PSYCHOLOGY, HEALTH & MEDICINE
2023, VOL. 28, NO. 7, 1924–1937
https://doi.org/10.1080/13548506.2023.2176525

Taylor & Francis
Taylor & Francis Group

Check for updates

Should testing for obstructive sleep apnea be offered routinely to older family medicine patients? A prospective cohort study

Sally Bailes[a,b], Dorrie Rizzo[b,c], Catherine Fichten[b,c,d], Marc Baltzan[e,f,g], Roland Grad[c,h,i], Laura Creti[a,b], Rhonda Amsel[j] and Eva Libman[b,c]

[a]Jewish General Hospital, Psychiatry Department, Centre Intégré Universitaire des Soins et Services Sociaux, Montreal, Canada; [b]McGill University, Faculty of Medicine, Department of Psychiatry, Montreal, Canada; [c]Jewish General Hospital, Lady Davis Institute for Medical Research, Centre Intégré Universitaire des Soins et Services Sociaux, Montreal, Canada; [d]Dawson College, Psychology Department, Montreal, Canada; [e]McGill University, Faculty of Medicine, Department of Epidemiology Biostatistics and Occupational Health, Montreal, Canada; [f]Mount Sinai Hospital, Sleep Apnea Clinic, Centre Intégré Universitaire des Soins et Services Sociaux, Montreal, Canada; [g]Institut de Médecine du Sommeil, Montreal, Canada; [h]Jewish General Hospital, Goldman Herzl Family Practice Center, Centre Intégré Universitaire des Soins et Services Sociaux, Montreal, Canada; [i]McGill University, Faculty of Medicine, Department of Family Medicine, Montreal, Canada; [j]McGill University, Department of Psychology, Montreal, Canada

ABSTRACT

In our previous studies, we offered older family medicine patients testing for obstructive sleep apnea (OSA) and discovered that 80% of patients who accepted, were later diagnosed with unsuspected OSA. In the present study, we followed such patients for 3 years of usual treatment. The goals were to (1) observe whether wider testing for OSA would increase case recognition and treatment uptake; (2) identify symptom and health characteristics associated with diagnosis and treatment efficacy. 101 women and 75 men (>45 years) recruited from family medicine clinics completed questionnaires, polysomnography and consented to chart review (Time 1). Participants with OSA were offered treatment and follow-up with a sleep medicine specialist. All were re-evaluated after 3 years (Time 2). At Time 1, 93% of participants received a diagnosis of OSA. Of these, 53 initiated treatment (46 PAP therapy); at Time 2, 24 PAP users met criteria for adherence. PAP-adherent participants had worse OSA and worse reported symptoms at Time 1 than non-adherent participants. At Time 2, PAP-adherent participants improved on insomnia and daytime symptoms compared to non-adherent participants who showed no change. Adherent and non-adherent participants showed no difference in health indices at Time 1 and no change at three-year follow-up. Benefits of treatment included improvements in co-morbid insomnia and daytime functioning; however, offering wider testing for OSA to older, family medicine patients yielded a high rate of diagnosis but low treatment adoption and adherence. Therefore, a cost-effective strategy would identify and support those likely to adopt and adhere to treatment.

ARTICLE HISTORY
Received 8 June 2022
Accepted 22 January 2023

KEYWORDS
Family practice; case finding; sleep apnea; adherence; treatment outcome

CONTACT Sally Bailes sally.bailes@mcgill.ca Institute of Community and Family Psychiatry, Jewish General Hospital, 4333 Cote Ste. Catherine, Montreal, QC H3T 1E4, Canada

The research was based at the Jewish General Hospital, Montreal, Canada.

© 2023 Informa UK Limited, trading as Taylor & Francis Group

Introduction

Obstructive sleep apnea (OSA) is a chronic disorder of the upper respiratory system characterized by repetitive collapse or narrowing of the airway during sleep. It is highly prevalent but under-recognized in general medical practice, particularly in women. Recurring apnea events during nocturnal sleep cause hypoxemia, arousals, and increased intrathoracic pressure (Morgenstern et al., 2014). Resulting changes in blood pressure cause sympathetic overstimulation, which contributes to hypertension and disturbance of glucose metabolism (Gonzaga et al., 2015). OSA is an important risk factor for cardiovascular disease, including stroke, ischemic heart disease (Gottlieb et al., 2010; Marin et al., 2005), and metabolic syndrome (hypertension, hyperlipidemia, diabetes). What is not yet known definitively is the course of health risks with and without OSA treatment (Barbé et al., 2010; Yu et al., 2017).

Prevalence rates are reported to range from 10% to 40% in the general population, the higher prevalence accruing for more susceptible populations, such as community-dwelling older adults (i.e.>65 years) (Ancoli-Israel et al., 1991; Johansson et al., 2009). Recognition of OSA in the wider clinical population is challenging as signs and symptoms include, in addition to snoring and daytime sleepiness, poor sleep quality, poor daytime functioning, and psychological distress. Chronic insomnia is particularly common in primary care practice (Morin & Benca, 2012; Morin et al., 2006), is frequently co-morbid with OSA and associated with hypertension (Jarrin et al., 2018) and type 2 diabetes (Hung et al., 2013; Spiegel et al., 2005). In our previous studies of consecutive older family medicine patients who were willing to undergo polysomnography (PSG), OSA diagnosis rates of approximately 80% were observed for both men and women, indicating under-recognition of OSA in this population (Bailes et al., 2005, 2005, 2009, 2017). Notably, OSA-related health problems, including insomnia and hypertension, are routinely diagnosed and managed by family physicians, often unaware of an underlying OSA, potentially posing an important barrier to achieving treatment goals.

The present study

In previous studies, we identified many unsuspected OSA cases in older family medicine patients, including as many as half with co-morbid insomnia (Bailes et al., 2009, 2017). These studies suggest that, in ideal medical practice, as many patients as are willing should undergo OSA testing. The principal aim of the present study was to observe the trajectory of screening and treatment when consecutive older family medicine patients are offered OSA testing. The purpose was to examine the longer-term outcomes (e.g. treatment acceptance, adherence, and efficacy) of this approach to case-finding. A period of 3 years was chosen to allow for treatment adaptation and for longer term benefit to occur. At initial screening (Time 1) questionnaires and chart review identified sleep, daytime functioning and health indices. At Time 2, questionnaires and chart reviews were repeated. Participants were designated according to study retention, treatment adherence or nonadherence to published criteria.

Additional aims were to: a) identify characteristics of those likely to be adherent to treatment; and b) explore how OSA treatment would impact co-morbid insomnia, quality of life, psychological adjustment, and other health indicators.

Methods

Participants

Participants were recruited as part of a large prospective study to identify symptoms and medical conditions indicative of OSA risk. Inclusion criteria were: age over 45, no prior testing for or diagnosis of OSA, and not currently experiencing severe medical or psychiatric illness preventing participation. We sought both those with possible OSA and those in good general health with low likelihood of OSA. A total of 295 individuals (172 women and 123 men) from two hospital-based family medicine clinics in Montreal, Canada, initially gave consent to enroll in the study. Of these, 176 individuals (101 women and 75 men) completed the Time 1 protocol, including questionnaires and polysomnography. Recruitment took place between March 2011 and June 2014 (Time 1). Three years after diagnosis, participants were retested between March 2014 and December 2017 (Time 2). Follow-up occurred at an average of 3.5 years post Time 1 testing, to a maximum of 4 years.

Measures

OSA testing was carried out by in-laboratory PSG. Sleep staging, respiratory events and associated arousals were scored manually according to the rules established by the American Academy of Sleep Medicine (Berry et al., 2012). An apnea event was defined as cessation of breathing lasting 10 s or more. Hypopneas were scored when there was a 30% or more decrease in airflow with 3% or more oxygen desaturation or a subsequent cortical arousal. The diagnosis of OSA was made by a medical sleep specialist based on PSG and clinical data. Self-report sleep questionnaires included the Sleep Symptom Checklist (SSC) (Bailes et al., 2009), a 21-item survey of symptoms both directly and indirectly related to sleep disorders in four domains: Insomnia, Daytime Distress, Sleep Disorder, and Psychological Maladjustment (Bailes et al., 2005); a sleep questionnaire (Fichten et al., 1995) to enquire about sleep quality, sleep fragmentation, medication use, etc. (Edinger et al., 1996; Fichten et al., 2000; K. L. Lichstein et al., 1999, 2006; K. Lichstein et al., 2003). Self-report measures of daytime functioning included the Epworth Sleepiness Scale (Johns, 1991), the Empirical Fatigue Scale (Bailes et al., 2008), the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983), and the SF-36 Health Survey (Ware et al., 2000). Adherence to PAP treatment was defined by self-report as usage at least 4 h per night, at least 70% of nights in the 6 months preceding Time 2 evaluation (Quan et al., 2013; Salepci et al., 2013; Wickwire et al., 2010). Participants were considered Nonadherent if they were offered but declined treatment, or if they initiated treatment but discontinued it and did not restart it during the three-year follow-up period. Results show that adherence, as measured by self-report and by the integrated computer chip in the PAP machine were significantly correlated ($r = 0.80$, $p < .0001$) within our cohort. Chart reviews were carried out to collect information on current medical status (i.e. blood pressure, weight, cholesterol, presence and degree of hypertension, coronary disease, medication use, etc.).

Procedure

Consecutive family medicine patients who met the inclusion criteria were introduced to the study recruiter by their family physician during a clinic visit. In each case, the recruiter explained the study to the patient (in person or by telephone), showed or mailed them the consent form, and reviewed questions about the protocol and consent form before gaining signed consent. Table 1 shows the numbers of participants (women and men) at initial recruitment as well as the rate of participant retention/dropout at each step of the study procedure. 485 patients were approached in two family medicine clinics and 295 initially consented to participate in the study. 176 participants underwent PSG (i.e. Time 1). Prior to OSA testing, participants completed the questionnaires battery, including measures of sleep and insomnia, daytime functioning, quality of life, and psychological adjustment. Health status was determined by chart review. The body mass index (BMI) was calculated based on measurements taken at the sleep laboratory.

After completing their PSG sleep study and questionnaires, PSG reports were interpreted by the sleep specialist (author M.B.) and a report was sent to the participants' family doctor. A large majority (163; 93%) of participants who completed the baseline measures in the study received a diagnosis of OSA at Time 1. Of these, 87 (53%) attended a consultation with the sleep specialist and were prescribed treatment, according to the shared decision-making model of patient care. Of these, 72 (83%) were recommended PAP therapy. The other 15 participants were recommended other options; these included: oral appliance, positional strategies and weight loss. All participants were offered a therapy that best suited them according to the sleep specialist (e.g. oral appliance therapy is offered if a person has adequate dentition, snores frequently, experiences fatigue, and has a low/normal BMI). The possibility of a one-month PAP rental was offered to all participants. At Time 2, 24 participants who had initiated PAP therapy continued to meet criteria for adherence; 51 were classified as Nonadherent, having either refused treatment or initiated but discontinued PAP therapy; five participants regularly used their PAP machine but did not meet minimum adherence criteria. Of the participants who were offered non-PAP treatment ($N = 15$), 7 were Adherent at Time 2.

To minimize participant attrition, we followed recommendations noted by Tansey (Tansey et al., 2007). These included: collection of detailed contact information, including email and name of referring physician/medical center; sending out reminder letters with times and location of lab visit, and sending a reminder phone message the day before the lab visit. Participant attrition was due to the following reasons: unable to contact, participant lacked time or interest to schedule sleep study or specialist appointment, participant did not believe OSA was a problem, participant regarded treatment too burdensome or expensive.

Data Analyses

Data analyses included comparisons of Adherent and Nonadherent groups at Time 1 and Time 2. Questionnaire responses regarding sleep (Sleep Questionnaire, SSC), SF-36 Health Survey, and psychological functioning were analyzed using 2 (Time) × 2 (Group) analysis of variance comparisons. Post hoc *t*-tests were performed where

Table 1. Flow chart showing numbers of participants enrolled and retained through each step of protocol.

Study Enrollment	Overnight Polysomnography (PSG)	Diagnosis	Sleep Specialist Appointment Post PSG	Treatment	Treatment Modality	Adherence 3-year Follow-up
N = 485 Approached in Two Family Medicine Clinics	Attended Overnight PSG (*N* = 176, F = 101)	OSA (*N* = 163, F = 90)	Attended Appointment (*N* = 87, F = 51)	Initiated Treatment (*N* = 53, F = 34)	Initiated PAP Treatment (*N* = 46)	Adherent to PAP (*N* = 24, F = 16)
						Suboptimal PAP Use (*N* = 5, F = 5)
						Nonadherent-Discontinued PAP (*N* = 17, F = 9)
					Initiated Non PAP Treatment (*N* = 7)	(*N* = 7, F = 4)
N = 295 Gave Initial Consent to Participate				Nonadherent-Refused Treatment (*N* = 34, F = 17)		
			Time 1 Only-Did not attend (*N* = 76, F = 39)			
		No OSA (*N* = 13, F = 11)				
	Dropped out before PSG (*N* = 119)					

PSG = polysomnography.
PAP = positive airway pressure.
Non PAP = e.g. dental appliance, bariatric surgery.
F = female.

a significant Time by Group interaction was obtained, including both between groups and repeated measures comparisons. Ordinal data, including stability or change of metabolic syndrome indicators (i.e. hypertension, hyperlipidemia, diabetes, and obesity) from Time 1 to Time 2 was analyzed using Chi-square tests. Descriptive data include demographic, medical and sleep apnea indices. Comparisons were made between Adherent and Nonadherent groups using *t*-tests or analysis of variance comparisons.

Results

Demographics and Time 1 PSG indices

Table 2 presents Time 1 demographic and PSG data for all participant groups. The age difference between men and women was not significant. A 2×2 Chi-square test of association between Gender and Adherence was not significant. Significant differences were found between Adherent ($n = 24$) and Nonadherent ($n = 51$) groups for SpO_2 minimum, $F(1,60) = 7.19$, $p = .01$, and SpO_2 average, $F(1,60) = 7.17$, $p = .008$, indicating lower blood oxygenation for Adherent compared to Nonadherent participants. AHI did not differ between Adherence groups.

Comparisons between adherent and nonadherent groups at Time 1 and Time 2

Table 3 presents means, standard deviations and repeated measures comparisons between Time 1 and Time 2 for Adherent ($n = 22$) and Nonadherent ($n = 41$) for whom we have complete data for both testing times. The two groups were compared on Sleep Quality, Daytime Fatigue, Sleepiness, Depression, and Anxiety measures. Except for medication use and psychological adjustment, comparisons between the two groups indicate significantly worse functioning for Adherent compared to Nonadherent participants at Time 1. Moreover, Adherent participants improved from Time 1 to Time 2 on most sleep and daytime variables, including Daytime Sleepiness and Fatigue. Nonadherent participants show no significant change from Time 1 to Time 2 on any variables evaluated.

Table 4 presents means, standard deviations and test scores for the SF-36 Health Survey for Adherent and Nonadherent participants at Time 1 and Time 2. Analysis of variance comparisons show that except for Vitality, there were no statistically significant Time or interaction effects. Between subject comparisons (Adherent vs Nonadherent, collapsed over time) show that Adherent participants reported significantly worse Quality of Life than Nonadherent participants on six subscales (no significant difference on Role Emotional or Mental Health subscales). Adherent participants showed no improvement over time.

The presence of hypertension and diabetes at Time 1 for all study groups, based on chart review, is presented in Table 2. At Time 1, hypertension was found to be almost twice as likely for Adherent ($n = 19$) than for Nonadherent ($n = 48$) participants, OR = 1.96, 95%CI = 0.62 to 6.20. Similarly, Time 1 diabetes was almost 50% more likely for Adherent participants, OR = 1.54, 95%CI = 0.48 to 5.00. At Time 2, based on 17 Adherent and 31 Nonadherent participants, there were no significant changes in either hypertension or diabetes diagnosis in either group compared to Time 1. Table 5 presents means,

Table 2. Participant group characteristics (Time 1) including gender, age, PSG indices, and diagnosis of hypertension and diabetes according to study participation group (determined at Time 2).

	N	Gender F/M N	Age M(SD)	AHI M(SD)	SpO_2 Mean M(SD)	SpO_2 Min M(SD)	Hypertension Diagnosis N(%)[c]	Diabetes Diagnosis N(%)[c]
Adherent to PAP	24	16/8	56.0(8.1)	40.1 (30.6)	93.7(2.7)	82.3(7.1)	7(36.8)	6(31)
Suboptimal PAP User	5	5/0	57.0 (14.1)	39.5 (27.7)	94.6(3.0)	86.8(5.6)	0(0)	2(50)
Nonadherent-Discontinued PAP	17	9/8	57.0 (13.5)	34.6 (24.8)	95.4(2.0)	85.4(6.6)	2(15.4)	1(7.1)
Nonadherent-Refused Treatment	34	17/17	54.5(9.6)	30.5 (30.3)	95.4(2.0)	85.4(7.1)	9(29)	9(29)
Other Treatment[a]	7	4/3	59.0 (10.9)	29.5 (14.0)	95.8(1.6)	87.7(3.5)	2(28.6)	0(0)
No OSA Diagnosis	13	11/2	53.0(4.5)	4.5(2.7)	96.3(1.5)	91.7(2.4)	2(16)	0(0)
Time 1 Only[b]	76	39/37	53.0 (11.4)	35.7 (29.6)	95.2(2.1)	84.3(8.4)	30(44.8)	14(20)
Total	176	101/75	54.5 (10.6)	32.7 (28.8)	95.1(2.2)	85.1(7.5)		

[a]Other treatment = Oral appliance, weight loss, etc.
[b]Time 1 only = Completed questionnaires and PSG study and declined further participation.
[c]Based on Time 1 chart review data available for Adherent/Nonadherent groups defined at Time 2.

Table 3. Insomnia and daytime functioning measures comparing Adherent ($N = 22$) and Nonadherent participants ($N = 41$)[1] at Time 1 and Time 2.

	Group	Time 1 M(SD)	Time 2 M(SD)	Effect	F (1,61)	p	η2	95% CI for difference	Post hoc tests
Empirical Fatigue Scale	Adherent	11.33 (4.75)[a]	9.48 (5.11)[b]	Time	1.07	ns	0.017	−0.57, 1.80	
	Nonadherent	8.63 (4.76)[c]	9.27 (4.96)[d]	Group	1.55	ns	0.025	−0.89, 3.79	
				Interaction	4.43	.040	0.068		a>b,a>c, b=d,c=d
Epworth Sleepiness	Adherent	9.35 (4.65)[a]	4.65 (5.01) [b]	Time	21.35	.000	0.262	1.63, 4.11	
	Nonadherent	7.30 (4.58)[c]	6.26 (4.73)[d]	Group	0.04	ns	0.001	−1.95, 2.40	
				Interaction	8.68	.005	0.126		a>b,a=c, b=d,c=d
Frequency Nocturnal Arousals	Adherent	3.02 (2.28)[a]	1.67 (1.15)[b]	Time	8.36	.005	0.126	0.20, 1.09	
	Nonadherent	1.97 (1.14)[c]	2.04 (1.20)[d]	Group	1.18	ns	0.020	−0.29, 0.97	
				Interaction	10.16	.002	0.149		a>b,a>c, b=d,c=d
[2] Sleep Quality	Adherent	4.46 (2.22)[a]	6.55 (2.20)[b]	Time	8.90	.004	0.127	−1.42, −0.28	
	Nonadherent	5.94 (2.20)[c]	5.76 (2.17)[d]	Group	0.24	ns	0.004	−1.25, 0.76	
				Interaction	13.13	.001	0.117		a<b,a<c, b=d,c=d
[2] Refreshed in Morning	Adherent	3.37 (2.49)[a]	6.34 (2.64)[b]	Time	17.42	.000	0.222	−2.15, −0.76	
	Nonadherent	5.12 (2.40)[c]	5.41 (2.50)[d]	Group	0.18	ns	0.003	−1.35, 0.88	
				Interaction	11.11	.001	0.154		a<b,a<c, b=d,c=d
Sleep meds	Adherent	1.00 (2.51)[a]	2.57 (3.38) [b]	Time	4.66	.035	0.077	−1.31, −0.05	
	Nonadherent	1.38 (2.76)[c]	1.16 (2.50)[d]	Group	0.56	ns	0.010	−0.86, 1.89	
				Interaction	8.10	.006	0.126		a<b,a=c, b=d,c=d
SSC Insomnia	Adherent	10.41 (4.49) [a]	7.28 (5.13)[b]	Time	12.03	.001	0.167	0.78, 2.93	
	Nonadherent	9.55 (4.45)[c]	8.96 (3.71)[d]	Group	0.69	ns	0.003	−2.45, 1.62	
				Interaction	5.63	.021	0.086		a>b,a=c, b=d,c=d
SSC Daytime Functioning	Adherent	9.70 (3.59)[a]	7.05 (4.33) [b]	Time	11.12	.001	0.159	0.63, 2.51	
	Nonadherent	6.74 (3.93)[c]	6.26 (3.82)[d]	Group	4.04	.05	0.064	0.00, 3.74	
				Interaction	5.35	.024	0.083		a>b,a>c, b=d,c=d
HADS Depression	Adherent	7.63 (4.06)	7.82 (4.09)	Time	0.03	ns	0.001	−1.13, 0.96	
	Nonadherent	6.18 (4.35)	6.13 (4.35)	Group	2.10	ns	0.036	−1.07, 3.64	
				Interaction	0.09	ns	0.002		
HADS Anxiety	Adherent	7.80 (4.06)	8.75 (4.31)	Time	0.03	ns	0.000	−0.88, 0.74	
	Nonadherent	7.38 (4.83)	6.59 (4.98)	Group	1.20	ns	0.012	−0.60, 3.74	
				Interaction	2.76	ns	0.046		

[1]Ns reflect missing data at Time 2.
[2]Higher score is better, else lower score is better.

standard deviations for all sample groups for Time 1 chart review data; this includes recent blood pressure, lipid profile, and fasting blood glucose, indicating that, on average, the sample was within normal limits.

Discussion

Does increased OSA case-finding necessarily lead to treatment uptake and benefit? The US Preventive Services Task Force (Feltner et al., 2022) issued a recommendation statement that the current evidence is insufficient to recommend general screening for OSA in the adult population. This was based on a series of systematic reviews evaluating the accuracy of screening questionnaires, the benefits of early detection and efficacy of treatment, as well as long-term impact of treatment on health outcomes. As this 2022

Table 4. Quality of life health (SF-36) comparing Adherent ($N = 22$) and Nonadherent participants ($N = 41$)[1] at Time 1 and Time 2.

	Group	Time 1 M(SD)	Time 2 M(SD)	Effect	F (1,61)	*p*=	η2	95% CI for difference
Physical Functioning	Adherent	61.36 (27.13)	60.57 (24.05)	Group	22.10	0.000	0.27	−31.77, −12.80
	Nonadherent	81.63 (20.30)	84.88 (14.12)	Time	0.19	ns	0.00	−6.79, 4.34
				Interaction	0.53	ns	0.00	
Role Physical	Adherent	45.45 (37.51)	56.82 (38.72)	Group	11.04	0.002	0.16	−40.23, −9.99
	Nonadherent	78.13 (27.84)	74.38 (30.74)	Time	0.80	ns	0.01	−12.31, 4.70
				Interaction	3.16	ns	0.05	
Body Pain	Adherent	49.48 (23.44)	52.76 (31.77)	Group	7.71	0.007	0.12	−25.33, −4.11
	Nonadherent	64.30 (20.42)	67.34 (24.62)	Time	0.65	ns	0.01	−11.09, 4.73
				Interaction	0.00	ns	0.00	
General Health	Adherent	49.06 (26.83)	52.26 (30.28)	Group	8.90	0.004	0.13	−29.12, −5.76
	Nonadherent	68.05 (19.53)	68.22 (20.69)	Time	0.60	ns	0.01	−6.06, 2.68
				Interaction	0.48	ns	0.01	
Vitality	Adherent	36.02 (21.45)	46.59 (27.10)	Group	4.56	0.037	0.07	−24.81, −0.80
	Nonadherent	51.51 (24.23)	56.71 (22.37)	Time	13.99	0.00	0.19	−12.10, −3.67
				Interaction	1.62	ns	0.03	
Social Functioning	Adherent	65.00 (23.86)	65.94 (27.47)	Group	4.78	0.033	0.08	−25.20, −1.10
	Nonadherent	75.66 (25.16)	81.58 (22.08)	Time	1.28	ns	0.02	−9.50, 2.64
				Interaction	0.68	ns	0.01	
Role Emotional	Adherent	62.12 (36.07)	69.70 (41.03)	Group	0.31	ns	0.01	−24.69, 14.01
	Nonadherent	74.17 (39.58)	68.33 (43.33)	Time	0.03	ns	0.01	−10.27, 8.52
				Interaction	2.04	ns	0.03	
Mental Health	Adherent	63.09 (20.65)	64.91 (20.51)	Group	1.68	ns	0.03	−16.38, 3.50
	Nonadherent	69.07 (20.61)	71.80 (20.47)	Time	1.08	ns	0.02	−6.65, 2.11
				Interaction	0.04	ns	0.00	

[1]Ns reflect missing data at Time 2.
Higher scores indicate better functioning.

Table 5. Means and standard deviations, M(SD), of physical and serum health measures at Time 1.

	N	Systolic BP	Diastolic BP	Total Cholesterol	LDL fraction	HDL fraction	Triglycerides	Fasting Glucose
Adherent	23	126(14.11)	80(9.22)	4.85(1.43)	2.64(1.21)	1.46(.50)	1.64(.97)	5.55(.83)
Sub-optimal User	5	107(12.58)	75(5.77)	5.48(1.07)	3.10(.66)	1.47(.32)	1.99(1.49)	7.84(3.68)
Treatment Drop Outs	17	132(15.38)	73(9.66)	4.89(.94)	2.80(.88)	1.46(.55)	1.38(.57)	5.26(.63)
Treatment Refuser	32	123(11.18)	77(7.32)	4.86(1.23)	2.80(1.02)	1.46(.43)	1.38(.81)	5.82(1.48)
Other Treatment	7	117(14.98)	77(8.83)	5.00(.96)	3.05(.82)	1.45(.42)	1.30(.33)	5.19(.42)
No Apnea	12	127(11.58)	77(6.79)	5.67(1.07)	3.31(1.00)	1.88(.39)	1.03(.50)	4.92(.16)
Time 1 only	70	125(12.95)	79(9.32)	5.11(1.63)	2.99(1.01)	1.42(.75)	1.61(1.32)	5.90(1.58)
All participants	160	125(13.37)	78(8.75)	5.05(1.39)	2.91(1.01)	1.47(.61)	1.51(1.06)	5.74(1.48)

BP, Blood pressure
LDL, low-density lipids
HDL, high-density lipids

guideline addresses several of the points in our present investigation, we use the Task Force findings to structure our discussion and provide context for our own findings.

We began recruiting for the present study well before those evidence reviews were carried out for the Task Force. We believed at that time that the appropriate goal was to identify as many people with unrecognized OSA as possible. The expectation was that many more individuals would benefit from becoming aware that they had OSA and would take the opportunity to correct it.

Testing for OSA

The Task Force concluded that screening questionnaires are not reliable enough to identify OSA in the general population, and that the evidence was insufficient to support screening asymptomatic adults. A strength of the present study is that participants were tested with polysomnography in a higher risk segment of the population (older) where we were more likely to find cases. We observed that it is easy to find older people with severe OSA and its many associated symptoms by simply offering them testing. Therefore, *testing* higher risk, symptomatic individuals may be warranted. However, the high attrition rate among participants with significant OSA, suggests that additional selection criteria are necessary to justify the high cost of PSG testing as a second step in a case finding program.

Treatment adherence

The Task Force did not address patient retention or treatment adherence. What the present study adds regarding testing unrecognized cases is that after 3 years of usual care, adoption of and adherence to treatment were low. As observed in Table 1, in each step of the process, we lost approximately half of the participants, even though their OSA was clinically important. A positive aspect of this approach was that it encouraged a high percentage of women to be tested – a group usually under-referred to sleep clinics. In our sample, this enhanced percentage of females was maintained to the initiation of treatment and to three-year follow-up. As effective as PAP therapy can be, it has been widely noted that adherence rates are only about 50% among those who initiate it. In the sleep

clinic, when patients are referred on suspicion of OSA, among patients who use their PAP machines, only 30% could be classified as adherent, while 38%, use their devices below therapeutic benchmarks (Wohlgemuth et al., 2015). There is a considerable literature that explores the determinants of non-adherence to PAP treatment: difficulty breathing, insomnia, difficulty adjusting to the mask, technical aspects (excessive or inadequate humidity) (D'rozario et al., 2016), little or no perceived benefit (Uematsu et al., 2016), and anatomy of the upper airway (Park et al., 2017). Factors associated with adherence have also been identified and include access to support from sleep specialists and technicians (Shapiro & Shapiro, 2010), humidification (PAP), older age, more severe OSA, and being overweight (Palm et al., 2018). However, once PAP therapy is adopted, adherence at therapeutic levels tends to be maintained (Cistulli et al., 2019).

Screening long-term health outcomes

Most of the studies reviewed by the Task Force evaluated treatment efficacy after only 12 weeks, so long-term benefits to health or reduced mortality were not evident. In contrast, the three-year follow-up in the present study is relevant to family medicine clinic patients who have access to routine health care. At Time 1, on average, measures of blood pressure, blood lipids and glucose were within normal limits in spite of significant OSA. Moreover, the frequency of hypertension and diabetes remained stable over 3 years, for both the adherent and nonadherent groups. In this context, good clinical management of co-morbid conditions may be enough to offset the impact of untreated OSA, at least in the short term. Future research should focus on much long-term implications of nonadherence to OSA treatment.

There was a high attrition rate in our study, despite our efforts to retain participation. This limited our ability to carry out repeated measures comparisons on some health variables. However, sufficient numbers allowed comparisons between adherence groups with acceptable effect sizes. On the other hand, this high attrition may demonstrate what actually would happen with wider screening for OSA. The loss of participants with each study requirement seems consistent with the challenge of referral and treatment compliance in clinical contexts for OSA (Guess et al., 2021; Saglam-Aydinatay et al., 2018; Salepci et al., 2013).

Study limitations

The burdensome nature of the protocol (i.e. testing with PSG which required overnight stay at sleep lab) may have contributed to the loss of participants at the testing stage. Home testing (type 3) has become increasingly common in sleep medicine practice and may have increased willingness to be tested.

We were unable to recruit sufficient patient participants who were without OSA in order to form a healthy control group. Such a comparison group could shed light on the differences in sleep measures at Time 1, and the lack of differences at Time 2.

Conclusions and recommendations

How should family physicians approach the question of case finding for OSA? In medical practice, the most appropriate and cost-effective question may be, 'Who is likely to have OSA, *and to be adherent* to treatment?' We concur with the Task Force recommendations, that testing should be symptom driven: those who have worse insomnia, daytime sleepiness and fatigue as well as poorer health functioning are more likely to be adherent. This possibility needs additional confirmatory research.

Based on current findings, a proposed approach to improved and cost-effective sleep health care is the following: All older patients should be fully informed about (a) the symptoms and risks of sleep apnea; (b) the range of treatment options available, and (c) the likely health benefits. *In addition*, they should be informed of (d) the challenges of adapting to the technology and (e) the cost burden if they are uninsured. A question to patients who will be offered testing, should be: 'If we find you have OSA, how likely is it that you would attempt one of the available treatments?'

Data availability statement

The data underlying this article will be shared on reasonable request to the corresponding author.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The study was funded by the Canadian Institutes of Health Research (CIHR), grant number: MOP106451.

Ethics

The study was approved by the McGill University Institutional Research Board, the Jewish General Hospital's REC and the St. Mary's Hospital's Research Ethics Board in Montreal.

References

Ancoli-Israel, S., Kripke, D. F., Klauber, M. R., Mason, W. J., Fell, R., & Kaplan, O. (1991). Sleep-disordered breathing in community-dwelling elderly. *Sleep*, *14*(6), 486–495. https://doi.org/10.1093/sleep/14.6.486

Bailes, S., Baltzan, M., Alapin, I., Fichten, C. S., & Libman, E. (2005). Diagnostic indicators of sleep apnea in older women and men: A prospective study. *Journal of Psychosomatic Research*, *59*(6), 365–373. https://doi.org/10.1016/j.jpsychores.2005.06.067

Bailes, S., Baltzan, M., Rizzo, D., Fichten, C. S., Amsel, R., & Libman, E. (2008). A diagnostic symptom profile for sleep disorder in primary care patients. *Journal of Psychosomatic Research*, *64*(4), 427–433. https://doi.org/10.1016/j.jpsychores.2007.10.011

Bailes, S., Baltzan, M., Rizzo, D., Fichten, C. S., Grad, R., Wolkove, N., Creti, L., Amsel, R., & Libman, E. (2009). Sleep disorder symptoms are common and unspoken in Canadian general practice. *Family Practice*, *26*(4), 294–300. https://doi.org/10.1093/fampra/cmp031

Bailes, S., Fichten, C. S., Rizzo, D., Baltzan, M., Grad, R., Pavilanis, A., Creti, L., Amsel, R., & Libman, E. (2017). The challenge of identifying family medicine patients with obstructive sleep apnea: Addressing the question of gender inequality. *Family Practice*, *34*(4), 467–472. https://doi.org/10.1093/fampra/cmx008

Barbé, F., Durán-Cantolla, J., Capote, F., de la Peña, M., Chiner, E., Masa, J. F., Gonzalez, M., Marín, J. M., Garcia-Rio, F., de Atauri, J. D., & Terán, J. (2010). Long-term effect of continuous positive airway pressure in hypertensive patients with sleep apnea. *American Journal of Respiratory and Critical Care Medicine*, *181*(7), 718–726. https://doi.org/10.1164/rccm.200901-0050OC

Berry, R. B., Brooks, R., Gamaldo, C. E., Harding, S. M., Marcus, C., & Vaughn, B. V. (2012). The AASM manual for the scoring of sleep and associated events. *Rules*, *Terminology and Technical Specifications*, American Academy of Sleep Medicine, 176.

Cistulli, P. A., Armitstead, J., Pepin, J. -L., Woehrle, H., Nunez, C. M., Benjafield, A., & Malhotra, A. (2019). Short-term CPAP adherence in obstructive sleep apnea: A big data analysis using real world data. *Sleep Medicine*, *59*, 114. https://doi.org/10.1016/j.sleep.2019.01.004

D'rozario, A. L., Galgut, Y., & Bartlett, D. J. (2016). An update on behavioural interventions for improving adherence with continuous positive airway pressure in adults. *Current Sleep Medicine Reports*, *2*(3), 166–179. https://doi.org/10.1007/s40675-016-0051-2

Edinger, J. D., Fins, A. I., Goeke, J. M., McMillan, D. K., Gersh, T. L., Krystal, A. D., & McCall, W. V. (1996). The empirical identification of insomnia subtypes: A cluster analytic approach. *Sleep*, *19*(5), 398–411.

Feltner, C., Wallace, I. F., Aymes, S., Middleton, J. C., Hicks, K. L., Schwimmer, M., Baker, C., Balio, C. P., Moore, D., Voisin, C. E., & Jonas, D. E. (2022). Screening for obstructive sleep apnea in adults: Updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*, *328*(19), 1951–1971. https://doi.org/10.1001/jama.2022.18357

Fichten, C. S., Creti, L., Amsel, R., Brender, W., Weinstein, N., & Libman, E. (1995). Poor sleepers who do not complain of insomnia: Myths and realities about psychological and lifestyle characteristics of older good and poor sleepers. *Journal of Behavioral Medicine*, *18*(2), 189–223. https://doi.org/10.1007/BF01857869

Fichten, C.S., Libman, E., Bailes, S., & Alapin, I. (2000). Characteristics of older adults with insomnia. In K.L. Lichstein & C.M. Morin (Eds.), *Treatment of late life insomnia* (pp. 37–80). New York: Sage. ISBN:9781452262192.

Gonzaga, C., Bertolami, A., Bertolami, M., Amodeo, C., & Calhoun, D. (2015). Obstructive sleep apnea, hypertension and cardiovascular diseases. *Journal of Human Hypertension*, *29*(12), 705–712. https://doi.org/10.1038/jhh.2015.15

Gottlieb, D. J., Yenokyan, G., Newman, A. B., O'connor, G. T., Punjabi, N. M., Quan, S. F., Redline, S., Resnick, H. E., Tong, E. K., Diener-West, M., & Shahar, E. (2010). Prospective study of obstructive sleep apnea and incident coronary heart disease and heart failure the sleep heart health study. *Circulation*, *122*(4), 352–360. https://doi.org/10.1161/CIRCULATIONAHA.109.901801

Guess, N. W., Fischbach, H., Ni, A. A., & Firestone, A. R. (2021). Referral rate for obstructive sleep apnea in a pre□doctoral dental clinic using the STOP□Bang Questionnaire. *Journal of Dental Education*, *86*(4), 456–462. https://doi.org/10.1002/jdd.12831

Hung, H. C., Yang, Y. C., Ou, H. Y., Wu, J. S., Lu, F. H., & Chang, C. J. (2013). The relationship between impaired fasting glucose and self□reported sleep quality in a Chinese population. *Clinical Endocrinology*, *78*(4), 518–524. https://doi.org/10.1111/j.1365-2265.2012.04423.x

Jarrin, D. C., Alvaro, P. K., Bouchard, M. -A., Jarrin, S. D., Drake, C. L., & Morin, C. M. (2018). Insomnia and hypertension: A systematic review. *Sleep Medicine Reviews*, *41*, 3–38. https://doi.org/10.1016/j.smrv.2018.02.003

Johansson, P., Alehagen, U., Svanborg, E., Dahlström, U., & Broström, A. (2009). Sleep disordered breathing in an elderly community-living population: Relationship to cardiac function, insomnia symptoms and daytime sleepiness. *Sleep Medicine*, *10*(9), 1005–1011. https://doi.org/10.1016/j.sleep.2009.01.011

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*, *14*(6), 540–545. https://doi.org/10.1093/sleep/14.6.540

Lichstein, K., Durrence, H., Taylor, D., Bush, A., & Riedel, B. (2003). Quantitative criteria for insomnia. *Behaviour Research and Therapy*, *41*(4), 427–445. https://doi.org/10.1016/S0005-7967(02)00023-2

Lichstein, K. L., Riedel, B. W., Lester, K. W., & Aguillard, R. N. (1999). Occult sleep apnea in a recruited sample of older adults with insomnia. *Journal of Consulting and Clinical Psychology*, *67*(3), 405. https://doi.org/10.1037/0022-006X.67.3.405

Lichstein, K. L., Stone, K. C., Donaldson, J., Nau, S. D., Soeffing, J. P., Murray, D., Lester, K. W., & Aguillard, R. N. (2006). Actigraphy validation with insomnia. *Sleep*, *29*(2), 232–239.

Marin, J. M., Carrizo, S. J., Vicente, E., & Agusti, A. G. (2005). Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: An observational study. *The Lancet*, *365*(9464), 1046–1053. https://doi.org/10.1016/S0140-6736(05)71141-7

Morgenstern, M., Wang, J., Beatty, N., Batemarco, T., Sica, A. L., & Greenberg, H. (2014). Obstructive sleep apnea: An unexpected cause of insulin resistance and diabetes. *Endocrinology and Metabolism Clinics of North America*, *43*(1), 187–204. https://doi.org/10.1016/j.ecl.2013.09.002

Morin, C. M., & Benca, R. (2012). Chronic insomnia. *The Lancet*, *379*(9821), 1129–1141. https://doi.org/10.1016/S0140-6736(11)60750-2

Morin, C., LeBlanc, M., Daley, M., Gregoire, J., & Merette, C. (2006). Epidemiology of insomnia: Prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep Medicine*, *7*(2), 123–130. https://doi.org/10.1016/j.sleep.2005.08.008

Palm, A., Midgren, B., Theorell-Haglöw, J., Ekström, M., Ljunggren, M., Janson, C., & Lindberg, E. (2018). Factors influencing adherence to continuous positive airway pressure treatment in obstructive sleep apnea and mortality associated with treatment failure–a national registry-based cohort study. *Sleep Medicine*, *51*, 85–91. https://doi.org/10.1016/j.sleep.2018.07.007

Park, P., Kim, J., Song, Y. J., Lim, J. H., Cho, S. W., Won, T. -B., Han, D. H., Kim, D. Y., Rhee, C. S., & Kim, H. J. (2017). Influencing factors on CPAP adherence and anatomic characteristics of upper airway in OSA subjects. *Medicine*, *96*(51), e8818. https://doi.org/10.1097/MD.0000000000008818

Quan, S. F., Budhiraja, R., Clarke, D. P., Goodwin, J. L., Gottlieb, D. J., Nichols, D. A., Simon, R. D., Smith, T. W., Walsh, J. K., & Kushida, C. A. (2013). Impact of treatment with continuous positive airway pressure (CPAP) on weight in obstructive sleep apnea. *Journal of Clinical Sleep Medicine*, *9*(10), 989. https://doi.org/10.5664/jcsm.3064

Saglam-Aydinatay, B., Uysal, S., & Taner, T. (2018). Facilitators and barriers to referral compliance among dental patients with increased risk of obstructive sleep apnea. *Acta Odontologica Scandinavica*, *76*(2), 86–91. https://doi.org/10.1080/00016357.2017.1386797

Salepci, B., Caglayan, B., Kiral, N., Parmaksiz, E. T., Comert, S. S., Sarac, G., Fidan, A., & Gungor, G. A. (2013). CPAP adherence of patients with obstructive sleep apnea. *Respiratory Care*, *58*(9), 1467–1473. https://doi.org/10.4187/respcare.02139

Shapiro, G. K., & Shapiro, C. M. (2010). Factors that influence CPAP adherence: An overview. *Sleep and Breathing*, *14*(4), 323–335. https://doi.org/10.1007/s11325-010-0391-y

Spiegel, K., Knutson, K., Leproult, R., Tasali, E., & Van Cauter, E. (2005). Sleep loss: A novel risk factor for insulin resistance and Type 2 diabetes. *Journal of Applied Physiology*, *99*(5), 2008–2019. https://doi.org/10.1152/japplphysiol.00660.2005

Tansey, C. M., Matté, A. L., Needham, D., & Herridge, M. S. (2007). Review of retention strategies in longitudinal studies and application to follow-up of ICU survivors. *Intensive Care Medicine*, *33*(12), 2051–2057. https://doi.org/10.1007/s00134-007-0817-6

Uematsu, A., Akashiba, T., Kumasawa, F., Akahoshi, T., Okamoto, N., Nagaoka, K., Gon, Y., Kaneita, Y., Uchiyama, M., & Hashimoto, S. (2016). Factors influencing adherence to nasal continuous positive airway pressure in obstructive sleep apnea patients in Japan. *Sleep and Biological Rhythms*, *14*(4), 339–349. https://doi.org/10.1007/s41105-016-0064-8

Ware, J., Snow, K., Kosinski, M., & Gandek, B. (2000). *SF-36 health survey and interpretation guide*. QualityMetric Incoporated.

Wickwire, E. M., Smith, M. T., Birnbaum, S., & Collop, N. A. (2010). Sleep maintenance insomnia complaints predict poor CPAP adherence: A clinical case series. *Sleep Medicine*, *11*(8), 772–776. https://doi.org/10.1016/j.sleep.2010.03.012

Wohlgemuth, W. K., Chirinos, D. A., Domingo, S., & Wallace, D. M. (2015). Attempters, adherers, and non-adherers: Latent profile analysis of CPAP use with correlates. *Sleep Medicine*, *16*(3), 336–342. https://doi.org/10.1016/j.sleep.2014.08.013

Yu, J., Zhou, Z., McEvoy, R. D., Anderson, C. S., Rodgers, A., Perkovic, V., & Neal, B. (2017). Association of positive airway pressure with cardiovascular events and death in adults with sleep apnea: A systematic review and meta-analysis. *JAMA*, *318*(2), 156–166. https://doi.org/10.1001/jama.2017.7967

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*(6), 361–370. https://doi.org/10.1111/j.1600-0447.1983.tb09716.x