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SCIENTIFIC INVESTIGATIONS

Randomized controlled trial on the efficacy of audio-visual health educational materials on CPAP adherence: the AHEAD trial

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Study Objectives: Educational interventions have been proposed to improve continuous positive airway pressure (CPAP) adherence; however, studies to date have not demonstrated robust effectiveness, due to methodological issues. Furthermore, these educational interventions have not specifically targeted low health literacy communication techniques, which have been demonstrated to improve outcomes in numerous other chronic diseases. We hypothesized that the addition of low-cost audio-visual educational videos (EVs) to usual standard-of-care (SC) education would improve CPAP adherence in adults with obstructive sleep apnea (OSA) syndrome.

Methods: At CPAP initiation, treatment-naïve adults with OSA syndrome were randomized to (1) usual SC or (2) SC + 5 EVs showing a patient's journey, designed with low health literacy communication techniques to teach patients about OSA and CPAP therapy. The primary endpoint was CPAP usage at 2 months (hours/night) and secondary endpoints were CPAP usage at 12 months and percentage of patients with ≥ 4 hours/night use at 2 months and 12 months.

Results: One hundred and ninety-five patients were randomized (SC 99, EV 96), with a mean age of 57 years (interquartile range [IQR] 44.1–64.8 years). There were no statistically significant differences in patient characteristics at baseline between the SC vs EV groups, with the diagnostic apnea-hypopnea index of 34 events/h (IQR 21–59 events/h) vs 30 events/h (IQR 20–50 events/h) and Epworth Sleepiness Scale score of 12.8 ± 6 vs 11.7 ± 5. At 2 months, there was no significant difference in hours of CPAP usage (SC: 3.45 hours/night [95% confidence interval (CI): 2.76 to 4.13] vs EV: 3.75 hours/night [95% CI: 3.14 to 4.37]) nor in proportion with adequate usage or overall commencement rate. However, at 12 months, there was a significant difference in hours of CPAP usage (SC: 2.50 hours/night [95% CI: 1.94 to 3.06] vs EV: 3.66 hours/night [95% CI: 2.92 to 4.40]). The probability of adequate CPAP usage at 12 months was higher in the intervention arm (odds ratio: 1.33; 95% CI: 1.04 to 1.7; $P = .013$). Patients with low education backgrounds benefitted substantially from the EV intervention compared with SC (mean difference at 12 months = 2.47 hours/night usage; 95% CI: 1.01 to 2.93; $P < .01$).

Conclusions: Low health literacy–designed EVs improve CPAP adherence at 12 months compared with SC, with the greatest impact in patients with a low educational background.

Clinical Trial Registration: Registry: Australian New Zealand Clinical Trials Registry; Name: Randomised controlled trial on the efficacy of audio-visual health educational materials on sleep health literacy and continuous positive airway pressure (CPAP) adherence in Sleep Clinic patients; URL: https://www.australianclinicaltrials.gov.au/anzctr/trial/ACTRN12619000523101; Identifier: ACTRN12619000523101

Keywords: CPAP usage, CPAP adherence, CPAP compliance, educational intervention, obstructive sleep apnea, health literacy, educational video

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BRIEF SUMMARY

Current Knowledge/Study Rationale: Educational interventions specifically utilizing low health literacy communication strategies have been shown in many chronic diseases to improve therapy adherence and outcomes; however, this has not been assessed in adults with obstructive sleep apnea requiring continuous positive airway pressure (CPAP) therapy. The goal of this study was to determine if educational videos designed using low-health literacy communication techniques (such as showing a patient's journey, minimizing jargon, high use of dot points and graphics) could improve CPAP usage compared with standard of care.

Study Impact: This study showed that the use of educational videos with communication techniques for low health literacy results in higher long-term CPAP adherence when added to standard of care, with the greatest improvement found for individuals with low education backgrounds.

INTRODUCTION

Optimal treatment of obstructive sleep apnea (OSA) often requires long-term adherence to continuous positive airway pressure (CPAP) therapy to achieve desired outcomes such as improved daytime sleepiness,[1–3] neurocognitive performance (memory and executive function[4]), work absenteeism, and blood pressure control.[1] These improvements are dose-dependent, with 4 hours/night

representing the minimum CPAP usage needed for efficacy.[5] Achieving adequate CPAP usage remains challenging, with between 29% and 83% of patients meeting this minimum limit, depending on the interventions used to support treatment commencement and adherence.[1,6,7]

Interventions to improve CPAP adherence fall under 4 major categories: educational, supportive, behavioral, and algorithm/mask modification. Educational interventions to improve CPAP adherence have used a range of modalities from situational videos, group education meetings, and risk framing messaging. These interventions have been shown to improve CPAP usage by +0.85 hours (95% confidence interval [CI]: 0.21–1.39 hours; odds ratio [OR] = 2.58; 95% CI: 1.5–4.44) in 10 studies of 1,128 patients; however, the quality of evidence was graded as "very low" due to high participant withdrawal, significant study heterogeneity, and methodological concerns.[7] Supportive interventions have varied from phone calls to check in on side-effects, to tele-monitoring, to home visits, with moderate-quality evidence indicating improved CPAP usage of +0.70 (0.36–1.05) hours in 13 studies of 1,426 patients.[7] The modality with the highest quality of evidence to improve CPAP usage are behavioral interventions, which predominantly have focused on motivational enhancement, with a mean improved usage of +1.31 (95% CI: 0.95–1.66) hours across 10 studies of 1,128 patients.[7] These behavioral interventions have required 2 hours or more of specialist psychologist or expert nursing time to achieve these improved outcomes, which is not feasible for many sleep services.

While there are several written resources available to support clinicians in educating patients, unfortunately these often have poor readability for patients.[8,9] For example, the widely used American Association of Sleep Medicine (AASM) educational material requires above a high school level of education and scored poorly on understandability and actionability and did not meet recommended clear communication standards.[8] This is of concern, given that it is estimated that only one-third of US adults have adequate health literacy[10] and, similarly, only approximately 40% of adult Australians and Europeans have adequate health literacy.[11,12]

Health literacy is a multifaceted concept defined as follows: "The personal, cognitive and social skills which determine the ability of individuals to gain access to, understand, and use information to promote and maintain good health."[13] It incorporates technical skills (such as reading, writing, and comprehension), which, together with self-efficacy, drives an individual to use information to successfully achieve a desired health outcome.[13] Health literacy has been established as a link between chronic disease health outcomes, socioeconomic status (SES),[14] and educational attainment background.[15] The likelihood of limited health literacy increases with increasing age, lower levels of education, and increasing socioeconomic disadvantage.[16] To date, educational interventions to improve CPAP usage have not specifically outlined the ways in which health literacy has been considered, nor have they been specifically designed to be suitable for patients with low health literacy. None of the large international sleep medicine organizations, such as the AASM, European National Sleep Society, and Australasian Sleep Society, have set health literacy as a standard for education material development and do not have educational videos available through online patient resources.

In many other chronic diseases, interventions designed for patients with low health literacy have improved outcomes: for example, in chronic kidney disease in improving dialysis adherence and reduces rates of peritonitis,[17] in diabetes mellitus improved glycated hemoglobin (HbA_1C) outcomes,[18] improved quit rates in smoking cessation programs, and increased uptake of prostate cancer screening.[19] Interventions defined as suitable for "low health literacy" include use of multimedia such as video, repetition of key messages,[18] and plain language rewriting of print-based materials[20]; images and diagrams should have clear titles; and patient journey storytelling is preferred above didactic information. Within sleep medicine, these techniques are seldom mentioned as specifically used in educational interventions. One example of a targeted educational intervention was conducted using a customized online educational platform tailored for African-American populations with low-health literacy communication techniques considered. This study found improved OSA-related knowledge and OSA self-efficacy[21]; however, it did not specifically assess hard endpoints of CPAP usage and further and the online platform is proprietary and not available without license fees. A gap in the literature exists evaluating the efficacy of low health literacy–developed educational videos to improve CPAP usage.

This study sought to undertake a single-blinded, randomized controlled trial to compare CPAP usage in patients receiving standard-of-care (SC) education, compared with SC plus educational videos (EVs) designed with low health literacy communication techniques. Our hypothesis was that there would be increased CPAP usage (hours/night) and a greater proportion of patients with adequate CPAP usage (≥ 4 hours/night) at 2 months and 12 months in the EV arm compared with the SC arm.

METHODS

Study design and setting

A prospective 2-arm randomized controlled trial was performed, comparing SC education with SC plus EVs, in adults with OSA starting CPAP therapy. The study was conducted following approvals from the relevant local Human Research Ethics Committee (HREC/2019/QMS/50224) and prospective registration on the Australian New Zealand Clinical Trials Registry (ACTRN12619000523101). Consecutive treatment-naïve adults with OSA (defined as per AASM testing criteria[22]) were recruited through a single-site university teaching hospital sleep disorders clinic on the night of the in-laboratory CPAP titration study. Data collected included demographic, polysomnographic, questionnaire data (Epworth Sleepiness Scale [ESS], quality of life, Pittsburgh Sleep Quality Index), and CPAP therapy information. Randomization occurred following written informed consent using a random-number generator and sealed envelope design. Clinicians evaluating CPAP usage at 2- and 12-month follow-up were blinded to participant intervention arm.

Participants

A total of 268 potentially eligible individuals were invited to participate and 266 met eligibility criteria, with 195 enrolled in the study. The CONSORT (Consolidated Standards of Reporting

Trials) statement of patient flow is shown in **Figure 1**. Inclusion criteria included diagnosis of OSA deemed by treating sleep physician to require CPAP therapy, age > 18 years, and sufficient English-language skills to undertake clinical consultation without an interpreter. Exclusion criteria included an inability to provide informed consent and previous treatment with CPAP.

Measures

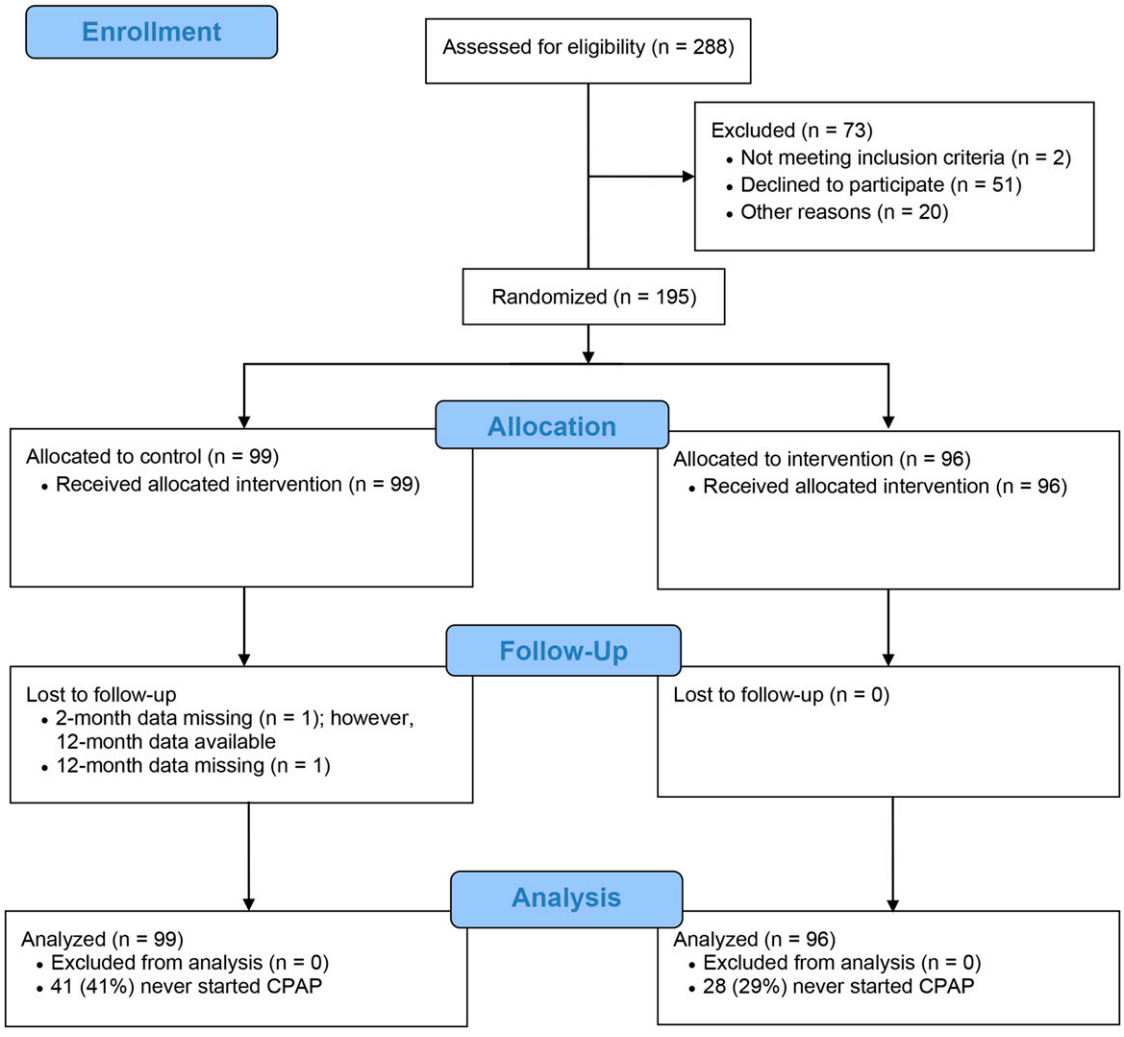
Demographic data included age, sex, educational level, occupation, country of birth, government concession card status, SES (postcode-derived Australian Bureau of Statistics national census deciles: Index of Relative Socioeconomic Advantage and Disadvantage [IRSAD]; Index of Economic Resources [IER]; and Index of Education and Occupation [IEO][23]). Educational background was self-reported completed education and categorized into (1) did not complete high school or (2) completed high school or greater education. Subjective sleepiness was measured using the ESS[24] at baseline and at 2 and 12 months.

Objective CPAP usage was downloaded from the CPAP device and recorded as mean hours of usage per day. CPAP was delivered in fixed pressure, using ResMed (ResMed Pty Ltd, Bella Vista, NSW, Australia) S9 and Airsense (Pty Ltd, Bella Vista, NSW, Australia) S10 units. Patients with government concession cards were provided with a long-term, cost-free government-funded CPAP machine following self-funded trial of CPAP through local private providers after the CPAP titration study. The minimum usage for government-funded CPAP was 224 hours over an 8-week period to be provided the cost-free, long-term government CPAP machine. CPAP commencement was defined as any hours of CPAP usage at 2 months or 12 months.

Control: SC education

SC education included 4 written handouts developed by the laboratory: (1) information on OSA (Flesch reading ease 54.6%, Flesch-Kincaid reading level 9.1), (2) CPAP therapy information (Flesch reading ease 57.4%, Flesch-Kincaid reading level 11.0), (3) accessing government-funded CPAP machines (Flesch reading ease 51.9%, Flesch-Kincaid reading level 10.3), and (4) instructions for CPAP equipment and accessory cleaning (Flesch reading ease 60.3%, Flesch-Kincaid reading level 8.4). Each morning,

Figure 1—Patient flow during the study.



CPAP = continuous positive airway pressure.

patients were seen by a sleep physician following their CPAP titration study and were told their diagnosis, need for CPAP therapy, and process to obtain a machine, including the 224-hour minimum CPAP usage requirement during the self-funded trial.

Each of the SC handouts were assessed using the Flesch reading ease score and Flesch-Kincaid reading level. The Flesch reading ease score and Flesch-Kincaid reading level are scores calculated from the total words in a sentence relative to the syllables in the words. Health care documents generally should aim to be written to achieve Flesch Reading Ease score of > 60% and Flesch-Kincaid readability of less than a grade 6–8 level.[25]

Intervention: EVs

Stakeholder consultation was undertaken, with a survey of patient preferences conducted; this found preferences for a combination of written and audio-visual information. A multidisciplinary team was then established comprising a sleep scientist, clinical psychologist, health literacy research nurse, and sleep physician. Following a review of health literacy interventional trials in other chronic diseases, the multidisciplinary team developed 5 short audio-visual clips, with a focus on low health literacy communication techniques, motivational phrases, and self-efficacy shown with a patient journey demonstrated. Content covered is outlined in **Table 1**. Low health literacy was specifically considered by using a patient's journey from symptoms at home, to initial consultation, to commencing therapy in keeping with evidence-based practice.[26] Key principles of adult learning theory were implemented, specifically problem-solving with hands-on demonstration; "need to know" information was incorporated, with an aim to build self-care and life-long skills.[27] The script involved plain language communication and simplified graphics. In addition to low health literacy communication principles, the script was developed using principles from a health belief model (HBM) and motivational interviewing nursing therapy (MINT). Both HBM[28,29] and MINT[30] techniques have been shown to improve CPAP usage. In the video scripts, the patient's susceptibility to illness (consequence if OSA was left untreated) was discussed and the perceived seriousness of the illness and impact on current functioning were included. Previous systematic reviews have indicated that videos that show how to undertake specific skills are effective in behavior change.[31,32] Thus, **Video 5** includes the patient seeking advice for side-effects management aiming to build confidence that barriers can be overcome through seeking assistance. The videos are available for viewing at: https://youtube.com/playlist?list=PLdEH7_YNda_Sa4bLJIGIkeXgW853TZBAC. **Video 1** and **Video 2** were played during the set-up before commencing the overnight CPAP titration study and **Video 3**, **Video 4**, and **Video 5** on the next morning following their study.

Statistical analysis

A sample size of 200 was determined to detect a 1-hour/night difference, assuming an average usage in our cohort of 5.6 ± 2.5 hours (based on historical laboratory CPAP usage) and power of 80%, with a 2-sided significance level of .05. This is above the 30-minute minimally clinically important difference (MCID) outlined by the AASM.[33] Analyses were performed in Stata software, version 17 (StataCorp LLC, College Station, Texas) with statistical significance set at a 2-tailed $P < .05$. Continuous data are presented as means ± standard deviations or medians (25th, 75th percentiles), whereas categorical data are presented as frequencies (percentages). To address differences in baseline characteristics between the intervention and control groups, *t* tests and chi-square tests (or their nonparametric equivalents) were used. Unstandardized logistic regression with 95% CIs was used to assess correlates of adequate CPAP usage at 2 and 12 months in univariate models, across the whole sample. Models were checked for all assumptions, and those with continuous predictors were found to not violate the assumptions of linearity with the logit of the outcome. An intention-to-treat analysis was performed with missing patients assumed to have never started and have zero hours of CPAP usage; those with no CPAP usage were considered to have zero hours of CPAP usage.

Due to the type of data (35% of patients with zero scores on the outcome variables), 2-part models with gamma distribution and a log link were utilized to address the primary outcomes of CPAP compliance at 2 and 12 months. In these models, the probability of observing a positive or zero outcome is first modeled (part 1: probit), followed by a generalized linear model for the positive scores (part 2: generalized linear model). Models accounted for covariates chosen a priori: age, SES (IRSAD),

Table 1—Educational video content.

Video	Topic and General Content	Duration (min)
1: About obstructive sleep apnea	Introduction to the symptoms, initial consultation with GP, and referral process to sleep specialist services	2:20
2: About the sleep study	Review of the preparation needed for attending a sleep study and what is involved	3:28
3: What is CPAP and how does it work	Discussion of the indications, benefits, and pitfalls of CPAP therapy	1:18
4: Accessing government-funded CPAP	Requirements and processes for qualifying for a Queensland government–funded CPAP machine	1:20
5: CPAP trouble-shooting	How to care for your equipment and what to do with common device troubles such as mask leak	6:02

CPAP = continuous positive airway pressure, GP = general practitioner.

and educational level (did not complete high school vs completed high school and above), as these measures have been previously linked to poor health literacy[16] and previous predictors of CPAP usage—ESS at baseline and change in ESS by 2 months.[6]

RESULTS

A total of 195 patients were randomized to the 2 arms: SC (n = 99) and EV (n = 96). At baseline, patients had a median age of 57 years (interquartile range [IQR] 44–65 years), were obese with a mean body mass index of 38.7 kg/m^2 (standard deviation ±8.9), and were predominantly male (n = 107, 55%). **Table 2** shows patient characteristics as a whole and within each group. No significant differences were observed on any characteristic between groups. The average ESS was slightly higher in the overall cohort at baseline (12 ± 6 overall), with improvements at 2 months (mean ESS 9 ± 5) and at 12 months (mean ESS 7 ± 5).

CPAP commencement

The rate of CPAP commencement was the same in both arms of the study, with a large proportion of patients never starting CPAP usage despite undergoing clinic assessment and the CPAP titration study with SC (41/99; 41%) and EV (28/96; 29%) (P = .09). Eligibility for the government-funded CPAP program was associated with CPAP commencement, with 25 of 51 (49%) of self-funding patients never starting therapy compared with 44 of 144 (30%) of those eligible for a government-funded machine (OR 1.76; 95% CI: 1.104–2.8; P = .026). Twenty-two patients ceased CPAP in the first 2 months, mostly reporting oronasal side effects (17; 9%), financial barriers (1; 0.5%), or medical comorbidity deterioration (4; 2.1%).

Table 2—Baseline characteristics.

	Total (n = 195)	Usual Care (n = 99)	EV Intervention (n = 96)
Age (years)	57.1 (44.1–64.8)	54.7 (42.2–63.2)	58.6 (44.8–66.5)
BMI (kg/m^2)	38.7 (8.9)	38.5 (7.9)	39.0 (9.9)
Weight (kg)	111.5 (28.8)	111.7 (27.1)	111.3 (30.6)
Sex			
Female	88 (45%)	42 (42%)	46 (48%)
Male	107 (55%)	57 (58%)	50 (52%)
Apnea-hypopnea index (events/h)	34.3 (21.0–59.4)	39.7 (22.5–63.9)	30.4 (20.4–50.5)
ESS	12.2 (5.6)	12.8 (6.1)	11.7 (4.9)
Educational level			
Did not complete high school	52 (27%)	22 (22%)	30 (31%)
Completed high school or greater	135 (69%)	73 (74%)	62 (65%)
Missing	8 (4%)	4 (4%)	4 (4%)
Smoking status			
Never smoker	77 (39%)	41 (41%)	36 (38%)
Current smoker	40 (21%)	18 (18%)	22 (23%)
Ex-smoker	78 (40%)	40 (40%)	38 (40%)
City dweller			
Regional/rural	37 (19%)	15 (15%)	22 (23%)
Major city	158 (81%)	84 (85%)	74 (77%)
Country of birth			
Other	55 (28%)	30 (30%)	25 (26%)
Australian	140 (72%)	69 (70%)	71 (74%)
IER	5.0 (3.0–8.0)	5.0 (3.0–8.0)	5.0 (3.0–8.0)
IEO	4.0 (2.0–7.0)	5.0 (2.0–8.0)	3.0 (2.0–6.0)
IRSAD	5.0 (3.0–8.0)	5.0 (3.0–9.0)	4.5 (2.0–7.0)
Government concession card			
No	51 (26%)	29 (29%)	22 (23%)
Yes	144 (74%)	70 (71%)	74 (77%)

Data are presented as n (%), mean ± SD, or median (interquartile range), where appropriate. BMI = body mass index, ESS = Epworth Sleepiness Scale, EV = educational video, IEO = Index of Education and Occupation, IER = Index of Economic Resources, IRSAD = Index of Relative Socio-economic Advantage and Disadvantage.

Baseline factors and CPAP usage at 2 and 12 months

The relationship between CPAP usage and a range of sociodemographic variables was assessed at 2 and 12 months (such as age, sex, education attainment level, smoking status, regional location, and SES). Increasing age increased the probability of adequate CPAP usage at 2 months (OR 1.02; 95% CI: 1.00–1.04; $P = .038$) and 12 months (OR 0.98; 95% CI: 1.02–0.06; $P = .001$). Government concession card status increased the probability of adequate CPAP usage at 2 months (OR 2.4; 95% CI: 1.23–4.65; $P = .01$) and 12 months (OR 2.33; 95% CI: 1.16–4.68; $P = .017$). There were no other significant demographic associations found, as shown in **Table S1** in the supplemental material. An improvement in ESS between baseline and 2 months was significantly associated with increased usage at 2 months (OR 1.13; 95% CI: 1.05–1.21; $P = .001$) and 12 months (OR 1.11; 95% CI: 1.05–1.2; $P = .002$). Age and concession card status were used as covariates for subsequent analyses of interaction effect.

CPAP usage and intervention effects

The average CPAP usage at 2 months was 3.45 hours/night (95% CI: 2.76–4.13) in the SC group, which was not significantly different from the EV group (3.75 hours/night; 95% CI: 3.14–4.37; $P = .516$). However, at 12 months, there was an average of 1.16 hours (95% CI: 0.22–2.10; $P = .016$) higher CPAP usage per night in the EV group (SC: 2.50 hours/night [95% CI: 1.94–3.06] compared with EV: 3.66 hours/night [95% CI: 2.92–4.40]), as shown in **Figure 2**. The probability of adequate CPAP usage (≥ 4 hours/night) at 12 months was higher in the EV group compared with SC group (OR 1.33; 95% CI: 1.04–1.7; $P = .013$). Fifty percent of EV patients and 33% of SC patients were using CPAP ≥ 4 hours/night at 12 months.

ESS and intervention effect

There was a significant difference in the average ESS score at 12 months in the EV group (5.52; 95% CI: 4.27–6.77) compared with the SC group (7.89; 95% CI: 6.23–9.43) ($P = .17$). For both EV and SC groups there was a significant correlation between CPAP usage and ESS score ($R = -0.423$; 95% CI: –0.56 to –0.25; $P < .001$).

Interaction effects with educational level

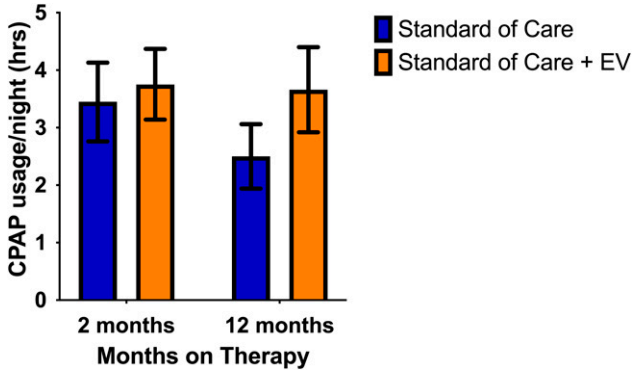
The interactions between CPAP usage, intervention group, and covariates such as age, sex, SES, and educational level were assessed. There were no significant interaction effects at 2 months. However, at 12 months, a significant interaction was found between intervention group and education attainment level and CPAP usage, which is shown in **Figure 3**. Post-estimation tests of marginal means indicated that participants with a high school or greater level of education showed a high average CPAP usage, regardless of intervention group (mean difference = 0.49 hours; 95% CI: –0.72 to 1.70). However, patients with a less than high school education benefitted substantially from the EV intervention compared with SC patients (mean difference = 2.47 hours/night usage; 95% CI: 1.01–2.93; $P < .01$).

While there was no significant difference in CPAP commencement between the SC and EV groups overall, there was a trend toward an educational level interaction effect. For patients with a less than high school level of education, the rate of never commencing CPAP was higher in the SC group (10; 45%) than in the EV group (6; 20%) ($P = .06$).

DISCUSSION

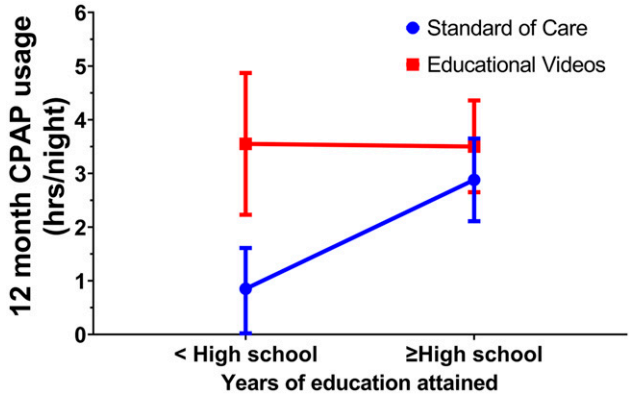
Given that adherence to CPAP therapy is the cornerstone of effective therapy for symptomatic adults with OSA, clinicians and sleep services seek evidence-based, inexpensive, and accessible interventions to support patients. This study found that EVs, designed with low health literacy communication techniques, when combined with SC, improves long-term adherence to CPAP therapy. In keeping with many previously published studies, the average usage of CPAP in this cohort at 2 and 12 months was below the threshold for adequate usage. The probability of adequate CPAP usage > 4 hours/night at 12 months was 30% higher in the EV intervention arm compared with the

Figure 2—CPAP usage at 2 and 12 months in SC vs EV groups.



CPAP = continuous positive airway pressure, EV = educational videos, hrs = hours, SC = standard of care.

Figure 3—CPAP usage at 12 months by years of education attained.



CPAP = continuous positive airway pressure, hrs = hours.

SC group. The videos had a marked benefit in improving CPAP usage in patients with less than a high school level of education attained, improving adherence in this group at 12-month follow-up. There was a trend toward improved CPAP commencement in the EV arm for patients with a less than high school level of education. In contrast, those with a higher educational level tended to have the same CPAP usage, irrespective of the addition of EVs to their usual SC. Indeed, those with lower educational achievements showed CPAP adherence equivalent to those with higher educational levels, if they participated in the EVs to enhance their usual SC.

The EV intervention in this study had no impact on usage at 2 months but was associated with higher levels of usage at 12 months, possibly reflecting the content covered in **Video 5**, in which the patient and partner are shown how to problem solve and trouble-shoot common barriers to adherence using scripts that included self-efficacy language. Additionally, the video finishes with the patient and partner discussing the long-term benefits of CPAP, thus the longer-term improved usage may be related to better understanding of expected CPAP benefits and increased "buy in." A significant difference in ESS score was seen in the EV group at 12 months compared with SC; this meets the threshold for a minimally clinically important difference (MCID)[34] and correlated with improved CPAP usage.

Previous education interventions to enhance CPAP adherence have previously demonstrated improved CPAP adherence, with a Cochrane review finding a mean difference of +0.85 hours (95% CI: 0.21–1.39) above SC. Reviewing the types of educational materials included in this meta-analysis, the "education" varied widely from didactic content about OSA and the physiological impacts[35–40] and interactive educational platforms[41] to short once-shown videos.[42–44] The most similar previous intervention to the present study is a 4-minute "understanding OSA and CPAP" video by Guralnick et al.[44] This trial had a 2-month follow-up window and found no significant difference in 30-day CPAP usage in the video group compared with SC (3.3 hours: 95% CI: 2.8–3.8 video education vs 3.5 hours: 95% CI: 3.1–4.0 usual care; $P = .44$). The video of Guralnick et al[44] is similar to a combination of **Video 1** and **Video 3** of the present study. One explanation for improved outcomes in the present study compared with Guralnick et al[44] could be the longer follow-up period (12 months) and specific low health literacy and MINT techniques, particularly in **Video 5**, which shows a problem-solving and navigating side-effect management. The video intervention delivered by Basoglu et al[42] was delivered by a clinician and covers OSA consequences and CPAP benefits, with an increased proportion of adherence at 6 months in the video arm compared with SC. In the mixed-methods intervention, Lai et al[45] used a 25-minute EV showing a patient's journey and combined this with a face-to-face motivational interview and found an additional 2.2 hours (95% CI: 1.2–3.2) mean daily usage compared with SC. A direct comparison with Basoglu et al[42] and Lai et al[45] is not possible as these videos are not available in the supplementary section of the journal, nor through other searchable online resources. Many EVs created in previous trials have not been made available for other laboratories to use or replicate results. Commercially neutral, evidence-based, and widely available educational interventions are needed, particularly with the shift of OSA management into primary care,[46] which has resulted in specialist behavioral services (such as clinical psychologists, sleep nurses) being decentralized from the environment in which OSA care is being conducted.

Study strengths

The strengths of this study include the high follow-up rate and long follow-up duration to 12 months, with 1 patient having missing data at 2 months and 1 missing data at 12 months. The improvement in CPAP usage is above the 30-minute MCID threshold for a clinically significant intervention outcome. An intention-to-treat model was used. The intervention is simple and does not require specialist scientific, nursing, or psychologist staff. The EVs were not expensive to produce and did not take significant laboratory staff time to administer, thus will be realistic for roll-out in clinic waiting rooms. With regard to translation, the videos are available for primary care and sleep services via https://youtube.com/playlist?list=PLdEH7_YNda_Sa4bLJIGIkeXgW853TZBAC.

Study limitations

The current study had several limitations. The study population was predominantly formed from government concession card holders, for whom usage at 2 months influences access to a long-term cost-free government-funded machine (free provision of the machine requires usage of at least 4 hours/night at 2 months). However, with randomization, the number of concession card holders was the same in each arm, thus this variable is unlikely to explain the differential effects of intervention upon CPAP usage. These government-funded program requirements are different from other international CPAP program requirements such as US Medicare. Known confounders for adherence such as marital status and presence of sinonasal disease were not recorded. Patient satisfaction for the intervention was not investigated. The SC educational material required high levels of education and did not score well on the readability statistics.

There are many potential applications of low health literacy–designed interventions to improve CPAP adherence. With telehealth being more widely utilized through the coronavirus disease 2019 (COVID-19) pandemic, online educational platforms with links to videos could potentially be used to prime patients prior to appointments. Similarly, the use of QR codes linking to online videos is another possible translation of such materials. This would also provide a bridge between specialist and primary care led OSA management.

CONCLUSIONS

This study has demonstrated that, in treatment-naïve adults with OSA, low health literacy–designed EVs in addition to SC improves 12-month CPAP usage by an average of 1.16 hours, which is a clinically significant outcome. Patients with low educational backgrounds particularly benefited from the addition of the EVs, with an additional 2.47 hours of usage compared

with those who received SC. The resources are available for other centers to use via https://youtube.com/playlist?list=PLdEH7_YNda_Sa4bLJIGIkeXgW853TZBAC.

ABBREVIATIONS

AASM, American Academy of Sleep Medicine
CI, confidence interval
CPAP, continuous positive airway pressure
ESS, Epworth Sleepiness Scale
EV, educational video
IQR, interquartile range
OR, odds ratio
OSA, obstructive sleep apnea
SC, standard of care
SES, socioeconomic status

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DISCLOSURE STATEMENT

All authors have seen and approved the manuscript. The authors report no conflicts of interest.