An exploratory study evaluating the use of coping strategies while driving in obstructive sleep apnoea syndrome patients and controls

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Untreated OSAS patients frequently use certain strategies which could be surrogate markers of sleepiness. Enquiring about such strategies may aid the clinician in identifying the patients who are at risk of driving incidents and to advise appropriately. https://bit.ly/3Tau6TO

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Abstract

Introduction Sleepiness while driving is potentially fatal, and it is recommended that a driver who starts to feel tired should stop and have a rest. However, some may use various countermeasures to try to stay alert. We devised a questionnaire that assessed various potential coping strategies that might be used against fatigue and compared them between obstructive sleep apnoea syndrome (OSAS) patients and controls and with sleepiness in general (Epworth Sleepiness Scale (ESS)), specifically while driving (Driving Sleepiness Scale (DSS)) and driving incidents.

Methods 119 untreated OSAS patients (male 82%, body mass index (BMI) 37±8 $kg \cdot m^{-2}$, ESS 14±5, DSS 3±2, oxygen desaturation index (ODI) 39±15) and 105 controls (male 70%, BMI 28±6 $kg \cdot m^{-2}$, ESS 4±3, DSS 7±6) matched for age and driving experience were recruited. All completed a questionnaire relating to their experience over the last year, which included sleepiness in general, sleepiness specifically while driving, 10 questions about various coping strategies they might adopt in order to avoid sleepiness and their history of incidents while driving.

Results As compared to controls, nearly a third of OSAS patients (29.4%) used more than three coping strategies "frequently". OSAS patients who used more than three such strategies had worse ESS (17±4 *versus* 12±5, p<0.0001); were more likely to feel sleepy while driving (10±8 *versus* 5±7, p=0.0002) and had more reported accidents (22.85% *versus* 2.38%, p=0.0002) as compared to OSAS patients who used less than three strategies. There was no difference in patient demographics, severity of OSAS, driving experience or episodes of nodding at the wheel and reported near miss events.

Conclusions Untreated OSAS patients frequently use certain strategies which could be surrogate markers of sleepiness. Enquiring about such strategies in clinical practice may aid the clinician in identifying the patients who are at risk of driving incidents and to advise appropriately.

Introduction

Driving is a complex task that involves many aspects such as perception, response time and physical ability, and is an essential part of an individual's life. Studies have shown that driving either on a motorway or on an urban road can be fatiguing even for an alert driver [1–3]. Untreated obstructive sleep apnoea syndrome (OSAS) is associated with increased road traffic accidents (RTA), and this is likely primarily due to excessive sleepiness, the hallmark symptom of OSAS [4–7]. Advising patients about driving is a key issue in the management of OSAS; clinicians find this challenging and there is considerable variation in the advice that a patient is likely to receive [8]. Stress and fatigue may impair driving performance, compromising safety [9], and drivers may adapt various countermeasures to tackle these issues. A survey [10] of commercial drivers unveiled a series of attitudes related to excessive

sleepiness at the wheel that were not usually considered in the medical context. These attitudes served as "alerting signals" that the sleepiness level was too high, and that stopping driving may be the best strategy to avoid an RTA. We hypothesised that enquiring about the use of coping strategies might be another way to identify the OSAS patient at risk of RTA as they are potentially driving on their "alertness reserve". Furthermore, patients may be reluctant to report accidents and underreport symptoms [11, 12]. While they might be reluctant to admit to problems driving because of fear that they might be prevented from driving, they might be more willing to admit to using coping strategies. This might therefore be a less threatening way of identifying the individual who is at increased risk of an accident due to fatigue. It is also possible that such strategies might be effective in preventing accidents.

The aims of this preliminary study were to identify whether such strategies are employed differently by OSAS patients and controls and compare their use with incidents while driving, sleepiness in general and specifically while driving.

Methods

Patients attending the sleep clinic at St. James's University Hospital, Leeds with a confirmed diagnosis of OSAS were invited to take part in this study. OSAS diagnosis was based on either an apnoea–hypopnoea index or oxygen desaturation index on a limited channel sleep study (Embletta; ResMed, Abingdon, UK) or overnight oximetry respectively. Patients with an Epworth Sleepiness Score (ESS) of >10 and being considered for a continuous positive airway pressure (CPAP) trial either due to excessive symptoms and/or severity of OSAS, who drove regularly on both motorway and non-motorways, were recruited. Healthy volunteers with no symptoms of OSAS and with an ESS of <10 were recruited as controls. Subjects with other causes of fatigue and excessive sleepiness, shift workers, those with chronic sleep deprivation and patients using sedatives/hypnotics were excluded. Both OSAS patients and controls were provided with an information leaflet, and written consent was obtained. Ethics approval for the study was granted (NHS Research Ethics Committee – 09/H1311/58).

Questionnaire

All subjects completed a questionnaire about driving (supplementary material). This was developed with the input of patients with OSAS and healthcare professionals working in the field. The questionnaire included:

- Demographic details.
- ESS.
- Driving incidents (episodes of nodding off at the wheel, near misses in the previous year and driving accidents).
- 10 questions about various countermeasures patients might adopt in order to stay awake. They were asked to rate their experience in the last year on a scale ranging from "never", "occasionally" to "frequently". Results are described as not frequently (never or occasionally) and frequently.
- Similar to ESS, a scale evaluated sleepiness specifically while driving termed the Driving Sleepiness Scale (DSS). Subjects were asked to rate on a scale ranging from "never" (score 0), "slight" (score 1), "moderate" (score 2) to "high" (score 3) their chance of dozing off or falling asleep while driving at different times of the day and on journeys of different durations (maximum possible score 30). This is shown in the supplementary material.

Statistical analysis

The statistical analysis was carried out using Graph Pad Prism software (Version-9, San Diego, CA, USA). The level of significance was set at $p<0.05$. Normally distributed data are presented as mean±SD. Unpaired t-test was used to evaluate for subject demographics and for univariate analysis. Chi-square tests were used to evaluate the difference in the use of coping strategies between controls and OSAS patients and accident history.

Results

119 OSAS patients and 105 controls, matched for age and driving experience, were recruited. The baseline demographics are described in table 1. ESS, BMI and DSS were significantly worse in OSAS patients compared to controls. In the DSS no control subjects reported a high chance of feeling sleepy while driving at various times of the day; 5% reported a moderate chance of feeling sleepy while driving during the mid-afternoon and 6% only during late night driving. However 7–15% of OSAS patients reported a moderate chance and 3–19% a high chance of feeling sleepy while driving at various times of the day ranging from early morning to late night. The detailed DSS questionnaire response is shown in the supplementary material.

TABLE 1 Baseline demographics of the study population

	Controls	OSAS patients	p-value
Participants n	105	119	
Age years	56±15	53±11	0.1
Sex			
Male	75 (71)	98 (82)	0.07
Female	30 (29)	21 (18)	
ESS	4±3	14±5	<0.0001
BMI kg·m^{-2}	28±6	37±8	<0.0001
Driving licence, years held	34±17	31±12	0.2
ODI	-	39±15	
Mild (5–15 per h)		22 (18)	
Moderate (16–30 per h)		33 (28)	
Severe (>30 per h)		64 (54)	
Professional drivers	6 (6)	14 (12)	0.17
Annual mileage			
<5000	26 (25)	14 (12)	
5000–10 000	32 (30)	47 (40)	
10 000–15 000	24 (23)	24 (20)	
15 000–20 000	9 (9)	14 (12)	
20 000–50 000	8 (8)	15 (13)	
>50 000	6 (5)	5 (4)	
DSS	2±1	7±6	<0.0001

Data are presented as n (%) or mean±SD unless indicated otherwise. OSAS: obstructive sleep apnoea syndrome; ESS: Epworth Sleepiness Score; BMI: body mass index; ODI: oxygen desaturation index; DSS: Driving Sleepiness Score.

Use of coping strategies

OSAS patients were more likely to use at least one coping strategy "frequently" as compared to controls, and this was statistically significant (43.7% *versus* 10.5%, p<0.0001; OR 6.6, 95% CI 3.2–13.6). No control used more than three different coping strategies "frequently" as compared to 29.4% of OSAS patients (figure 1). The various types of "frequently" used coping strategies by OSAS patients and controls are shown in table 2.

Driving incidents

OSAS patients were more likely to have either reported an accident or have been involved in an accident irrespective of any insurance claims in the last year as compared to controls (16.8% *versus* 2.85%, p<0.0013; OR 6.87, 95% CI 1.98–22.84). OSAS patients as compared to controls reported a higher

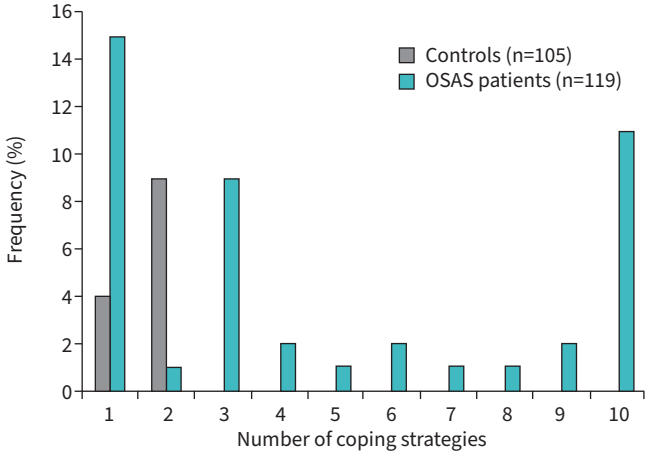

FIGURE 1 Number of "frequently" used coping strategies between controls and obstructive sleep apnoea syndrome (OSAS) patients.

TABLE 2 Types of "frequently" used coping strategies between controls and obstructive sleep apnoea syndrome patients

Types of coping strategies	Controls[#]	Patients[¶]	p-value
Stopped for a nap	2 (2)	12 (10)	0.02
Stopped for a walk/exercise	0 (0)	14 (12)	0.01
Opened the window	11 (10)	48 (40)	<0.0001
Turned up the radio/stereo	2 (2)	24 (20)	0.0006
Stopped to drink tea/coffee	8 (8)	40 (26)	<0.0001
Stopped at service area to wash face in cold water	0 (0)	13 (9)	0.02
Sing/talk to yourself	0 (0)	24 (15)	0.0005
Chew gum/eat something	0 (0)	21 (14)	0.007
Fidget/exercise	0 (0)	18 (12)	0.01
Changed seat position	2 (2)	24 (15)	0.0006

Data are presented as n (%). [#]: n=105; [¶]: n=119.

episode of nodding >2 times (11.7%) and near miss of >2 times (14.5%) in the last 12 months respectively (table 3).

Subgroup analysis

A *post hoc* analysis was done between OSAS patients who used more than three coping strategies *versus* those who used less than three coping strategies. This cut-off was chosen because no controls used more than three strategies "frequently" (figure 1). This was done to evaluate for any specific traits in demographics and driving incidents. ESS, DSS and reported accidents were significantly higher in OSAS patients who used more than three coping strategies on a frequent basis. They also had higher incidences of recurrent nodding and near miss events (>2 times in a year), but this was not statistically significant as shown in table 4.

Discussion

The principal outcome from this observational study was that behaviours adopted by untreated OSAS patients may be a useful additional way of identifying an individual who is potentially at risk of an accident because of sleepiness. We found feeling sleepy generally (ESS) or specifically while driving (DSS) was associated with the frequent adoption of various strategies to counter sleepiness. This confirms the hypothesis that using coping strategies may be a surrogate marker for sleepiness and might be a way of identifying patients who have a problem, but do not admit to it directly. We found that OSAS patients using more than three strategies "frequently" are more likely to have reported accidents.

Coping is a complex multidimensional process determined by environmental conditions, cognitive abilities and personality dispositions [13]. A study comparing the driving habits of professional and non-professional drivers has shown that stopping for a short nap is effective in counteracting fatigue and benefits performance [14]. There are some limited data to suggest that stopping for a walk/exercise or

TABLE 3 Driving-related incidents in controls and obstructive sleep apnoea syndrome patients

	Controls[#]	Patients[¶]
Nodding episodes		
Never	101 (96.2)	84 (70.6)
1–2 times	4 (3.8)	21 (17.7)
3–4 times	0 (0)	5 (4.2)
>5 times	0 (0)	9 (7.5)
Near miss events		
Never	85 (81)	72 (60.5)
1–2 times	20 (19)	31 (26)
3–4 times	0 (0)	10 (9.5)
>5 times	0 (0)	6 (5)
Reported accidents	3 (2.85)	20 (16.8)

Data are presented as n (%). [#]: n=105; [¶]: n=119.

TABLE 4 Subgroup analysis of obstructive sleep apnoea syndrome patients

Parameters	⩽3 coping strategies[#]	>3 coping strategies[¶]	p-value
Age years	53±11	52±11	0.78
BMI kg·m^{-2}	37±8	36±6	0.63
ODI	41±25	33±25	0.1
ESS	12±5	17±4	<0.0001
DSS	5±7	10±8	0.0002
Driving licence, years held	32±12	30±12	0.52
>2 nodding	7 (8.3)	7 (20)	0.08
>2 near miss	10 (12)	6 (17)	0.41
Reported accidents	2 (2.4)	8 (22.9)	0.002

Data are presented as n (%) or mean±SD. BMI: body mass index; ODI: oxygen desaturation index; ESS: Epworth Sleepiness Score; DSS: Driving Sleepiness Score. [#]: n=84; [¶]: n=35.

stopping for a drink or, particularly, "washing the face" can have a positive effect, albeit for a short period in the general population [15, 16]. It could be argued that measures which involve taking a break from driving are a legitimate and "appropriate" response to fatigue. However, their use still indicates that the driver is experiencing fatigue while driving. Measures adopted while the patient continues to drive indicate that the individual is "fighting" sleepiness and might therefore be "inappropriate". Our data suggest that strategies employed to counter fatigue is a marker of a patient who is driving with less reserves of alertness. Whether coping strategies are used "appropriately" or "inappropriately", if it is "frequently", it indicates that drivers are driving with increased sleepiness likely to impair safe driving. No control admitted to the use of more than three different countermeasures, and we suggest that the use of three or more different coping strategies "frequently" should raise concerns about future driving.

There were limitations to this study. We only evaluated OSAS patients of sufficient severity to warrant a trial of CPAP; this is the group in which a risk assessment needs to be made about an individual's continued driving. It would not be appropriate to say that someone did not have OSAS of sufficient severity to warrant treatment but that it was severe enough that a patient should not drive. Annex III of the European Union Directive on Driving Licences states that patients with OSAS needing treatment in the opinion of a physician and not receiving it should not receive an unconditional licence [17]. However, this study needs to be extended to patients with milder OSAS, as they may still be at increased risk of an accident. We did not perform sleep studies in controls. However, the questionnaire included questions about symptoms of snoring or OSA, and controls were only included if they had a very low probability for OSAS. We think it is very unlikely that we included any controls with significant OSAS; if there were, this would strengthen the results further. Reporting and recall bias cannot be excluded, especially regarding the use of countermeasures in the last year. However, in the absence of any validated reliable objective test, the assessment of an individual's ability to drive safely depends upon their account and is what the clinician has to base their opinion upon. We did not enquire when patients used the countermeasures; for example, stopping for a nap after 30 min is likely to be more significant than doing so after several hours. These are factors which the clinician will have to weigh in their assessment. We did not evaluate the impact of age, sex or sociocultural factors and the use of countermeasures. These may be relevant and need to be considered in future studies. Finally, both the coping strategies and the driving sleepiness score needs to be validated.

Conclusion

Patients with OSAS of sufficient severity to warrant a trial of CPAP may use various countermeasures to deal with sleepiness while driving. Use of more than three such measures "frequently" is associated with an increased risk of driving incidents. Asking about the use of countermeasures may be a complementary, and less threatening way, to ask about sleepiness likely to impair safe driving. Future research should focus on the use of "inappropriate" and "appropriate" coping strategies in determining accident risk, refinement of when and how strategies are used within a journey and their use in patients with milder OSAS.

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Ethics statement: Patients' consent was obtained. Ethics approval for the study was granted (NHS Research Ethics Committee, 09/H1311/58).

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