Care of Patients with Sleep Disorders

Social support, mastery, sleep-related problems and their association with functional status in untreated obstructive sleep apnoea patients

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ARTICLE INFO

Article history:
Received 8 September 2017
Accepted 18 April 2018
Available online 31 May 2018

Keywords:
Sleep apnea
Social support
Mastery
Sleep-related problems
Functional status

ABSTRACT

Background: Social support and mastery are important aspects in the treatment of chronic diseases, however their role in connection with Obstructive Sleep Apnoea (OSA) remains unclear.

Objectives: The study examined the associations between social support, mastery, sleep-related problems and functional status in untreated OSA patients.

Methods: All patients in this cross-sectional study completed the Multidimensional Scale of Perceived Social Support, the Pearlin Mastery Scale, the Pittsburgh Sleep Quality Index, the Epworth Sleepiness Scale and the Functional Outcomes of Sleep Questionnaire. Multiple linear regression and mediation analyses were used to analyse the data.

Results: Participants were 150 newly diagnosed OSA patients (Apnoea-Hypopnoea Index—AHI≥5; 68% male; mean age 48.9 ± 9.5 years). Compared with social support, mastery was more strongly associated with functional status. The indirect effects of sleep-related problems on functional status via mastery varied between 17.7% and 23.3%.

Conclusions: Supporting OSA patients’ sense of mastery may significantly contribute to better disease management.

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Introduction

Obstructive Sleep Apnoea (OSA) is an incapacitating chronic disease caused by pharyngeal collapse during sleep.1 OSA, along with insomnia, is considered to be one of the most common sleep disorders in adults, with an estimated prevalence of 2–10%,2 and is related to higher all-cause mortality.3 OSA has been shown to be associated with night-time sleep disturbance4,5 and daytime sleepiness.6 These disabling symptoms pose multiple challenges for functional status in patients with OSA,7 with a larger effect in females.8–11 Recent studies have also emphasized the importance of studying patients’ functional status in sleep medicine research, because of its ability to provide insights which may go beyond the pathophysiology of commonly-investigated OSA-related symptoms.11

Despite the acceptance of continuous positive airway pressure (CPAP) as a standard OSA treatment, there is a lack of consensus regarding the CPAP treatment effect on functional status in patients with OSA. Several studies have concluded that patients with OSA, even with a good CPAP treatment adherence, do not achieve normal functional status5,7,12,13 when compared to the general population. This suggests that other key factors may play a role.12 Moreover, personalization of the OSA treatment,14 which includes overall evaluation of functional status and the psychosocial aspects of disease, becomes more important in current clinical practice.11

Social support may be one of the essential, though under-investigated, protective factors associated with healthier sleep and better functional status in people with OSA.15 There are several
plausible pathways which may link social support with sleep, including protecting against social isolation, attenuating stress responses, encouraging healthy sleep behaviours, and entraining circadian rhythms.19 Patients with OSA may experience lower levels of social support compared to other populations with chronic diseases. A study by Glenn et al. (2015)37 revealed an association between a low level of social support and the presence of sleep-disordered breathing symptoms. Poor social support was also found to be independently associated with short sleep duration when controlled for sociodemographic variables.17 Moreover, partners of patients with OSA also described their relationship as adversely affected by their partners’ OSA symptomatology.18 Lack of social support has a significant impact on health-related behaviour and risk of illness.19,20 Moreover, lack of social support was associated with poorer self-rated health in patients with acute myocardial infarction,21 chronic arthritis pain,22 multiple sclerosis23 and depression.24 Social support also had a positive influence on sleep in people with insomnia.25 Although it has been posited that social support may be a key indicator of how patients with OSA manage their disease,15 to date only one study26 has been performed regarding social support in the association with health outcomes in patients with OSA. Social support was also found to have a positive effect on CPAP treatment adherence.27 Insufficient emotional (e.g., encouragement) and instrumental (e.g., help with putting on mask, verbal reminders) support from partners of OSA patients was identified as a barrier for adherence with CPAP treatment.16

As patients with OSA have very little control over the symptoms of their disease and have to learn how to live with it, mastery may help them to reduce the stress that breathing and sleep-related symptoms bring about, and may thus improve their functional status.28 According to Pearlin and Schooler,27 mastery is defined as a general sense of control over one’s life and circumstances. In line with this, a diminished sense of mastery was associated with a decrease in overall functional ability,29 physical, mental and social functioning,30,31 and with increased mortality rates32 in patients with various chronic conditions or the general population.33 In older people a greater sense of mastery was found to be associated with seeking treatment at an early stage of disease and more efficient use of healthcare services.34 In OSA patients with comorbid insomnia, the positive associations between mastery and both physical and mental quality of life remained significant even after adjustment for age, obesity, chronic diseases, erectile dysfunction, sleepiness, mood and financial strain.34 It has also been suggested that the relationship between social support and mastery may be reciprocal, and that higher levels of mastery may help to facilitate needed social support, while greater perceived social support may lead to greater feeling of mastery over one’s life and circumstances.35

Sleep-related problems are associated with functional status in patients with chronic conditions,36 including OSA.11 Previous studies have shown that sleep disruption,37 poor sleep quality and daytime sleepiness38 were associated with impaired functional status in patients with idiopathic pulmonary fibrosis37 and OSA.39 Research and clinical practice should focus therefore not only on treating OSA, but also on ensuring that all OSA-related symptoms, including sleep-related problems, are managed adequately. To achieve this, we first need to understand how these symptoms and constructs relate to functioning in untreated patients with OSA.

Patients with OSA are known to have a high level of sleep-related problems; in contrast, the role of social support and mastery in the association between poor sleep quality, daytime sleepiness and functional status is less clear. Therefore, the purpose of this study was to examine the associations between social support, mastery, sleep-related problems and functional status in untreated patients with OSA, and to assess the mediating role of social support and mastery in the association between sleep-related problems and functional status in patients with OSA.

Methods

Study design and setting

This cross-sectional study was conducted at the Department of Pneumology and Phthisiology, L. Pasteur University Hospital and the Medical Faculty of PJ Safarik University in Kosice, Slovak Republic. All patients who visited the Department for one-night polysomnography (PSG) between July 2013 and June 2016 and underwent PSG were eligible for the study. To maintain ethical principles with regard to the participants, we explained the purpose of the study and guaranteed confidentiality. We also explained that the collected data would only be used for the purposes of this research. Each patient completed and signed an informed consent form prior to their participation in the study, which was fully voluntary and included no incentives for participation. The study was approved by the Ethics Committee of PJ Safarik University in Kosice (approval no. 115/2011).

Sample and procedure

Indication for PSG was based on a general practitioner referral form. OSA was diagnosed based on an overnight sleep examination. Only patients with OSA between 18 and 65 years of age were included due to possible functional changes, increased vulnerability and decline in abilities and performance related to age. The study sample comprised patients with an Apnoea Hypopnoea Index (AHI; number of apneas/hypopneas per hour of sleep) score of 5 or more,40 who had no previous continuous positive airway pressure (CPAP) therapy or other OSA treatment, were Slovak-speaking and had no major comorbidities. Out of 283 eligible patients, 41 patients who underwent PSG refused to participate in the study, yielding a total response of 84.0%. Another 72 were excluded because of major comorbidities: The reasons for exclusion were major comorbidities related to sleep (coexisting sleep disorder such as insomnia, narcolepsy, or circadian rhythm sleep disorder); major cardiovascular diseases (e.g., myocardial infarction, angina pectoris; primary pulmonary hypertension); pulmonary conditions (e.g., chronic obstructive pulmonary disease; Pickwick syndrome); and a history of cancer in the past twelve months. Neurological and psychological comorbidities included neurological condition (e.g., stroke, epilepsy); major psychiatric diagnosis (e.g., psychotic disorders, major depression) in the medical record, and/or current usage of psychiatric medications which may affect cognitive functions (e.g., benzodiazepine, antipsychotics or antidepressants); drug abuse in the past six months, and regular shift work in the past six months. Due to assessment of health outcomes related to sexual functioning, we excluded patients with diabetes and those using hypotensive medication, which may affect sexual functioning (following Hoekema et al.).41 Screening for comorbidities was based on medical data and an initial clinical interview prior to data collection. The clinical diagnoses were established according to the standard International Classification of Diseases-10 revision Codes. Medical examinations of patients were conducted by a pulmonologist specialized in sleep-disordered breathing. Patients with non-respiratory sleep-related complaints (e.g., narcolepsy, insomnia) were routinely referred to another group of clinical specialists. The invitation letter, the informed consent and the questionnaires were sent to participants by postal mail three weeks before the medical examination. One week before the medical examination, patients were reminded about the questionnaires by phone call. Patients filled in self-report questionnaires at home.
Variables and measures

Functional status

Functional status was assessed using the Functional Outcomes of Sleep Questionnaire (FOSQ).41 The FOSQ is a 30-item self-report, disease-specific measure designed to assess the impact of sleep disorders or excessive daytime sleepiness on multiple activities of daily living. The FOSQ has five subscales: activity level, vigilance, intimacy and sexual relationships, general productivity, and social outcomes. Responses are averaged (excluding missing responses) to create a subscale score of 1 to 4, and then subscale scores are summed for the total score (5–20), with higher scores indicating less effect of sleepiness on daily life.42 In our sample, Cronbach’s alpha was 0.90 for the total scale, 0.90 for the activity level, 0.84 for vigilance, 0.95 for intimacy and sexual relationships, 0.90 for the general productivity subscale and 0.82 for the social outcomes subscale.

Social support

The Multidimensional Scale of Perceived Social Support (MSPSS) is a 12-item self-report measure of social support.43 It uses a seven-point Likert-type scale, with scores ranging from ‘very strongly disagree’ (1) to ‘very strongly agree’ (7), so the total score ranges from 12 to 84, with higher scores indicating greater social support.44 The MSPSS has three subscales: significant others, family and friends. In our sample, Cronbach’s alpha was 0.90 for all three separate subscales. Cronbach’s alpha of the total scale was 0.94.

Mastery

Mastery was measured using the Pearlin Mastery Scale (PMS).27 The PMS measures an individual’s level of mastery, a psychological resource that has been defined as “the extent to which one regards one’s life-chances as being under one’s own control in contrast to being fatalistically ruled”.27 The scale includes 7 items (five negatively-worded items and two positively-worded items), e.g. “You have little control over the things that happen to you”, and “What happens to you in the future mostly depends upon you”. The negatively-worded items require reverse coding prior to scoring, resulting in a score range of 7 to 28, with higher scores indicating higher levels of mastery.27 Cronbach’s alpha of the total scale was 0.85.

Sleep-related problems

Sleep-related problems concerned night-time sleep quality and daytime sleepiness. Night-time sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI).44 The PSQI is a self-rated questionnaire to assess sleep quality and disturbances over a one-month time interval. The PSQI consists of 19 self-report questions which cover seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. The score ranges from 0 to 21, with higher scores reflecting poor night-time sleep quality. A cut-off score of 5 separates good from poor sleepers.44 Cronbach’s alpha in our sample was 0.85.

Daytime sleepiness was measured using the self-report Epworth Sleepiness Scale (ESS), an eight-item questionnaire assessing the tendency to fall asleep in various daytime scenarios.45 The score ranges from 0 to 24, with higher scores indicating greater daytime sleepiness. An ESS total score greater than 10 indicates excessive daytime sleepiness.45 Cronbach’s alpha in our sample was 0.86.

Sociodemographic and clinical data

Information on age, gender and marital status was obtained from patient records. The Body Mass Index (BMI; height and weight) was assessed by a physician. BMI was used to sort patients into categories: underweight (<18.50), normal (18.50–24.99), overweight (25.00–29.99) and obese (≥30.00). PSG was used to determine whether the diagnosis of OSA was present and to identify the severity of the disorder. PSG consists of a simultaneous recording of multiple physiological parameters related to sleep and wakefulness, which directly monitor and quantify the number of respiratory events, related hypoxemia and arousals. PSG consisted of the overnight recording of left and right electrooculograms, standard central and occipital electroencephalogram, submental electromyogram (EMG), bilateral tibialis EMG, nasal and oral airflow using a thermistor and thoracic, and abdominal excursions using respiratory inductive plethysmography. OSA severity was determined using PSG and was based on an AHI (number of apnoeas + hypopnoeas per hour of sleep) score of 5 or more, according to standard criteria.49 According to this, OSA severity is mild (AHI≤5 ≤ 15), moderate (AHI 15 ≤ 30) or severe (AHI>30).

Statistical analyses

All analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS 23) and MedGraph. Firstly we described the background characteristics of the sample and calculated means and standard deviations for functional status (FOSQ), social support (MSPSS), mastery (PMS), night-time sleep quality (PSQI), daytime sleepiness (ESS) and OSA severity (AHI) for the total sample and stratified by gender. T-tests were conducted to assess gender differences in the continuous variables. Differences in the categorical variables were analysed using Chi-square tests. Secondly we investigated the bivariate correlations between all variables. Thirdly, multiple linear regressions were used to examine the associations between social support, mastery, sleep-related problems and functional status for the total scale and by subscales, controlled for sociodemographic and clinical variables. Using regression analyses we firstly assessed the crude effects (i.e. associations unadjusted for the number of predictors) of each variable separately on functional status, and then we continued with multiple regression analyses. Multicolinearity was assessed using the variance inflation factor (VIF<2.0). We applied the enter method in linear regression to identify the factors associated with summary scores of functional status in the total scale and in the subscales. For each factor, beta coefficients represent the mean variation of functional status for the total scale and by subscales. The first model of the variables included sociodemographic data (age, gender, marital status). A second model included a clinical variable (OSA severity – measured by AHI), and a third model included night-time sleep quality and daytime sleepiness. Finally, in the fourth and fifth models, social support and mastery were included separately to assess the increase in the explained amount of total variance in functional status.

Mediation analyses were used to assess the role of social support and mastery in the association between sleep-related problems and functional status. According to Baron and Kenny,46 the following conditions must be met to establish mediation: the independent variable must affect the dependent variable; secondly, the independent variable must affect the mediator; and finally, the mediator must affect the dependent variable. The proportion of the effect which is mediated was calculated as the indirect effect divided by the total effect and multiplied by 100, while the as-advised standardized total effect was at least ±0.2.47 The Sobel z-test was used to examine the mediating effects of social support and mastery on the association between sleep-related problems and functional status in patients with OSA. We used partial correlation analyses to assess the association between variables under study, when controlled for age, gender, marital status and OSA severity.
each variable. Power analysis revealed that the statistical power for univariate analysis was 98%, with a medium effect size at $\alpha = 0.05$. The statistical power for univariate analysis was 98%, with a medium effect size at $\alpha = 0.05$.46

Results

Sample characteristics

The final sample consisted of 150 patients with OSA (AHI ≥ 5). The mean age of participants was 48.9 ± 9.5 years. The majority of patients were male (68.0%), had secondary education (57.3%) and had a partner (76.0%). A total of 47.7% were obese and 49.3% had severe OSA. The mean score for functional status was 13.68 ± 4.04. Female patients with OSA reported a significantly poorer level of perceived social support, greater sleep-related problems and poorer functional status compared with male patients with OSA (Table 1).

Correlations between the study variables

Table 2 shows the correlations between the study variables. Poor social support, low level of mastery, poor night-time sleep quality and daytime sleepiness were significantly correlated with functional status impairment in patients with OSA.

 Associations between social support, mastery, sleep-related problems and functional status (total scale)

Significant crude associations on functional status were found for gender (B: −2.68; 95% CI: −4.07; −1.30; $p < 0.001$), OSA severity (B: −0.06; 95% CI: −0.09; −0.03; $p < 0.001$), sleep quality (B: −0.43; 95% CI: −0.58; −0.28; $p < 0.001$), daytime sleepiness (B: −0.43; 95% CI: −0.53; −0.33; $p < 0.001$), social support (B: 0.08; 95% CI: 0.03; 0.13; $p < 0.01$), and mastery (B: 0.54; 95% CI: 0.42; 0.67; $p < 0.001$) (Table 3). In the subsequent multivariate models, the effects of gender, OSA severity and sleep-related problems on functional status were statistically significant (Model 1 - Model 3). The association

### Table 1
Baseline characteristics of the patients with OSA with AHI ≥ 5

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>OSA patients (N = 150)</th>
<th>Male (N = 102)</th>
<th>Female (N = 48)</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years; mean, sd</td>
<td>48.9 ± 9.5</td>
<td>47.9 ± 9.5</td>
<td>51.4 ± 9.3</td>
<td>0.04*</td>
</tr>
<tr>
<td>Gender; male, N (%)</td>
<td>102 (68.0%)</td>
<td>102 (68.0%)</td>
<td>48 (32.0%)</td>
<td></td>
</tr>
<tr>
<td>Education; N (%)</td>
<td></td>
<td></td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>8 (5.3%)</td>
<td>4 (3.9%)</td>
<td>4 (8.3%)</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>86 (57.3%)</td>
<td>56 (54.9%)</td>
<td>30 (62.5%)</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>56 (37.3%)</td>
<td>42 (41.2%)</td>
<td>14 (29.2%)</td>
<td></td>
</tr>
<tr>
<td>Marital status; single, N (%)</td>
<td>36 (24.0%)</td>
<td>26 (25.5%)</td>
<td>10 (20.8%)</td>
<td>0.53</td>
</tr>
<tr>
<td>Body Mass Index; mean, sd</td>
<td>30.2 ± 7.7</td>
<td>30.1 ± 7.4</td>
<td>30.6 ± 8.2</td>
<td>0.73</td>
</tr>
<tr>
<td>Body Mass Index; N (%)</td>
<td></td>
<td></td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Underweight; &lt;18.50</td>
<td>9 (6.0%)</td>
<td>4 (3.9%)</td>
<td>5 (10.4%)</td>
<td></td>
</tr>
<tr>
<td>Normal; 18.50–24.99</td>
<td>42 (28.0%)</td>
<td>32 (31.4%)</td>
<td>10 (20.8%)</td>
<td></td>
</tr>
<tr>
<td>Overweight; 25.00–29.99</td>
<td>32 (21.3%)</td>
<td>23 (22.5%)</td>
<td>9 (18.8%)</td>
<td></td>
</tr>
<tr>
<td>Obese; &gt;30.00</td>
<td>67 (44.7%)</td>
<td>43 (42.2%)</td>
<td>24 (50.0%)</td>
<td></td>
</tr>
<tr>
<td>Apnoea Hypopnoea index; mean, sd</td>
<td>361 ± 22.3</td>
<td>339 ± 21.0</td>
<td>394 ± 24.6</td>
<td>0.16</td>
</tr>
<tr>
<td>OSA severity; N (%)</td>
<td></td>
<td></td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>Mild (AHI 5 ≤ 15)</td>
<td>23 (15.3%)</td>
<td>16 (15.7%)</td>
<td>7 (14.6%)</td>
<td></td>
</tr>
<tr>
<td>Moderate (AHI 15 &gt; 30)</td>
<td>52 (34.7%)</td>
<td>38 (37.2%)</td>
<td>14 (29.2%)</td>
<td></td>
</tr>
<tr>
<td>Severe (AHI &gt;30)</td>
<td>74 (49.3%)</td>
<td>47 (46.1%)</td>
<td>27 (56.2%)</td>
<td></td>
</tr>
<tr>
<td>Night-time sleep quality; mean, sd (PSQI; 0–21)</td>
<td>9.7 ± 4.1</td>
<td>9.2 ± 4.1</td>
<td>10.7 ± 4.1</td>
<td>0.03*</td>
</tr>
<tr>
<td>Excessive daytime sleepiness; mean, sd (ESS; 0–24)</td>
<td>11.0 ± 5.3</td>
<td>10.2 ± 4.9</td>
<td>12.5 ± 5.8</td>
<td>0.01**</td>
</tr>
<tr>
<td>Perceived social support; mean, sd (MSPSS; 12–84)</td>
<td>62.9 ± 13.5</td>
<td>63.6 ± 12.6</td>
<td>62.0 ± 15.3</td>
<td>0.50</td>
</tr>
<tr>
<td>Perceived social support; family; mean, sd</td>
<td>21.2 ± 5.4</td>
<td>21.4 ± 5.2</td>
<td>20.8 ± 5.8</td>
<td>0.50</td>
</tr>
<tr>
<td>Perceived social support; friends; mean, sd</td>
<td>19.9 ± 4.9</td>
<td>19.9 ± 4.7</td>
<td>19.8 ± 5.4</td>
<td>0.92</td>
</tr>
<tr>
<td>Perceived social support; signif. other; mean, sd</td>
<td>220.0 ± 4.9</td>
<td>223.7 ± 4.7</td>
<td>214.3 ± 5.4</td>
<td>0.31</td>
</tr>
<tr>
<td>Mastery; mean, sd (PMS; 7–28)</td>
<td>20.4 ± 4.3</td>
<td>20.9 ± 4.5</td>
<td>19.4 ± 3.6</td>
<td>0.05</td>
</tr>
<tr>
<td>Functional status; mean, sd (FOSQ; 5–20)</td>
<td>13.7 ± 4.0</td>
<td>14.5 ± 3.9</td>
<td>11.8 ± 4.2</td>
<td>0.001**</td>
</tr>
<tr>
<td>Activity level</td>
<td>2.8 ± 0.8</td>
<td>2.9 ± 0.9</td>
<td>2.5 ± 0.8</td>
<td>0.01**</td>
</tr>
<tr>
<td>Vigilance</td>
<td>2.1 ± 0.8</td>
<td>2.3 ± 0.8</td>
<td>1.7 ± 0.8</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Intimacy and sexual relationships</td>
<td>2.6 ± 1.3</td>
<td>2.8 ± 1.1</td>
<td>2.1 ± 1.4</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>General productivity</td>
<td>3.0 ± 0.8</td>
<td>3.2 ± 0.8</td>
<td>2.7 ± 0.9</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Social outcome</td>
<td>3.2 ± 0.9</td>
<td>3.3 ± 0.9</td>
<td>2.9 ± 1.0</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

OSA – Obstructive Sleep Apnoea; PSQI – Pittsburgh Sleep Quality Index; ESS – Epworth Sleepiness Scale; MSPSS – Multidimensional Scale of Perceived Social Support; SS – Social Support; PMS – Pearlin Mastery Scale; FOSQ – Functional Outcomes of Sleep Questionnaire; *p < 0.05; **p < 0.01. Missing values: OSA severity: (0.7%); age: (1%); ESS, PSQI (15); MSPSS: (2.0%).

Table 2
Correlations between age, gender, marital status, OSA severity, social support, mastery, night-time sleep quality and daytime sleepiness

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Gender</th>
<th>Marital status</th>
<th>OSA severity</th>
<th>Social support</th>
<th>Mastery</th>
<th>Night-time sleep quality</th>
<th>Daytime sleepiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.17*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Marital status</td>
<td>-0.13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OSA severity</td>
<td>0.13</td>
<td>0.12</td>
<td>0.13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Social support</td>
<td>0.06</td>
<td>-0.07</td>
<td>-0.12</td>
<td>0.07</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mastery</td>
<td>-0.07</td>
<td>-0.17*</td>
<td>-0.08</td>
<td>-0.12</td>
<td>0.20**</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Night-time sleep quality</td>
<td>0.05</td>
<td>0.17*</td>
<td>-0.09</td>
<td>0.19**</td>
<td>-0.16*</td>
<td>-0.28***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>-0.00</td>
<td>0.21**</td>
<td>0.12</td>
<td>0.24**</td>
<td>-0.13</td>
<td>-0.28***</td>
<td>0.15*</td>
<td>-</td>
</tr>
<tr>
<td>Functional status</td>
<td>-0.05</td>
<td>-0.34***</td>
<td>-0.05</td>
<td>-0.35**</td>
<td>0.26**</td>
<td>0.58***</td>
<td>-0.43***</td>
<td>-0.56***</td>
</tr>
</tbody>
</table>

*p < 0.05; ** p < 0.01; *** p < 0.001.
Associations between social support, mastery, sleep-related problems and functional status by subscale

Significant crude effects on all functional status subscales were found for social support, mastery, sleep quality and daytime sleepiness. Social support was significantly associated with intimacy-sexual relationships only, while mastery was associated with all functional status subscales in the final models (with an explained total variance of 38% for activity level, 48% for vigilance, 45% for intimacy-sexual relationships, 63% for general productivity and 38% for social outcome). Sleep-related problems were associated with all functional status subscales in the final models, except for the association between night-time sleep quality and vigilance (Table 4).

Mediating effect of social support on the association between sleep-related problems and functional status

No mediating role of social support was observed in the association between night-time sleep quality and functional status (Sobel z-value=−1.55, p = 0.12).

Mediating effect of mastery on the association between sleep-related problems and functional status

A significant partial mediating effect of mastery on the association between night-time sleep quality (Sobel z-value = −3.202; p < 0.001), daytime sleepiness (Sobel z-value = −3.302; p < 0.001) and functional status was found. Standardized coefficients showed that 17.7% of the total effect of night-time sleep quality (PSQI) on functional status was mediated by mastery (−0.076), and 82.3% of the total effect was direct (−0.351) (Figure 1).

Further, standardized coefficients showed that 23.3% of the total effect of daytime sleepiness (ESS) on functional status was mediated by mastery (−0.131), and 76.7% of the total effect was direct (−0.430) (Figure 2).

Discussion

Our results provide evidence that suggests that poor social support, low levels of mastery, poor night-time sleep quality and daytime sleepiness were associated with impaired functional status in patients with OSA. The association between social support and functional status was weak, and no longer significant when mastery was added to the model. Mastery was strongly associated with functional status. Furthermore, mastery mediated the association between sleep-related problems and functional status.

We found a small but significant association between social support and functional status in patients with OSA. Given the evidence that sleep disturbances may represent an important predictor of daytime functioning, including engagement in social activities, it may be hypothesized that in cases of extreme daytime sleepiness, the sources of social support may not be adequately utilized and thus may be of less importance. Furthermore, recent studies have suggested that sleep disturbances may lead to more negative perceptions of the social environment. Previous research has shown that disturbed sleep in people with OSA and their partners was associated with mood swings and aggression which affected...
Nevertheless, the subscale analyses in our study showed that social support was significantly associated only with one functional status subscale, i.e. intimacy-sexual relationships, while mastery was strongly associated with all functional status subscales. Thus, it may be assumed that mastery, together with social support, may improve intimate and sexual functioning in patients with OSA. This may be crucial as better relationship quality was identified as being the most important need expressed by untreated patients with OSA. Mastery was strongly associated with overall functional status and explained an additional 10% of the variance in functional status beyond the variance explained by sociodemographic, clinical, sleep-related variables and social support. Moreover, the association between social support and functional status was attenuated and no longer significant when mastery was added to the model. These results are in line with findings from studies of other incapacitating diseases, including one preliminary study involving OSA patients with comorbid insomnia, where higher levels of mastery were associated with better self-rated health and quality of life. As expected, our study identified a significant association between poor sleep quality, daytime sleepiness and consequent functional relationships in a negative way. Patients with OSA also had difficulties initiating new intimate relationships or friendships. In line with these assumptions, OSA symptoms were also associated with reduced social participation. Nevertheless, the subscale analyses in our study showed that social support was significantly associated only with one functional status subscale, i.e. intimacy-sexual relationships, while mastery was strongly associated with all functional status subscales. Thus, it may be assumed that mastery, together with social support, may improve intimate and sexual functioning in patients with OSA. This may be crucial as better relationship quality was identified as being the most important need expressed by untreated patients with OSA.
improvement. As elimination of OSA symptoms with CPAP does not improve their health behaviour and to have or to take control over aspects of their lives that are related to health. Additionaly, our results reveal possible gender differences in the impact of OSA on functional status. We found that despite the absence of a significant difference in age, marital status, body mass index and AHI, newly-diagnosed female patients with OSA reported significantly greater sleep-related problems and functional status impairment when compared with male OSA patients. In previous studies, functional status and sleep quality were also more impaired in female OSA patients compared with male patients,5-10,62 despite similarity in sociodemographic and clinical variables.62 This larger impact of OSA severity on health outcomes cannot be explained only by female gender per se66; there are other attendant factors, for instance that women may be more often underdiagnosed regarding OSA when compared with men due to circumstances related to family lifestyle, sociocultural factors and different OSA clinical expressions.8,9

Strengths and limitations

The strength of our study lies in the objective assessment of OSA using PSG. To our knowledge, this is the first study examining the ways in which social support and mastery are associated with functional status in patients with OSA. Some limitations should be noted, however. Due to the cross-sectional design of our study, causal relationships cannot be established. In addition, in our sample 68% of the patients with OSA were men; thus, our results may be less generalizable to female patients with OSA. However, the number of participants in our study is consistent with the man-to-woman ratio in OSA (3:1). Another limitation is the length of the questionnaires used, which may influence the data quality, especially in patients with sleep-related problems. This limitation was mitigated by our sending the questionnaires to the patients three weeks in advance by postal mail, so they had enough time to fill them in.

Implications for practice and future research

This study shows that social support, mastery and sleep-related problems are associated with functional status in patients with OSA, and that mastery may contribute to functional status improvement. As elimination of OSA symptoms with CPAP does not lead to complete restoration of daytime energy, subjective and objective sleepiness,18,63 and overall functional status5,7,13 in many adherent patients, present research and clinical practice should focus not just on standard treatment of OSA, but also on functional status in these patients. In line with this, health care professionals should be aware of the possibility that interventions focusing on mastery enhancement may help improve functional status in patients with OSA. Mastery as a part of patient empowerment44 was also found to be associated with individuals' capacity to make decisions about their health behaviour and to have or to take control over aspects of their lives that are related to health.65 Moreover, as psychological resources associated with control over one's life, such as

![Fig. 2. The mediating role of mastery in the association between daytime sleepiness and functional status. ESS – Epworth Sleepiness Scale; PMS – Pearlin Mastery Scale; FOSQ – Functional Outcomes of Sleep Questionnaire; ***p < 0.001.](image-url)
self-efficacy\textsuperscript{69} or internality,\textsuperscript{70} were found to contribute to CPAP treatment adherence, the role of mastery may have a similar effect.

As mastery is not considered as a fixed personality trait but as an adaptive self-concept born of pivotal experience,\textsuperscript{71} education of patients with OSA, provided by psychologists or trained nurses focusing on personal empowerment for maintaining an adequate level of mastery in people affected by OSA, may be important. Mastery may also be improved by relaxation techniques,\textsuperscript{58} or by chronic disease management programmes which have been found to be effective in patients with pulmonary disease.\textsuperscript{72} Thus, health practitioners’ education about the role of mastery and counselling supporting mastery for patients with OSA may be one of the important components of effective patient management. Additionally, we found that these interventions should be aimed especially at the group of female patients with a severe condition, who have higher probability of experiencing significant impairment in functional status.

Research advancing our knowledge of protective factors to enhance functional status in patients with OSA may help to develop comprehensive multidisciplinary strategies designed to improve self-management skills in patients with OSA. Further research should identify risk groups of patients with low mastery levels, so that counselling and interventions can be tailored to these patients. Future longitudinal intervention studies targeting patients with OSA should be designed to cast more light on the causality in the associations between social support, mastery and functional status. We recommend that our study be replicated with a larger sample and in a longitudinal setting. As mastery may reflect components of negative affectivity or neuroticism,\textsuperscript{73} future studies should examine the associations between mastery, anxiety and affective symptomatology. Finally, future studies may verify the association between mastery and CPAP treatment adherence. General CPAP treatment adherence has been found to be poor\textsuperscript{51} due to various reasons including discomfort and feelings of claustrophobia due to the mask,\textsuperscript{74} as well as other unspecified reasons.\textsuperscript{75} However, interventions to increase patients’ autonomous motivation (e.g. self-efficacy) have demonstrated increased nightly use.\textsuperscript{76} Similarly, mastery is likely to increase patients’ autonomous motivation to manage their condition,\textsuperscript{77} so it may be useful for improvement of CPAP treatment adherence.

Conclusion

While poor social support was weakly associated with impaired functional status in patients with OSA, we found a strong association between low mastery and impaired functional status. Mediation analysis showed that mastery may have the potential to diminish the negative effect of sleep-related problems on functional status. As supporting mastery of patients with OSA may play an important role in management of the condition, patients and health care professionals should learn more about the concept of mastery in connection with sleep-related problems and functional status.

Acknowledgements

The authors wish to thank the people with obstructive sleep apnoea who participated in this study. We also wish to express our gratitude to Dr. I. Tomeckova and Dr. I. Paranicova for the recruitment of patients, their clinical management and the scoring of the sleep studies, and to Ms. A. Schejbalova and Ms. Z. Lazarova for all the technical work in the Sleep Laboratory, Department of Respiratory Medicine, Faculty of Medicine, P.J. Safarik University and L. Pasteur University Hospital, Kosice, Slovakia.

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