Published in final edited form as:

Behav Sleep Med. 2020 ; 18(1): 68–80. doi:10.1080/15402002.2018.1545651.

Coping Processes, Self-Efficacy, and CPAP Use in Adults With Obstructive Sleep Apnea

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Abstract

Background: Coping strategies are predictive of 1-week CPAP use. Coping strategies may predict longer-term CPAP use among adults with obstructive sleep apnea (OSA).

Objectives: To investigate the influence of two coping styles (active and passive) and individual coping processes on CPAP use at 1-week and 1-month; and explore the association between self-efficacy and coping on CPAP use.

Participants: CPAP-naïve adults (52.3% male, 90.9% white) newly diagnosed with OSA (AHI 5 events/hour) from two U.S. clinical sleep centers (n=66).

Methods: A post-hoc analysis from a prospective, longitudinal study that examined influential factors on CPAP use among CPAP-naïve patients with newly-diagnosed OSA (N=97). The Ways of Coping Questionnaire-revised, and the Self-Efficacy Measure for Sleep Apnea were completed immediately after CPAP titration polysomnography. Objective 1-week and 1-month CPAP use (mean hours/night) were the primary outcomes. Descriptive analyses and stepwise multiple linear regression analyses modeling for CPAP use (mean hours/night).

Results: Active coping was significantly associated with greater CPAP use (mean hours/night) at 1-week, but not at 1-month ($p = 0.0397$; $p = 0.0556$, respectively). Higher Planful Problem Solving was significantly associated with greater average CPAP use at 1-week and 1-month ($p = 0.0117$, $p = 0.0378$, respectively). Self-efficacy was significantly associated with greater average CPAP use at 1-week ($p = 0.0056$) and 1-month ($p = 0.0056$).

Conclusions: Self-efficacy and Planful Problem Solving coping are promising behavioral intervention targets to promote CPAP use in newly-diagnosed OSA.

Keywords

Obstructive sleep apnea; Continuous positive airway pressure; Treatment compliance; Coping; Self-efficacy

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder characterized by recurrent cessation of breathing due to partial (i.e., hypopnea) and/or complete (i.e., apnea) upper-airway obstruction (Greenberg, Lakticova, & Scharf, 2017). Among adults 30-70 years of age, approximately 13% of men and 6% of women have moderate to severe OSA (apnea-hypopnea index [AHI] ≥ 15 events/hour), whereas 14% of men and 5% of women have any OSA defined as AHI ≥ 5 and daytime symptom(s) (Peppard et al., 2013). Untreated OSA is associated with significant morbidity and mortality, including increased risk for cardiovascular disease, cancer, and all-cause death (Gami et al., 2013; Javaheri et al., 2017; Marshall, Wong, Cullen, Knuiman, & Grunstein, 2014; Martínez-García, Campos-Rodriguez, & Barbé, 2016). Quality of life, mood and every day functions are also impaired if OSA is left untreated (Appleton et al., 2015; Edwards et al., 2015; Jackson, Howard, & Barnes, 2011). At a societal level, untreated OSA contributes to increased healthcare utilization costs, reduced work performance, and motor vehicle accidents due to daytime sleepiness and fatigue (Alghanim, Comondore, Fleetham, Marra, & Ayas, 2008; George, 2007).

Continuous positive airway pressure (CPAP) is considered the gold standard treatment for OSA (Spicuzza, Caruso, & Di Maria, 2015). Evidence suggests that CPAP reverses subjective symptoms of daytime sleepiness and fatigue, increases quality of life, and resolves or reduces nocturnal respiratory events among OSA patients (Gay, Weaver, Loubé, & Iber, 2006; Patel, White, Malhotra, Stanchina, & Ayas, 2003). Despite the efficacy of this treatment, the effectiveness of CPAP is limited by patient's non-use of the device (Sawyer, Gooneratne, et al., 2011; Weaver & Grunstein, 2008). It is estimated that 25% of patients stop using the device during the first weeks of home treatment and non-adherence rates range from 29-83% when non-adherence is defined as <4 hrs/night of use (Sawyer, Gooneratne, et al., 2011; Weaver & Grunstein, 2008). Furthermore, early CPAP use is a robust predictor of long-term CPAP use (Aloia, Arnedt, Stanchina, & Millman, 2007; Budhiraja et al., 2007; Weaver et al., 1997), which begs the need for early interventions to improve CPAP use.

Understanding factors that facilitate CPAP use will lead to intervention opportunities to potentially increase clinical effectiveness of the treatment. CPAP use is influenced by biomedical factors, such as disease and patient characteristics, titration procedures, device factors and side effects, as well as psychological and social factors (Crawford, Espie, Bartlett, & Grunstein, 2014; Sawyer, Gooneratne, et al., 2011). Among the potentially influential psychological factors, coping processes may be an intervention target to improve CPAP use. According to Lazarus and Folkman (1984), coping refers to "the cognitive and behavioral efforts to manage specific external and/or internal demands appraised as taxing or exceeding the resources of the individual" (p.141). Coping processes, measured by Ways of Coping questionnaire, have been preliminarily examined as influential on CPAP use. In a

descriptive correlational study of 23 CPAP-naïve participants with moderately severe OSA, Stepnowsky and colleagues (2002) found that coping processes were the only influential variables on CPAP use at 1-week despite measuring a number of psychological variables. Active coping processes independently contributed to 16% of the variance in CPAP adherence. In this study, the two active subscales of Planful Problem Solving (i.e. the deliberate efforts to modify a situation/solve the problem), and Confrontive Coping (i.e. aggressive efforts to change the situation), measured by Ways of Coping – Revised (WAYS-R), were most closely associated with short-term CPAP adherence (Stepnowsky, Bardwell, Moore, Ancoli-Israel, & Dimsdale, 2002). A second descriptive correlational study did not identify coping processes as influential on longer-term CPAP use at 30 days of treatment (Moran et al., 2011).

Given the relative paucity of studies addressing coping processes as influential on CPAP use and the reported inconsistent findings, we sought to investigate the influence of active and passive coping processes on CPAP use at both 1-week and 1-month. Self-efficacy has been proposed as a relevant component that might facilitate coping with specific stressful treatment experiences associated with physical illness (Johnson & Lauver, 1989). The concept of self-efficacy derives from the social cognitive theory (Bandura, 1977), and reflects the individual's confidence in their ability to engage in a behavior (treatment self-efficacy). Previous work indicates that self-efficacy significantly influences CPAP use (Sawyer, Canamucio, et al., 2011; Stepnowsky, Marler, & Ancoli-Israel, 2002; Wallace, Shafazand, Aloia, & Wohlgemuth, 2013); therefore, we sought to explore the relationship between self-efficacy and coping processes. We also explored the eight WAYS-R coping subscales as influential on CPAP use at 1-week and 1-month. Thus, based on previous evidence showing the association of coping with CPAP use, we hypothesized the following: Active coping, but not passive coping will be influential on CPAP use at 1-week and 1-month. Also, based only on prior theory (Johnson & Lauver, 1989), we explored the relationship between self-efficacy and coping on CPAP use.

Methods

This study is a post-hoc analysis of data from a prospective, longitudinal study wherein the diagnostic utility of a risk screening index for nonadherence to CPAP was tested among adults with newly-diagnosed OSA prior to home treatment; full description of the parent study has been previously reported (Sawyer et al., 2014). The parent study participant recruitment and data collection period was 6/2011-11/2013. The study was approved by the respective Institutional Review Boards (IRB).

Participants

Consecutive convenience sampling was used in the parent study; CPAP-naïve patients newly diagnosed with OSA from two clinical sleep centers in the U.S. were recruited. Inclusion criteria were: (1) newly-diagnosed OSA with AHI ≥ 5 events/hour on in-laboratory polysomnogram (PSG), conducted and scored in accordance with standard criteria at time of the parent study (Iber, Ancoli-Israel, Chesson, & Quan, 2007; Kushida et al., 2006), (2) referral to CPAP titration PSG, and (3) able to speak and read English. Exclusion criteria

were: (1) supplemental oxygen or bi-level positive airway pressure during titration PSG; (2) new psychiatric disorder within previous six months of study enrollment; and (3) any medical contraindication to CPAP. The post-hoc analysis included all participants with complete data for Self-Efficacy Measure in Sleep Apnea (SEMSA), WAYS-R, and 1-week and 1-month objective CPAP use ($n=66$). No a priori power analysis was conducted for this post-hoc analysis. Prior studies of WAYS-R and CPAP use have included sample sizes ranging from 23 to 63 subjects (Moran et al., 2011; Stepnowsky, Bardwell, et al., 2002); the current sample size is larger than previously published studies of this phenomenon. To determine adequacy of the sample size for this post-hoc analysis, confidence intervals around the estimate were evaluated.

Procedures

Baseline measures, including self-reported demographics, medical record extraction of medical history, and diagnostic PSG data, were collected. Participants then underwent an overnight, in-laboratory CPAP titration PSG. Immediately after CPAP titration PSG, study participants completed a risk screening questionnaire (i.e. Index for Non-adherence to Positive Airway Pressure, I-NAP, see Sawyer et al., 2014), inclusive of SEMSA and WAYS-R. Home CPAP treatment was initiated and participants returned to the sleep center for a research visit after 1-month (i.e. 30 days) of CPAP treatment when objective CPAP use was collected.

Study Measures

Epworth Sleepiness Scale (ESS).—This 8-item, self-report questionnaire is a valid and reliable instrument for measurement of subjective sleepiness in the general population and adult OSA population (Johns, 1993, 1994). The ESS asks respondents to estimate, on a 4-point scale (0-3), their chances of dozing-off or falling asleep in eight common situations. The total score range is 0-24, with greater scores indicating more daytime sleepiness.

Ways of Coping Questionnaire-revised (WAYS-R).—This 66-item questionnaire was designed to learn about participant's thoughts and actions when coping with self-identified stressful situations (Folkman & Lazarus, 1988). Individual items are scored on a 4-point frequency scale (0-3), indicating the frequency that each listed strategy was used when coping with a specific recent stressful encounter. Raw non-missing sum scores for each of the eight analytically derived coping scales of WAYS-R were computed. High raw scores indicate more frequent use of the coping process. Note that not all WAYS-R items contribute to the scoring of the scales; only 50 out of 66 items are scored and contribute to the scale scores. The WAYS-R questionnaire has been used to assess coping processes among different populations (Folkman & Lazarus, 1988; Knussen & Lee, 1998; Patterson et al., 1993), including adult OSA populations (Bardwell, Ancoli-Israel, & Dimsdale, 2001; Moran et al., 2011; Stepnowsky, Bardwell, et al., 2002). The internal consistency by Cronbach's alpha ranges from .61-.79 for the eight WAYS-R sub-scales (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986).

After conducting a secondary factor analysis on the eight WAYS-R coping scales, Patterson et al. (1993) found that the original eight subscales could be loaded into two over-arching

coping styles – active coping and passive coping. Active Ways of Coping is based on the sum of raw scores of endorsed items from the following four WAYS-R coping scales: Confrontive Coping, Seeking Social Support, Planful Problem Solving, and Positive Reappraisal. Passive ways of coping is based on the sum of raw scores from endorsed items from the four remaining coping scales in the WAYS-R questionnaire: Distancing, Self-Controlling, Accepting Responsibility, and Escape-Avoidance. No total score for the WAYS-R was calculated as is consistent with the WAYS-R scoring manual (Folkman & Lazarus, 1988). Coping processes are the primary independent research variable for the reported research.

Self-Efficacy Measure for Sleep Apnea (SEMSA).—This 26-item disease-specific questionnaire includes three subscales: the perceived risks of OSA, CPAP outcome expectancies, and CPAP self-efficacy. SEMSA asks respondents to estimate, on a 4-point scale (1-4), their agreement with statements in each of the three domains. Mean non-missing item responses are summed for each sub-scale; there is no total SEMSA score (Weaver et al., 2003). For this analysis, the mean of the non-missing item responses was calculated for the “CPAP self-efficacy (SE)” domain only. Higher scores in the SE domain indicate a greater willingness to engage in CPAP therapy despite adverse situations (Shahid, Wilkinson, Marcu, & Shapiro, 2012). The questionnaire was found to have an internal consistency of .92 and a test-retest reliability ranging from .68 to .77 (Weaver et al., 2003).

CPAP use.—Objective 1-week and 1-month CPAP use, the primary dependent variables, was collected using the internal microprocessor on standard CPAP devices. Use was recorded as hours/night at effective pressure >20 minutes.

Analysis

Data was summarized by standard descriptive statistics. Multiple linear regression models with a stepwise loading procedure were used to test the influence of coping processes on the outcome of 1-week and 1-month CPAP use. Due to the modest sample size, separate regression models were used to analyze active and passive coping and the eight individual coping process variables. An additional analysis was employed to assess the influence of self-efficacy on the coping-CPAP use relationship by testing it as an interaction term for active and passive coping strategies in separate 1-week and 1-month multiple linear regression models. Correlations between self-efficacy and coping were also computed as part of this exploratory analysis. All models were adjusted for apnea hypopnea index (AHI, events/hour), age, and subjective sleepiness (i.e., ESS total score) as prior studies identified that these variables are consistent, albeit weak, confounding factors for the primary outcome of CPAP use (Sawyer, Gooneratne, et al., 2011). Lowest AIC value was used as criteria for stepwise model selection. The continuous outcome variable of average (mean) CPAP use (hours/night), at 1-week and 1-month, was modeled in all multiple linear regression analyses. Also, secondary analyses using binary logistic regression were conducted for the outcome variable of non-use (i.e., non-adherence) defined as <4hrs/night in 70% of nights, as well as for the outcome of non-use defined as < 4 hours/night (For these secondary results, see Online Supplement). The employment of a cut-off point for CPAP use is supported by dose response studies which have identified that, at a minimum, 4 hours of

CPAP use per night is required to see improvement in the primary expressive symptom of subjective daytime sleepiness among people with moderate to severe OSA (Antic et al., 2011; Weaver et al., 2007). Also, among OSA patients, the use of CPAP for less than 4 hours per night is associated with considerable risk of cardiovascular events, such as stroke and coronary heart disease (Campos-Rodriguez et al., 2014), and increased mortality (Campos-Rodriguez et al., 2005). We prioritized modeling active and passive coping mechanisms as our primary analysis and conducted an exploratory data analysis on the eight subscales and interaction of self-efficacy and active/passive coping. Statistical significance was defined as $p < 0.05$. All analyses were performed using RStudio software version 1.0.136.

Results

Sample, Coping (WAYS-R), and Self-Efficacy (SEMSA) description.

The sample ($n=66$) included predominantly middle-aged (54.15 ± 11.31 years) men (53%) with severe OSA (AHI 37.5 ± 18.3 events/hour). Participants were married (69.7%), educated at college level (69.7%), employed full-time (69.8%), and primarily self-identified as white (90.9%). Mean SEMSA self-efficacy score was $2.98 (\pm 0.64)$ and median was 3 (IQR 2.67-3.44). Mean 1-week and 1-month CPAP use was 4.5 h/night (SD 2.6), and 4.3 h/night (SD 2.5), respectively (Table 1). CPAP use ranged from 0-11.25 hours at 1-week (median 5 [IQR 2.59-6.12]), and 0-8.9 hours at 1-month (median 5 [IQR 2.08-6.15]). Raw scores for each of the eight WAYS-R scales, as well as for the two over-arching coping styles of active and passive coping, are summarized in Table 2. Because of the limited sample size, and the exploratory nature of this work, outliers were evaluated and only removed if significantly influential on any of the results.

Active and passive coping influence on CPAP use (mean hours/night) at 1-week and 1-month.

Variable selection was performed using a stepwise elimination procedure for two separate models (i.e. 1-week & 1-month) containing active and passive scores, adjusted for subjective sleepiness, age, and AHI; only subjective sleepiness was retained in the fully adjusted final model. The final multiple linear regression models for CPAP use (mean hours/night) at 1-week and 1-month were selected based on lowest AIC value (Table 3). Active coping was significantly associated with greater CPAP use (mean hours/night) at 1-week, but not at 1-month ($p = 0.0397$; $p = 0.0556$, respectively). Active coping, independently accounted for 5% and 1% of the variability in average hours of CPAP use at 1-week and 1-month, respectively. Passive coping was retained only at 1-month and was not significant ($p = 0.1457$). Greater subjective daytime sleepiness significantly influenced average CPAP use at both 1-week and 1-month ($p = 0.0328$; $p = 0.0124$, respectively). Different results were obtained when modeling the CPAP use outcome variable defined as <4 hrs/night on 70% of nights, as well as for the outcome of non-use defined only as <4 hours/night (see Online Supplement).

Individual coping strategies influence on CPAP use (mean hours/night) at 1-week and 1-month.

Two separate multiple linear regression models (i.e. for 1-week & 1-month) were reduced by stepwise selection. The final multiple linear regression models for CPAP use (mean hours/night) at 1-week and 1-month with lowest AIC value were selected (Table 4). Planful Problem Solving (PPS), an active coping process, was the only significant individual coping process that was influential on CPAP use at both 1-week and 1-month. Higher PPS scale scores, indicating more frequent use of this coping process, were significantly associated with greater average CPAP use at 1-week and 1-month ($p = 0.0117$, $p = 0.0378$, respectively). PPS coping, independently accounted for 8% and 3% of the variability in average hours of CPAP use at 1-week and 1-month, respectively. Accepting Responsibility, a passive coping strategy, was retained in the 1-month final model but was not independently significant ($p = 0.1368$). Comparable results were obtained when modeling the outcome variable of non-use defined as <4hrs/night in 70% of nights, as well as for the outcome of non-use defined as < 4 hours/night (see Online Supplement).

Self-efficacy and coping

There was a positive correlation between self-efficacy and active coping (Pearson's $r = 0.228$, $p = 0.0649$, with a $R^2 = 0.05$). A negative correlation was found between self-efficacy and passive coping (Pearson's $r = -0.122$, $p = 0.3276$, with a $R^2 = 0.01$) (Figure 1). Final linear regression models for self-efficacy analysis are reported in Table 5. Self-efficacy and subjective sleepiness were the only predictors retained at both 1-week and 1-month. Self-efficacy was a significant predictor, and independently accounted for 9% of the variability in average hours of CPAP use at both 1-week ($p = 0.0056$) and 1-month ($p = 0.0056$). Different results were obtained when modeling the outcome variable of non-use defined as <4hrs/night in 70% of nights, as well as for the outcome of non-use defined as < 4 hours/night (see Online Supplement).

Discussion

The major findings of our study indicate that greater use of active coping strategies among newly-treated OSA adults using CPAP treatment was significantly associated with greater CPAP use (mean hours/night) at 1-week, but not at 1-month. These findings do not fully support our hypothesis that active coping, but not passive coping, is influential on both 1-week and 1-month CPAP use. We also identified that using Planful Problem Solving coping process, an active coping strategy, significantly influenced greater average CPAP use at both 1-week and 1-month. A positive, though weak, correlation was observed between self-efficacy and active coping. Self-efficacy and passive coping were negatively correlated, albeit weak. Also, when exploring the relationship between self-efficacy and coping on CPAP use, self-efficacy was found to be more influential on CPAP use than coping processes.

Engaging in active coping strategies has been previously reported to be positively associated with CPAP use (Stepnowsky, Bardwell, et al., 2002). Stepnowsky et al (2002) identified that active ways of coping independently accounted for a significant amount of variance in CPAP

use at 1-week. More specifically, Planful Problem-Solving and Confrontive Coping processes were most strongly associated with CPAP use. However, a second study by Moran et al (2011) failed to replicate these early results when looking at longer-term CPAP use. Methodological and sampling differences may account for the contradictory findings.

Adherence rates differed across prior studies. Stepnowsky et al (2002) reported a mean nightly CPAP use of 5.8 hours/night (SD 0.86) and 1-week nightly CPAP use range of 4.4 to 7.7 hours per night; low PAP use, commonly defined as <4hrs/night, was not represented in this early study. In contrast, Moran et al (2011) included both low and high PAP users, with a 61.9% adherence rate reported when adherence was defined as >4h/night on 70% of the nights; non-adherers represented 38.1% of the sample. The present study distribution of CPAP use demonstrates representation of low and high users; similar to Moran et al (2011), adherence rates were 66.7% and 63.6% at 1-week and 1-month, respectively. Convenience sampling across all studies, including the present study, resulted in under-representation of non-adherers. Thus, the contrasting findings between the three studies may be largely attributed to under-representation of CPAP non-adherence or low CPAP use.

Other important methodological considerations are noteworthy; all studies examined different outcome intervals. Moran et al (2011) looked at long-term CPAP (i.e. use ranging from 30 to 171 days), whereas Stepnowsky and colleagues reported 1-week CPAP use only. Also, Moran et al (2011) modeled for only three out of eight WAYS-R subscales and did not account for the overarching influence of active and passive coping on CPAP use. This a priori subscale selection introduces the risk of bias in their results.

The present study extends the findings of Stepnowsky et al (2002) by examining the influence of coping processes on 1-month CPAP use in addition to 1-week CPAP use. Future studies will consider a sampling approach that allows for the recruitment of a more balanced sample in terms of the CPAP use outcome. Inconsistent results were obtained in the secondary analyses when modeling, separately, for the two binary outcomes based on the commonly employed clinical benchmarks of CPAP non-use < 4 hours/night and < 4 hours/night on 70% of nights (see Online Supplement). It is evident, therefore, that failing to use the entire continuum of the outcome data, particularly with a modest sample size, results in potentially erroneous conclusions with imprecise final models (i.e., confidence intervals). Thus, although employing a cut-off point (e.g., < or = 4 hours/night) for CPAP use might be clinically meaningful based on the scientific evidence for symptom resolution (Antic et al., 2011; Weaver et al., 2007) and on current insurance coverage policy (Department of Health and Human Services & Centers for Medicare & Medicaid Services, 2016), researchers are urged to use the full range of the outcome variable, CPAP use, in analyses. Failure to do so increases risk of drawing erroneous conclusions.

The relationship between self-efficacy and coping in the context of CPAP use has been unexplored until now. Self-efficacy has long been a central concept related to health behavior change (Bandura, 1977, 2002). Self-efficacy interventions for CPAP use, when using an educational and/or supportive approach, have demonstrated small to modest effect sizes (Wozniak, Lasserson, & Smith, 2014). However, intensive interventions that may indirectly affect coping processes and improve self-efficacy (i.e. individualized motivational

enhancement therapy) have revealed more robust effect sizes (Aloia, Arnedt, Strand, Millman, & Borrelli, 2013). Exploratory correlation results from the present study revealed a small, yet, theoretically sound association between self-efficacy and coping. Our study yields hypothesis-generating preliminary data, suggesting that interventions directly targeting coping, particularly planful problem solving processes, may influence both self-efficacy and CPAP use. These findings and conclusions are, however, cautiously offered due to the absence of a robust distribution of self-efficacy scores in the present study.

Even though active coping was significantly influential on CPAP use at 1-week, this predictor was not retained when self-efficacy was simultaneously incorporated in the analyses. Our results are consistent with the extant literature that supports the influence of self-efficacy as a significant predictor of CPAP use (Bartlett et al., 2013a; Sawyer, Canamucio, et al., 2011; Stepnowsky, Marler, et al., 2002). Several interventions targeting self-efficacy have resulted in improved CPAP use (Bartlett et al., 2013b; Richards, Bartlett, Wong, Malouff, & Grunstein, 2007; Wozniak et al., 2014); most of these studies did not discern if self-efficacy was the underlying mechanism that changed with intervention exposure. Future studies will measure self-efficacy change at each intervention exposure period and at the outcome to understand causal mechanism(s) underlying CPAP use interventions.

This study is not without limitations. The clinical sample included predominantly well-educated subjects, minimal representation of diversity in terms of race and ethnicity, and a relatively low representation of absolute non-adherers (i.e., 0 hours of use). Thus, the external validity and generalizability of our findings is limited. As evidenced by the wide confidence intervals, the estimates are based on a likely underpowered sample, and interpretation should be made with caution.

The WAYS-R questionnaire was validated among a healthy population of community-residing white married couples (Folkman et al., 1986). Since then, several subsequent studies have looked at the WAYS-R factor structure among clinical populations. Despite some evidence supporting the original 8-factor structure (Ax, 1999; Lundqvist & Ahlström, 2006), most studies have suggested the appropriateness of using alternative factor structures (Newth & DeLongis, 2004; Rosberger, Edgar, Collet, & Fournier, 2002; Sørli & Sexton, 2001; Van Liew, Santoro, Edwards, Kang, & Cronan, 2016; Vitaliano, Russo, Carr, Maiuro, & Becker, 1985; Wineman, Durand, & McCulloch, 1994). These findings are supportive of revising the WAYS-R, and making it population-specific. For a further discussion on previous factor analytic studies on the WAYS-R questionnaire and their suggested structures see Van Liew et al. (2016). To the best of our knowledge, no studies have investigated the factor structure of the WAYS-R in a sample of patients with OSA. It is reasonable to assume that people facing a chronic condition, such as OSA, will have unique coping requirements that likely differ from those needed in the daily life of well individuals. For clinical purposes, the use of a 66-item questionnaire may not be feasible. A shorter version of the WAYS-R was proposed by Hatton & Emerson (1995) for direct care staff members in learning disability services but has not been systematically validated in other populations, including OSA populations. Alternative coping measures are available; however, similar shortcomings (length of instrument; non-specific to population) limit translational capacity

of these instruments (Carver, Scheier, & Weintraub, 1989; Rosenstiel & Keefe, 1983; Stone & Neale, 1984; Tobin, Holroyd, Reynolds, & Wigal, 1989). Thus, future work should focus on examining the factor structure of the WAYS-R in a large sample of adults with OSA and CPAP treatment, as well as revising, adapting, and potentially shortening this instrument to be treatment-specific among OSA patients. Although generic measures of coping mechanisms have been shown to be influential on CPAP use, we believe that a disease specific assessment of coping mechanisms would likely contribute insights for CPAP adherence intervention targets.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Scatterplots for exploratory correlation between self-efficacy, coping, and CPAP use. *CPAP* continuous positive airway pressure. Figure generated with RStudio version 1.0.136.

Table 1.*Sample Description (n=66)*

Characteristic	Frequency (n [%]) or Mean ($\pm$ SD)
Male	35 (53%)
Age, years	54.15 ($\pm$ 11.31)
Race	
White	60 (90.9 %)
Black or African-American	3 (4.5 %)
Asian	1 (1.6 %)
American Indian/Alaska Native	2 (3 %)
Ethnicity	
Hispanic or Latino	5 (7.6 %)
Not Hispanic or Latino	61 (92.4 %)
Married	46 (69.7 %)
Highest Education Completed	
High School	18 (27.3 %)
Some college or more	46 (69.7 %)
Employment	
Working full-time	46 (69.8 %)
Working part-time	5 (7.6 %)
Homekeeper	2 (3 %)
Unemployed	4 (6 %)
Student	2 (3 %)
Retired	7 (10.6 %)
Consistent night shift	6 (9 %)
Body Mass Index, kg/m ²	38.6 ($\pm$ 9.97)
Apnea Hypopnea Index, events/hour	37.5 ($\pm$ 18.3)
Mild, 5-15 events/hour	9 (13.6 %)
Moderate, 15-30 events/hour	12 (18.2 %)
Severe, 30 events/hour	45 (68.1 %)
NR oxyhemoglobin saturation nadir, %	81.7 ($\pm$ 6.8)
Epworth Sleepiness Scale score	10.82 ($\pm$ 5.13)
Self-Efficacy (SEMSA)	2.98 ($\pm$ 0.64)
CPAP use, 1 week, hours/night	4.5 ($\pm$ 2.6)
1-week non-users, <4hours/night CPAP	22 (33.3%)
CPAP use, 1 month, hours/night	4.3 ($\pm$ 2.5)
1-month non-users, <4hours/night CPAP	24 (36.4%)

Note. NR non-REM, SEMSA Self-efficacy Measure in Sleep Apnea, CPAP continuous positive airway pressure.

Table 2.*WAYS-R Questionnaire Raw Scores.*

Subscale (# of items)	Mean ($\pm$ SD)	Median (IQR)
Active Coping [*] (25)	53.32 ($\pm$ 13.71)	52 (43-62.25)
Confrontive Coping (6)	11.38 ($\pm$ 3)	11 (9-13)
Seeking Social Support (6)	12.79 ($\pm$ 4.15)	12 (10-15)
Planful Problem Solving (6)	14.41 ($\pm$ 4.17)	14 (12-17)
Positive Reappraisal (7)	14.74 ($\pm$ 5.44)	14 (10-18.75)
Passive Coping ^{**} (25)	48.06 ($\pm$ 9.52)	48.50 (42-55)
Distancing (6)	11.7 ($\pm$ 2.99)	12 (10-13)
Self-Controlling (7)	15.91 ($\pm$ 3.96)	16.50 (13-18)
Accepting Responsibility (4)	7.39 ($\pm$ 2.18)	7 (6-9)
Escape-Avoidance (8)	13.06 ($\pm$ 3.45)	12 (11-15)

^{*}“Active Coping” is comprised of four subscales: Confrontive Coping + Seeking Social Support + Planful Problem Solving + Positive Reappraisal.

^{**}“Passive Coping” is comprised of four subscales: Distancing + Self-Controlling + Accepting Responsibility + Escape-Avoidance.

Table 3.

Multiple Linear Regression Model: Active and Passive Coping as Influential on CPAP Use (hours/night), 1-week & 1-month (n=66)

Variable	1 week [†]			Variable	1 month [‡]		
	β	SE β	Change in R^2_{adj}		β	SE β	Change in R^2_{adj}
Intercept	0.59	1.41	NA	Intercept	2.68	1.64	NA
ESS	0.13 [*]	0.06	0.05	ESS	0.15 [*]	0.06	0.06
Active	0.05 [*]	0.02	0.05	Active	0.05 [●]	0.02	0.01
				Passive	-0.05	0.03	0.01

[†]AIC: 123.52; Total R^2_{adj} : 0.10 (95% CI: -0.03 to 0.22); $F(2,63) = 4.55$. $p < 0.05$

[‡]AIC: 118.15; Total R^2_{adj} : 0.09 (95% CI: -0.03 to 0.21); $F(3,62) = 3.15$. $p < 0.05$

Lowest AIC value used for stepwise model selection

[●] $p < 0.1$;

^{*} $p < 0.05$

R^2_{adj} Adjusted R-squared; ESS Epworth Sleepiness Scale

Variables not retained in final model: AHI, age, and passive (1 week)

Table 4.

Multiple Linear Regression Model: Individual Coping Strategies as Influential on CPAP Use (hours/night), 1-week & 1-month (n=66)

Variable	1 week [†]			Variable	1 month [‡]		
	β	SE β	Change in R^2_{adj}		β	SE β	Change in R^2_{adj}
Intercept	0.34	1.28	NA	Intercept	2.13	1.44	NA
ESS	0.13 [*]	0.06	0.05	ESS	0.14 [*]	0.06	0.06
PPS	0.19 [*]	0.07	0.08	PPS	0.15 [*]	0.07	0.03
				AR	-0.21	0.14	0.02

[†] AIC: 121.27; Total R^2_{adj} : 0.13 (95% CI: -0.01 to 0.27); $F(2,63) = 5.78$. $p < 0.01$

[‡] AIC: 116.66; Total R^2_{adj} : 0.11 (95% CI: -0.02 to 0.24); $F(3,62) = 3.7$. $p < 0.05$

Lowest AIC value used for stepwise model selection

^{*} $p < 0.05$

R^2_{adj} : Adjusted R-squared; *ESS* Epworth Sleepiness Scale, *AR* Accepting Responsibility, *PPS* Planful Problem Solving

Variables not retained in the final model: AHI, age, Confrontive Coping, Seeking Social Support, Positive Reappraisal, Distancing, Escape-Avoidance, Self-Controlling, and Accepting Responsibility (1 week).

Table 5.

Multiple Linear Regression Model: Self-efficacy, Active and Passive Coping as Influential on CPAP use (hours/night), 1-week (n=65) & 1-month (n=66).

Variable	1 week [†]			Variable	1 month [‡]		
	β	SE β	Change in R^2_{adj}		β	SE β	Change in R^2_{adj}
Intercept	-0.66	1.37	NA	Intercept	-0.57	1.37	NA
ESS	0.11 [●]	0.05	0.08	ESS	0.10	0.05	0.06
SE	1.29 ^{**}	0.45	0.09	SE	1.30 ^{**}	0.45	0.09

[†]AIC: 109.8; Total R^2_{adj} : 0.17 (95% CI: 0.02 to 0.33); $F(2,62) = 7.85$. $p < 0.001$

[‡]AIC: 112.27; Total R^2_{adj} : 0.15 (95% CI: 0.01 to 0.30); $F(2,63) = 7.01$. $p < 0.05$

Lowest AIC value used for stepwise model selection

[●] $p < 0.1$;

^{**} $p < 0.01$

R^2_{adj} : Adjusted R-squared; *ESS* Epworth Sleepiness Scale, *SE* Self-Efficacy SEMSA subscale

Variables not retained in the final model: AHI, age, SE*Active, and SE*Passive, Active, and Passive.