) as a specific measure of dental anxiety, in which patients are asked to rate their fear regarding four dental situations on a 5-point scale. The sum of the scores yields the global score (range from 4 to 20). Higher scores indicate higher levels of dental anxiety.

2.8. Oral Health Impact Profile 14 (OHIP-14)

The validated Hebrew version of the OHIP-14 (Kushnir et al., 2004) was used to assess the Oral health-related quality of life (OHRQoL) (Slade, 1997; Slade and Spencer, 1994). The OHIP-14 includes seven conceptual domains of OHRQoL, including: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap. For each OHIP-14 question, subjects were asked how frequently they had experienced the impact in the last month (the same time frame as the PSQI). OHIP-14 scores range from 0 (no adverse impact during previous month) to 56 (all 14 impacts experienced very often during the previous month). OHIP-14 domains were calculated for each domain by adding the scores for the two corresponding items.

Table 1
Demographic characteristics of the study population.

Parameter	Variable	Total	DA group	GAG group	Control group	p[a] value (all groups)	p[a] value (DA vs. GAG)
		No. (%)	No. (%)	No. (%)	No. (%)		
Gender	Male	130 (58.8)	43 (64.2)	35 (64.8)	52 (52)	0.172	0.942
	Female	91 (41.2)	24 (35.8)	19 (35.2)	48 (48)		
Education (Y)	≤12	137 (67.2)	40 (59.7)	36 (66.7)	61 (73.5)	0.201	0.431
	>12	67 (32.8)	27 (40.3)	18 (33.3)	22 (26.5)		
Country of origin	Africa	34 (17.0)	14 (20.9)	16 (29.6)	4 (5.1)	<0.001	0.437
	Asia	33 (16.5)	14 (20.9)	7 (13.0)	12 (15.2)		
	Western	24 (12.0)	6 (9.0)	3 (5.6)	15 (19.0)		
	FSU	6 (3.0)	5 (7.5)	1 (1.9)	0 (0)		
	FSU[c]						
	Israel	76 (38.0)	15 (22.4)	14 (25.9)	47 (59.9)		
	Mixed	27 (13.5)	13 (19.4)	13 (24.1)	1 (1.3)		
Birth country	Africa	2 (0.9)	1 (1.5)	0 (0)	1 (1.0)	0.088	0.641
	Asia	5 (2.3)	1 (1.5)	2 (3.7)	2 (2.0)		
	Western	9 (4.1)	1 (1.5)	0 (0)	8 (8.0)		
	FSU	6 (2.7)	4 (6.0)	2 (3.7)	0 (0)		
	Israel	198 (89.6)	59 (88.1)	50 (92.6)	89 (89.0)		
Smoking	Yes	67 (30.3)	31 (46.3)	19 (35.2)	17 (17.0)	<0.001	0.218
	No	154 (69.7)	36 (53.7)	35 (64.8)	83 (83.0)		

Y = years, DA = Dental anxiety, GAG = exacerbated gag reflex.
Country classification: Africa, Asia, 'Western' (North and South America, Europe [excluding FSU], Australia), Former Soviet Union (FSU), Israel. The FSU was considered as a separate ethnic group as immigration to Israel occurred over the last twenty years and this population has unique cultural characteristics.
[a] ANOVA or *T* test.

We assessed the influence of DAS and OHIP-14 scores on the PSQI global scores among the DA and the GAG groups and among the DA group alone.

2.9. Clinical examinations

Clinical examinations included: Dental caries status assessed with the DMFT index (Decay, Missing and Filled Teeth) following the WHO criteria (http://www2.paho.org/hq/dmdocuments/2009/OH_st_Esurv.pdf) and oral hygiene assessed with the Plaque Index, PI (Loe and Silness, 1963). Patients were examined by one of three calibrated examiners. Clinical examinations were conducted with the aid of light, mouth-mirrors and a WHO probe. Bilateral bitewings radiography was included. The differences between patients with DA, GAG and controls regarding plaque index and dental caries experience have been thoroughly analyzed in a previous study which we recently published (Almoznino et al., 2014). We assessed the influence of PI and DMFT scores on the PSQI global scores among the DA and the GAG groups and among the DA group alone.

2.10. Statistical analysis

Data was tabulated and statistical analyses performed using SPSS software version 21.0. Two-tailed level of statistical significance (α) was set at 5%.

Continuous variables are presented as means and standard deviations, and categorical variables are presented as frequencies and percentages.

Differences between groups were examined with a Pearson Chi-Square for categorical variables and an analysis of variance (ANOVA) for numeric variables. Significance tests between PSQI and the independent variables included Chi-square test, ANOVA, *t*-test and Bonferroni POST HOCS. Based on the univariate results significant parameters were selected for multivariate logistic regression (LR) using a stepwise backward model.

3. Results

221 participants completed the study: 67 patients with DA, 54 patients with GAG and 100 control subjects. Three patients in the DA group and 6 patients in the GAG group were excluded from the final analysis due to missing data.

Tables 1 and 2 present distribution by age, gender, education, country of origin, country of birth and smoking, as well as statistical analyses. There were no significant differences between the study groups regarding gender, education and birth country (Table 1). Older age, non-Israeli and non-Western countries of origin and being a smoker were positively associated with DA and GAG patients compared to controls (Tables 1 and 2). There were no significant differences in any of the demographic parameters between the DA and the GAG groups (Tables 1 and 2).

3.1. Pain evaluation

ANOVA analysis of numeric rating scale (NRS) scores is presented in Table 2. Higher current and higher maximal NRS scores were positively associated with DA and GAG groups compared to the control group (Table 2). The values of current and maximal NRS were similar and smaller than 1 among controls, while in the DA and GAG groups the maximal NRS were significantly higher than the current NRS (5 and 6 times, respectively). There were no significant differences regarding the NRS scores between the DA and GAG groups, although DA patients exhibited higher current and maximal NRS scores (Table 2).

Table 2
Age and current and maximal numeric rating scale (NRS) score.

Parameter	Study group	No. of patients	Mean ± SD	95% CI		p[a] value (all groups)	p[a] value (DA vs. GAG)
				Lower bound	Upper bound		
Age (years)	DA	67	28.5 ± 9.3	26.2	30.7	<0.001	0.978
	GAG Group	53	28.4 ± 9.3	25.8	30.9		
	Control	100	20.8 ± 1.5	20.5	21.1		
	Total	220	24.9 ± 7.9	23.9	26.0		
Current NRS	DA	67	1.6 ± 2.6	0.9	2.2	0.009	0.368
	GAG Group	54	1.2 ± 2.3	0.6	1.8		
	Control	100	0.6 ± 1.8	0.2	0.9		
	Total	221	1.0 ± 2.2	0.7	1.3		
Maximal NRS	DA	67	8.0 ± 2.9	7.3	8.8	<0.001	0.183
	GAG Group	54	7.3 ± 3.0	6.5	8.1		
	Control	100	0.6 ± 1.9	0.2	0.9		
	Total	221	4.5 ± 4.4	3.9	5.1		

[a] ANOVA or *T* test, DA = Dental anxiety, GAG = exacerbated gag reflex.

3.2. Pittsburgh Sleep Quality Index (PSQI)

The PSQI components scores as well as the global scores among the different study groups are presented in Table 3. Compared to controls, DA and GAG groups exhibited higher scores in the sleep disturbances PSQI components. DA patients exhibited higher scores in the sleep duration component compared to both controls and GAG group and higher mean PSQI global scores compared to controls (Table 3).

Table 4 presents comparison between good (PSQI ≤ 5) and poor (PSQI > 5) sleepers among the study population. 49.3% of the DA group and 38.9% of the GAG group were poor sleepers, compared to 29.0% in the controls ($p = 0.029$) (Table 4).

3.3. Associations of socio-demographic parameters, smoking habits and numeric rating scale (NRS) scores with PSQI global scores

The significant associations of poor sleep (PSQI > 5) as well as the PSQI global scores with demographic parameters, smoking habits and numeric rating scale among the entire study population ($N = 221$ patients) are presented in Tables 4 and 5, respectively. Smoking and higher current and maximal NRS were positively associated with poor sleep quality (PSQI score > 5) (Table 4). No significant associations were found between PSQI score > 5 and the following parameters: age ($p = 0.859$), gender ($p = 0.281$), education ($p = 0.854$), country of origin ($p = 0.136$) and birth country ($p = 0.467$) (data are not in Table).

Females, smokers, patients whose parents originated from Asia or of mixed origin, and patients with higher current and maximal NRS exhibited higher global PSQI scores (Table 5). No significant associations were found between PSQI global scores and the parameters of age ($p = 0.492$), education ($p = 0.307$) and birth country ($P = 0.758$) (data are not in Table).

3.4. Multivariate linear regression analysis of factors influencing the PSQI scores

Table 6 presents a multivariate backward stepwise linear regression analysis of all parameters reaching statistical significance ($p < 0.05$) in the univariate analysis with the mean global PSQI score as well as PSQI score > 5. The mean global PSQI score retained a significant positive association with female gender and with higher current and maximal NRS, while maximal NRS was the

Table 3
Pittsburgh Sleep Quality Index (PSQI) and its components among the study groups.

PSQI component	Group	No. of patients	Mean ± SD	p value[b] (all groups)	p value[c] (DA vs. GAG)	p value[d] (DA vs. Control)	p value[d] (GAG vs. Control)
Sleep duration	DA	67	1.3 ± 1.0	0.002	0.033	0.002	NS[a]
	GAG	54	0.9 ± 0.9				
	Control	100	0.8 ± 0.8				
	Total	221	0.9 ± 0.9				
Sleep disturbances	DA	67	1.3 ± 0.7	0.001	0.604	0.013	0.003
	GAG	54	1.3 ± 0.7				
	Control	100	0.9 ± 0.52				
	Total	221	1.2 ± 0.6				
Sleep latency	DA	67	1.2 ± 1.1	0.087	0.740	NS	NS
	GAG	54	1.2 ± 1.1				
	Control	100	0.9 ± 0.9				
	Total	221	1.1 ± 1.0				
Daytime dysfunction	DA	67	0.8 ± 0.9	0.513	0.623	NS	NS
	GAG	54	0.7 ± 0.9				
	Control	100	0.9 ± 0.9				
	Total	221	0.8 ± 0.9				
Habitual sleep efficiency	DA	67	0.2 ± 0.5	0.723	0.636	NS	NS
	GAG	54	0.1 ± 0.5				
	Control	100	0.2 ± 0.5				
	Total	221	0.2 ± 0.5				
Sleep quality	DA	67	0.9 ± 0.8	0.172	0.919	NS	NS
	GAG	54	0.9 ± 0.8				
	Control	100	0.7 ± 0.7				
	Total	221	0.8 ± 0.8				
Sleeping medication	DA	67	0.1 ± 0.4	0.663	0.394	NS	NS
	GAG	54	0.04 ± 0.3				
	Control	100	0.1 ± 0.7				
	Total	221	0.1 ± 0.5				
Global PSQI	DA	67	5.8 ± 3.4	0.029	0.394	0.027	NS
	GAG	54	5.2 ± 3.6				
	Control	100	4.5 ± 2.7				
	Total	221	5.1 ± 3.2				

DA = Dental anxiety, GAG = exacerbated gag reflex.
[a] NS – Non significant.
[b] ANOVA.
[c] *T* test.
[d] Bonferroni POST HOCS.

only parameter retaining a significant association with poor sleep (PSQI score > 5) (Table 6).

3.5. Associations of DAS and OHIP-14 scores with PSQI global scores in DA and GAG patients

There were no statistically significant differences between DA and GAG regarding the socio-demographic parameters, smoking habits, NRS scores (Tables 1 and 2), DAS global score (14.3 ± 2.8, DA group; 13.1 ± 3.8 GAG group, $p = 0.064$) and OHIP-14 global score (34.8 ± 12.5, DA group; 32.5 ± 13.8, GAG group, $p = 0.394$). Therefore, since all these parameters matched in the DA and GAG groups we assessed the influence of DAS and OHIP-14 scores on the PSQI global scores among the DA and the GAG groups. Pearson's Correlations (R) among DA and GAG patients, revealed that higher DAS global scores ($R = 0.3$; $p < 0.001$) and higher OHIP-14 global scores ($R = 0.5$; $p = <0.001$) scores were positively associated with PSQI global scores.

Tables 7 and 8 present associations between PSQI global scores and OHIP-14 domain scores among patients with DA and GAG. PSQI

Table 4
Comparison between good (PSQI ≤ 5) and poor (PSQI > 5) sleepers.

		PSQI ≤ 5 (N = 138)	PSQI > 5 (N = 83)	p[a]
		No. of patients (%)	No. of patients (%)	
Study groups	DA	34 (50.7%)	33 (49.3%)	0.029
	GAG	33 (61.1%)	21 (38.9%)	
	Control	71 (71.0%)	29 (29.0%)	
Smoking	Yes	33 (49.3%)	34 (50.7%)	0.008
	No	105 (68.2%)	49 (31.8%)	
		Mean ± SD	**Mean ± SD**	**p[b]**
Current NRS		0.62 ± 1.74	1.73 ± 2.74	<0.001
Maximal NRS		3.49 ± 4.21	6.14 ± 4.14	<0.001

[a] Pearson Chi-Square.
[b] *T* test, A = Dental anxiety, GAG = exacerbated gag reflex, NRS: numeric scale for the assessment of pain.

Table 5
Associations of socio-demographic parameters, smoking habits and numeric rating scale (NRS) scores with PSQI global scores.

		No. of patients	Mean ± SD	p[a]
Gender	Male	130	4.6 ± 2.8	0.038
	Female	91	5.5 ± 3.6	
	Total	221	5.1 ± 3.2	
Smoking	Yes	67	5.8 ± 3.5	0.010
	No	154	4.6 ± 3.0	
	Total	221	5.0 ± 3.2	
Country of Origin	Africa	34	5.1 ± 2.9	0.015
	Asia	33	6.4 ± 3.6	
	Western	24	3.7 ± 2.2	
	FSU	6	5.2 ± 3.5	
	Israel	76	4.8 ± 3.0	
	Mixed	27	6.3 ± 4.1	
	Total	200	5.2 ± 3.3	
		N	***R*[b]**	**p[b] (2-tailed)**
Current NRS		221	0.3[b]	<0.001
Maximal NRS		221	0.3[b]	<0.001

FSU = Former Soviet Union, NRS: numeric scale for the assessment of pain.
[a] ANOVA or *T* test.
[b] Pearson Correlations (R), Correlation is significant at the 0.01 level (2-tailed).

Table 6
Multivariate linear regression analysis of factors influencing the PSQI global score and poor sleep (PSQI > 5).

Parameter	*B* (95% CI)	SE	*β*	*p*
Factors influencing the PSQI global score				
Constant	3.8 (1.4–6.2)	1.2		0.002
Gender–Female	0.9 (0.1–1.9)	0.5	0.1	0.039
Current NRS	0.21 (0.003–0.4)	0.1	0.0	0.046
Maximal NRS	0.2 (0.03–0.4)	0.1	0.3	0.019
Factors influencing PSQI > 5 (poor sleepers)				
Constant	0.312	0.242	−1.165	<0.001
Maximal NRS	1.21 (1.05–1.39)	0.071	0.192	0.007

SE = Standard Error, NRS: numeric scale for the assessment of pain.

global scores were positively associated with each OHIP-14 domain (Table 7). Backward regression revealed that the physical pain and the physical disability domains of the OHIP-14 had the most significant association with the PSQI global scores compared to other OHIP-14 domains in these patients (Table 8); this association was confirmed by multivariate linear regression analysis controlling for all parameters reaching statistical significance ($p < 0.05$) with the global PSQI global score among DA and GAG patients in the univariate analysis (i.e. female gender, current and maximal NRS, DAS, and OHIP-14 global scores), which revealed a significant influence of the OHIP-14 global scores ($p < 0.001$, $B = 0.110$, S.E. = 0.02, $\beta = 0.4$, 95% confidence interval: 0.1–0.2).

3.6. Associations of demographics, DAS and OHIP-14 scores with PSQI global scores in DA patients alone

The associations between PSQI global scores and demographic parameters and DAS score among the DA group alone, revealed only age had a statistically significant positive association with the PSQI global score among the DA group (Pearson Correlation: $R = 0.259$; $p = 0.034$). As can be seen from Table 7 impaired sleep in DA patients was influenced by all OHIP-14 domains, and as can be seen in Table 8 the physical pain domain had the significant association with the DA group.

3.7. Associations of PI and DMFT index with PSQI global scores among DA and GAG patients and among DA patients

Table 9 presents Pearson's Correlations (*R*) of PI and DMFT index with the mean PSQI global score among DA and GAG patients and among DA patients alone. PI and DMFT did not reach significant statistical association with PSQI global scores among the DA and GAG group taken together. However, missing teeth experience (M) was significantly associated with the PSQI score among the DA group alone.

Table 7
Pearson's Correlations (*R*) of PSQI global scores according to OHIP-14 domains among dental anxiety and exacerbated gag reflex patients and among the DA group.

	PSQI among DA and GAG		PSQI among DA	
	R	*p*	*R*	*p*
Functional limitation (OHIP-1+2)	0.3	<0.001	0.325	0.007
Physical pain (OHIP-3+4)	0.5	<0.001	0.550	<0.001
Psychological discomfort (OHIP-5+6)	0.4	<0.001	0.364	0.002
Physical disability (OHIP-7+8)	0.5	<0.001	0.439	<0.001
Psychological disability (OHIP-9+10)	0.4	<0.001	0.319	0.009
Social disability (OHIP-11+12)	0.4	<0.001	0.380	0.002
Handicap (OHIP-13+14)	0.4	<0.001	0.384	0.001

OHIP-14: Oral Health Impact Profile 14.

Table 8
Backward regression of PSQI global scores according to OHIP-14 domains among dental anxiety and exacerbated gag reflex patients and among the DA group.

Parameter	*B* (95% CI)	SE	*β*	*p*
PSQI global score according to OHIP-14 domains among DA and GAG patients				
Constant	0.8	0.8	–	0.291
Physical pain (OHIP-3+4)	0.4	0.2	0.2	0.003
Physical disability (OHIP-7+8)	0.4	0.1	0.3	0.001
PSQI global score according to OHIP-14 domains among DA patients				
Constant	0.308	1.033	–	0.766
Physical pain (OHIP-3+4)	0.652	0.175	0.441	<0.001

OHIP-14: Oral Health Impact Profile 14.

Multivariate linear regression analysis all parameters reaching significantly significant association with the mean PSQI global score within the DA group alone, i.e. age,OHIP-14 global score and missing teeth (M) revealed a significant influence of the OHIP-14 global scores ($p < 0.001$, $B = 0.169$, S.E. = 0.027, $\beta = 0.611$, 95% confidence interval: 0.116–0.223) and missing teeth score ($p = 0.003$, $B = 0.445$, S.E. = 0.142, $\beta = -0.369$, 95% confidence interval: 0.728–0.162).

4. Discussion

The results of the present study indicate that sleep quality in DA patients is impaired compared to controls and GAG patients, and is influenced by demographic parameters, smoking habits, higher dental pain scores, higher dental anxiety levels, more missing teeth and poorer oral health related quality of life.

4.1. Differences in global PSQI scores between DA, GAG and control patients

Almost 50% of the DA group and 40% of the GAG group were poor sleepers, compared to 30% of controls (Table 4). The rate of poor sleepers among our control group matches the findings that about one-third of the general population experience sleep difficulties (Marcks et al., 2010; Ramsawh et al., 2009). The prevalence of sleep disturbances among DA patients is similar to that reported among chronic low back pain patients (51%), but lower than in general anxiety disorders (64%–74%) (Marcks et al., 2010; Ramsawh et al., 2009), rheumatoid arthritis (70%), fibromyalgia (75%) and burning mouth syndrome (80%) (Adamo et al., 2013; Onen et al., 2005).

Compared to controls, patients with DA exhibited statistically significant higher mean global PSQI scores (5.8 ± 3.4, DA group; 5.2 ± 3.6 GAG group vs. 4.5 ± 2.7, control group; $p = 0.029$) (Table 3). These scores are similar to those reported for temporomandibular joint disc displacement patients (5.64 ± 3.53) but lower than the

Table 9
Pearson's Correlations (*R*) of Plaque index (PI) and Decay, Missing and Filled Teeth (DMFT) index with PSQI global scores among dental anxiety (DA) and exacerbated gag reflex (GAG) patients and among DA patients.

	PSQI among DA and GAG patients		PSQI among DA	
	R	*p*	*R*	*p*
PI	0.04	0.639	0.036	0.775
DMFT	0.03	0.773	0.149	0.233
D	0.07	0.424	0.009	0.945
M	0.1	0.159	0.298	0.014
F	0.003	0.978	0.009	0.943

scores reported for myofascial pain (7.27 ± 3.80) (Sener and Guler, 2012), anxiety disorders (7.57 ± 4.03) (Ramsawh et al., 2009) and specific anxiety disorders including: post traumatic stress disorders (10.31 ± 4.10) (Insana et al., 2013) and panic disorders (9.9 ± 4.8) (Hoge et al., 2011). Temporomandibular joint disorders and DA are both prevalent health problems managed by dentists and have a psychosocial impact on patients (Schierz et al., 2008), therefore it is not surprising that these two entities have a negative impact on sleep quality. It seems that DA has less of an impact on sleep than other anxiety disorders; however this conclusion should be taken cautiously, as the present study only assessed younger patients.

4.2. Differences in PSQI domains between DA, GAG and control patients

Analysis of PSQI components revealed that sleep duration and the sleep disturbances appeared to have the strongest relationship with DA, compared to controls (Table 3). Patients with DA exhibited shorter sleep duration even compared to GAG patients (Table 3). However, it is not clear whether anxiety is the cause or effect of short sleep duration, or both (Liu and Zhou, 2002).

When calculating the sleep disturbance component score, a number of factors interfering with sleep can be taken into account, including: difficulty falling asleep within 30 min, waking up in the middle of the night or early morning, having to get up to use the bathroom, difficulty breathing comfortably, coughing or snoring loudly, feeling too cold or to hot, having pain and having bad dreams (Buysse et al., 1989). Indeed, Cohen et al. reported that DA patients experienced nightmares, especially before dental treatment, but even without any plans for dental treatment (Cohen et al., 2000). Similarly, Ramsawh et al. found that the sleep disturbance PSQI component was significantly associated with all anxiety disorders assessed (Ramsawh et al., 2009).

4.3. The influence of demographics on PSQI global scores

Univariate analysis of the entire study population revealed that females, patients with parents originating from Asia or of mixed origin and smokers exhibited higher mean global PSQI scores. Our findings are in agreement with the literature: women have higher PSQI scores than men (Carpenter and Andrykowski, 1998; Hung et al., 2013); sleep quality was severely affected in women with a migrant background due to problems related to integration into a new culture (Voss and Tuin, 2008); a strong correlation was found between sleep quality and smoking status (Hu et al., 2007). In the present study non-Israeli and non-Western country of origin and smoking were positively associated with DA and GAG patients compared to controls. A higher prevalence of anxiety disorders has also been reported among immigrant populations (Potochnick and Perreira, 2010) and higher rates of smoking have been noted among individuals with general anxiety disorders (Lasser et al., 2000) and dental fear, with the assumption that nicotine is an anxiogenic agent (Pohjola et al., 2013). Reasons for higher smoking prevalence among immigrants and anxiety patients could include the use of cigarettes as an anxiolytic self-treatment (Moylan et al., 2012). However, tobacco use predisposes people to develop anxiety over time by, e.g. producing chronic withdrawal symptoms and possible precipitation of emotional or somatic symptoms that maintain anxiety (McLeish et al., 2009).

4.4. The influence of dental pain, PI, DMFT, DAS and OHIP-14 scores on PSQI global scores

The relationship between sleep quality with dental pain is noted in the present study by the significant positive association of the global PSQI score with: (1) current and maximal NRS scores and (2) with the physical pain domain of the OHIP-14 (OHIP-14 3+4) and (3) by the significant positive association of poor sleep (PSQI > 5) with the current and maximal NRS. Research indicates that those suffering from higher general pain intensity are more likely to experience poor sleep quality (Wilson et al., 1998) and disturbed sleep is a common complaint among people with acute and chronic pain (Morin et al., 1998; Roehrs and Roth, 2005). Sleep disturbances are known to modify sensitivity to nociceptive stimuli and poor sleep may lower pain thresholds (Onen et al., 2000, 2005).

In line with this hypothesis is our finding that in the DA and GAG groups, the maximal NRS were significantly higher than the current NRS. Similarly, anxious patients expected more pain than they experienced while low-anxiety patients accurately predicted the amount of pain they would experience, no matter what procedure was performed (Kent, 1984). Maximal NRS represents memories of experienced pain which are reconstructed over time in order to become consistent with existing levels of anxiety (Kent, 1985). Others also reported that anxiety can lead to the exacerbation of pain perception when the source of anxiety is related to the pain experience (al Absi and Rokke, 1991; Cornwall and Donderi, 1988; Weisenberg et al., 1984).

Consistent with the literature that anxiety negatively influences sleep, in the present study dental anxiety levels measured by means of DAS scores, showed “dose-related” responses when measured against PSQI among the DA and GAG groups.

Higher global scores in the OHIP-14 scale measuring the level of impact of dental problems (Table 8) as well as higher OHIP-14 domain scores (Table 7) were associated with higher PSQI scores. Indeed, one of the OHIP-14 domains is psychological disability, a domain that includes interrupted sleep as one of its criteria (Slade, 1997). Regarding the physical disability domain, Lenze et al. (2001) found an independent association between sleep disturbance and physical disability (Lenze et al., 2001). Furthermore, Maggi et al. (1998) showed that physical disability was strongly associated with night awakening (Maggi et al., 1998).

There is a strong body of evidence for the strong relationship between DA and avoidance of dental care (Hakeberg et al., 1990, Moore et al., 1993, Pohjola et al., 2009, Schierz et al., 2008, Skaret et al., 2007, 1999, Smith and Heaton, 2003, Vika et al., 2008). Indeed, missing teeth (M) scores were significantly associated with higher PSQI scores within DA patients, implying that dental status but not age is strongly related with sleep quality.

The main strengths of the present study are the large sample size (220 patients) and the strict protocol utilizing standardized internationally accepted PSQI, DAS and OHIP-14 questionnaires and NRS scores which allow comparison with other socioeconomic or ethnic groups. We eliminated confounders such as aging and illness on sleep quality by focusing on a young adult population. Moreover, to the best of our knowledge, other studies evaluating the impact of DA on sleep quality and its components compared to GAG and control patients have not been published in the English language literature.

Limitations of this study include the possibility of selection bias of this convenience cohort. Moreover, although in the present analysis we considered the impact of multiple parameters on the PSQI score, such as the impact of specific diagnoses (e.g. DA, GAG, control), demographics, smoking habits, dental pain scores, dental anxiety levels, OHIP-14, PI and DMFT index, due to the depth and complexity of the issues there are many other parameters that could affect the quality and pattern of sleep that were not considered. The present study included self assessment measures and did not include polysomnographic measures. On the other hand, the PSQI instrument measures sleep quality and disturbances over a 1 month period, while polysomnographic measures represent a one-time measurement.

5. Conclusions

This is the first study to assess the sleep quality in DA patients compared to GAG and control patients. Clinicians and health authorities should be aware of the unique characteristics of DA patients, especially among those with known risk factors such as females, smokers and immigrant populations. Those patients should be identified and monitored carefully, and encouraged to seek appropriate behavioral treatment in order to treat their dental anxiety and improve their OHRQoL and quality of sleep.

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Contributors

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Galit Almoznino – principal investigator, made substantial contributions to the study's conception and design, acquisition of data, and analysis and interpretation of data; drafted the submitted article and provided final approval of the version to be published.

Avraham Zini – analysis and interpretation of data and approved the manuscript.

Yair Sharav – Interpretation of the results, revised and approved the manuscript.

Adi Shahar – analysis and interpretation of data, wrote the draft and approved the manuscript.

Hulio Zlutzky – Data collection and approved the manuscript.

Yaron Haviv – revised and approved the manuscript.

Alex Lvovsky – Data collection and approved the manuscript.

Doron J. Aframian – made substantial contributions to the study's conception and design, interpretation of data, revised and approved the manuscript.

Conflict of interest

The authors deny any conflicts of interest.

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