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Wrist actigraphic assessment of sleep in 116 community based subjects suspected of obstructive sleep apnoea syndrome

H A M Middelkoop, A Knuistingh Neven, J J van Hilten, C W Ruwhof, H A C Kamphuisen

Abstract

***Background* – The combined use of wrist actigraphic assessment and self assessment of sleep in the screening of obstructive sleep apnoea syndrome was evaluated in a community based sample.**

***Methods* – One hundred and sixteen community based subjects clinically suspected of having obstructive sleep apnoea (syndrome) were evaluated by means of simultaneous ambulatory recording of respiration (oronasal flow thermistry), motor activity (wrist actigraphy), and subjective sleep (sleep log) during one night of sleep.**

***Results* – The subjects were distributed according to their apnoea index (AI); AI<1 (non-apnoeic snorers) 44%; AI 1–<5 39%; and AI ⩾5 17%. High apnoea index values were associated with self reported disturbed sleep initiation and more fragmented and increased levels of motor activity and decreased duration of immobility periods, particularly in those with an apnoea index of ⩾5. Across subjects the duration of immobility periods was the only predictor of the apnoea index, explaining 11% of its variance. Use of the multiple regression equation to discriminate retrospectively between those with an apnoea index of <1 and ⩾5 resulted in sensitivity and specificity values of 75% and 43%, and 5% and 100%, respectively.**

***Conclusions* – The combined use of a sleep log and actigraphic assessment of sleep failed to identify reliably those subjects who suffered from obstructive sleep apnoea (syndrome) in a sample of community based subjects reporting habitual snoring combined with excessive daytime sleepiness and/or nocturnal respiratory arrests.**

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Keywords: obstructive sleep apnoea, motor activity, actigraphy, oronasal thermistry.

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Obstructive sleep apnoeas are caused by a collapse of the upper airway at the level of the pharynx and are usually accompanied by snoring, a generalised startle response, and gasping. The main daytime consequence of repetitive obstructive sleep apnoea is excessive daytime sleepiness.[1 2] Excessive daytime sleepiness is most probably related to fragmented sleep by recurrent arousals, loss of the deeper levels of sleep, and effects of hypoxaemia on cerebral function.[2 3]

When the clinical features suggest obstructive sleep apnoea syndrome the diagnosis is generally confirmed by nocturnal polysomnography in the sleep laboratory. However, obstructive sleep apnoea syndrome is a relatively common disorder with a prevalence estimated to lie between 0·4% and 8·5%,[4] and polysomnography is expensive and complex. This emphasises the need for less expensive and convenient monitoring techniques in the diagnostic examination of patients with obstructive sleep apnoea syndrome. As these patients invariably exhibit increased motor activity during sleep,[2 3 5–7] activity monitoring may offer a useful approach in the assessment of this disorder. Two studies have addressed the use of activity monitoring in obstructive sleep apnoea syndrome,[5 6] but both only compared patients with polysomnographically confirmed severe obstructive sleep apnoea syndrome with normal controls.

In the present study we have evaluated the applicabililty of activity monitoring in 116 community based subjects who were clinically suspected of suffering from obstructive sleep apnoea syndrome. Additionally, the extent to which combined sleep log and activity monitoring measures are related to obstructive sleep apnoea (as assessed by concomitant oronasal thermistry) has been studied.

Methods

SUBJECTS

The subjects were a subgroup of a larger sample comprising all 2476 inhabitants (men ⩾35 years and women ⩾50 years of age) of the general practice serving the town of Krimpen aan de Lek, The Netherlands, who were selected for a large epidemiological study on the prevalence of obstructive sleep apnoea syndrome and correlates. This cross sectional study was performed in two stages.

Firstly, a questionnaire was sent to the 2476 inhabitants addressing sociodemographic variables, lifestyle factors (alcohol and tobacco consumption), (sleep) medication, cardiovascular symptoms, snoring, and sleeping habits. A response rate of 88% (2174 subjects; 1402 men) was obtained after two reminders. The questionnaire data were subsequently used to select subjects in which obstructive sleep apnoea syndrome was highly suspected[2 4 8 9]: (1) habitual snoring (more than three nights per week) combined with (2) excessive daytime sleepiness – presence of inappropriate and undesirable sleepiness during waking hours, considered excessive when a score of ⩾3 was obtained on a

four point rating scale (never, sometimes, often, always present) – and/or (3) nocturnal respiratory arrests (spouse report) ($\geqslant 3$ scored on a similar scale).

The second part of the study consisted of an overnight home recording of sleep by combined sleep log and wrist motor activity monitoring and respiration by oronasal thermistry in those subjects who fulfilled the aforementioned criteria. Both respiratory and motor activity monitoring techniques are not liable to any significant "first night" effect.[10 11] Of the 2181 respondents 178 fulfilled the criteria for obstructive sleep apnoea syndrome, of whom 167 participated in this part of the study (two subjects refused recording and nine were excluded because of severe asthma). The subjects were asked to maintain their habitual 24 hour pattern of activities during the recording period.

The study was approved by the Leiden University Hospital ethics committee for medical research.

ONE NIGHT HOME RECORDING OF RESPIRATION AND SLEEP

Respiration: oronasal thermistry

Nocturnal respiration was monitored with an oronasal thermistor connected to a portable modified four channel Medilog recorder.[11 12] Besides the thermistor signal, the event marker and crystal clocked time were also recorded and stored on tape. Before the recording night each subject was invited to the general practice for a 20 minute instruction session during which the subject was shown how to handle the apparatus. To synchronise the different recordings the subject's watch was set to PC time (PC time = Medilog recorder time) which was on-line visible on screen when the activity monitor (connected to the PC actigraph interface) was started.

One hour before bedtime the subjects attached the activity monitor and thermistor and started the Medilog recorder to obtain one hour's data of respiration during wakefulness. The subjects had to press the event marker of the recorder at the moment they turned off the lights to go to sleep. The "lights off" time and the time they switched off the recorder in the morning had to be indicated in the sleep log.

The recordings were digitised at 1 Hz. The sampling process was continuously synchronised to the recorded time signal, resulting in an inaccuracy of less than 15 seconds over 24 hours.[12] A display program allowed the digitised recording to be viewed at any time scale. The recordings were scored by one of us (CR), a skilled technician. The recording was considered sufficient when more than five hours were obtained without artifact or signal dropout. Apnoeas were scored when there was at least a 90% reduction of oronasal airflow (lasting $\geqslant 10$ seconds) compared with the value of the immediately preceding respiration. Possible artifacts were also scored. Time in bed (TIB) was defined as the period (hours) from "lights out" until definitive awakening and was derived from the subject's sleep log. Artifact time was subtracted from TIB (yielding a corrected TIB: TIB_c) before a subject's apnoea index (number of apnoeas/TIB_c) was computed.

Sleep: sleep log

Sleep was assessed by a sleep log in which the subjects indicated general aspects of sleep during the recording night (the time they settled in bed, the "lights off" time, self estimated sleep latency, the number of awakenings after sleep onset, time of definitive awakening and rise time), daytime naps, and the use of alcohol and hypnotics/sedatives. On the recording night the presence of a problem in any of the following categories was evaluated: (1) disturbed initiation of sleep (sleep latency >30 minutes), (2) disturbed sleep maintenance (number of awakenings after sleep onset $\geqslant 3$), (3) restless sleep (1 = no restlessness to 5 = extreme restlessness), (4) snoring (yes/no), (5) difficulty with awakening in the morning (1 = no difficulty to 5 = extremely difficult).

The subjects also had to indicate possible reason(s) for night time awakening(s) and whether they experienced any complaints after final awakening. Sleep log items (3) and (5) were considered clinically relevant if a score of $\geqslant 4$ was obtained.

Sleep: activity monitor

Parallel to the respiration recording motor activity was continuously recorded by means of a solid state activity monitor worn on the wrist of the non-dominant arm. Wrist activity recordings detect both integrated generalised movements and small movements that occur at the distal extremities.[13] The non-dominant wrist was chosen for convenience. The characteristics of the activity monitor (Gaehwiler Electronic, CH-8634 Hombrechtikon) used in this study have been reported elsewhere.[10 14] For each subject the following activity monitoring measures were calculated for the TIB period: (1) the movement index (%) indicating the percentage of epochs with an activity count of >0. This reflects the proportion of activity >0 epochs of all activity and immobility (activity = 0) epochs that make up the TIB period; (2) the activity level (activity counts/15 second epoch); (3) the adjusted AL (activity counts/number of activity >0 epochs); (4) the duration (min) or uninterrupted activity (activity >0) (DAP) and immobility (activity = 0) periods (DIP). DAP and DIP values were derived from a converted raw actigram which is a separate time series consisting of 15 second epochs each containing the duration of the ongoing activity or immobility period. To discriminate DAPs from DIPs, the DAP values were tagged by a minus sign; (5) the fragmentation indices (F_{15}–F_{60}), the percentage of one (F_{15}), two, three, and four successive epochs (F_{30}–F_{60}) without movement with respect to the total number of immobility periods of all durations. The term "fragmentation" was previously described as a measure of sleep disturbance reflecting the increased occurrence of activity periods at close intervals.[5] Hence, the number

Table 1 Number (%) of subjects (n=116) across the selection criteria categories excessive daytime sleepiness and witnessed apnoeas as assessed by the sleep questionnaire. + = present (score ≥3 on a four-point rating scale (never, sometimes, often, always present)); − = not present; ? = don't know

	Excessive daytime sleepiness		Total
	−	+	
Observed apnoeas (spouse report)			
−	0 (0%)	48 (41%)	48 (41%)
+	38 (33%)	13 (11%)	51 (44%)
?	0 (0%)	17 (15%)	17 (15%)
Total	38 (33%)	78 (67%)	116 (100%)

of immobility periods of short duration to the total number of immobility periods of all durations increases.

The motor activity data were processed by means of ACTSTAT 1·0 software.[15]

STATISTICAL ANALYSES

Analysis was performed with the Statisical Package for Social Sciences (SPSS/PC+, release 4.0.1)[16] in two parts: (1) one way analysis of variance (ANOVA) (continuous variables) and the χ^2 test (ordinal categorial variables) were used to examine the anthropometric and sleep characteristics of the subjects across the following three apnoea index groups; <1 (non-apnoeic snorers), 1–<5, and ≥5.[1] After a significant F ratio the Student-Newman-Keuls test was used for comparison of group means; (2) multiple linear regression analysis (backward method) was used to investigate whether sex, age, body mass index, sleep log, and activity monitoring measures could serve as relevant predictors of obstructive sleep apnoea. In this part of the analysis the apnoea index was considered as a continuous, rather than discrete, dependent variable to avoid a relatively arbitrary partitioning of the sample.[9]

To investigate relations between measures Pearson product moment correlation analysis was used. A level of $p<0·05$ was regarded as statistically significant.

Results

Of a total of 167 respiration recordings 116 (103 men) satisfactory recordings (both thermistry and activity monitoring successful and lasting more than five hours without artifact and/or signal dropout (thermistry)) were finally submitted to analysis. The distribution of the 116 analysed subjects across the various categories of the selection criteria is presented in table 1. Their anthropometric characteristics did not vary significantly across the three apnoea index groups (table 2).

CHARACTERISTICS OF THE SUBJECTS IN WHOM MONITORING FAILED

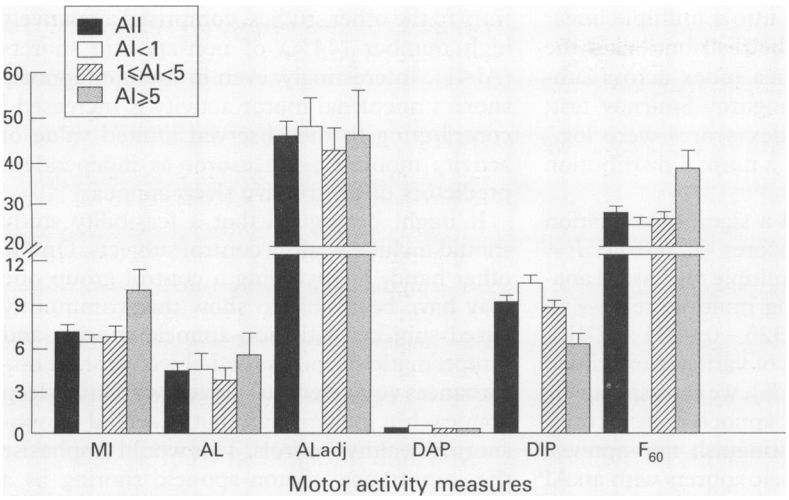
The relatively high proportion of dropouts in this study (51 out of a total of 167 recorded subjects, 30%) was the result of an unfavourable distribution of failed or unsatisfactory recordings across the subjects with nine (5%) dropouts from thermistry: 22 (13%) dropouts from activity monitoring, and 31 (19%) dropouts in which either thermistry or activity monitoring was unsatisfactory. Of the remaining 136 adequately recorded subjects 20 (15%) had less than five hours thermistor signal without artifact and/or signal dropout. The relatively high number of activity monitoring dropouts – which is quite uncommon in research using activity monitoring[15] – resulted from a critical computer hardware failure (eight recordings), erroneous usage of the activity monitoring computer interfacing system (nine recordings), and physical damage to the accelerometer of the activity monitor (five recordings).

The group of 51 subjects in whom monitoring failed (group: M−) comprised 42 men and nine women of mean (SD) age 56·0 (13·4) years and mean (SD) body mass index 23·6

Table 2 Mean (SD) or percentages of anthropometric, respiration, and sleep log data according to apnoea index group

	All subjects (n=116)	AI<1 (n=51)	AI 1-<5 (n=45)	AI≥5 (n=20)	ANOVA or χ^2
Anthropometric data					
Sex (M:F)	103:13	45:6	39:6	19:1	$\chi^2=1·0$
Age (years)	53·6 (10·7)	52·1 (10·2)	55·0 (11·0)	54·5 (11·3)	$F=0·9$
BMI (kg/m^2)	25·9 (3·0)	26·1 (3·2)	25·3 (2·5)	26·4 (3·5)	$F=0·3$
Respiration measure					
AI (no. of apnoeas/TIB$_c$)	2·9 (4·7)	0·4 (0·3)	2·4 (1·1)	10·4 (7·4)[a]	$F=73·3$***
Sleep log: general characteristics of sleep					
Daytime nap (%)	23	18	9	11	$\chi^2=1·8$
Use of hypnotics (%)	11	12	9	11	$\chi^2=1·8$
Alcohol before going to bed (no. of glasses)	1·0 (1·5)	1·0 (1·5)	0·6 (1·0)	1·6 (2·0)[b]	$F=3·4$*
Sleep latency (min)	25·9 (30·9)	17·3 (21·0)	28·8 (36·1)	40·0 (33·7)[c]	$F=4·5$*
WASOs	2·4 (4·9)	2·7 (7·2)	2·3 (2·6)	2·1 (1·4)	$F=0·1$
TIB (h)	7·1 (1·1)	7·1 (1·1)	7·2 (1·1)	6·7 (1·1)	$F=1·2$
TIB$_c$ (h)	6·7 (1·3)	6·7 (1·6)	7·0 (1·2)	6·6 (1·1)	$F=0·9$
Sleep log: sleep disturbances					
Disturbed sleep initiation (%)	18	10	16	40	$\chi^2=8·9$*
Disturbed sleep maintenance (%)	32	29	35	32	$\chi^2=0·4$
Difficulty with awakening (%)	16	14	24	5	$\chi^2=4·2$
Restless sleep (%)	24	22	22	35	$\chi^2=1·8$
Snoring (%)	77	88	71	64	$\chi^2=4·3$

AI = apnoea index; BMI = body mass index; WASO = awakenings after sleep onset; TIB = time in bed; TIB$_c$ = corrected TIB.
* $p<0·05$; *** $p<0·001$.
[a,b,c] Significant differences by the Student-Newman-Keuls test after post hoc comparisons between AI groups <1, 1–<5 and ≥5[a], AI1–<5 and ≥5[b], and AI<1 and ≥5[c]



Means (+1 SE) of the following motor activity measures: MI (movement index; % activity >0 epochs), AL (activity level; activity counts/15 s), ALadj (adjusted activity level; activity counts/15 s divided by the number of activity >0 epochs), the DAP and DIP (durations of uninterrupted activity and uninterrupted immobility periods, respectively; min), and the fragmentation index F_{60} (%) computed for all subjects (n=116) and by apnoea index (AI) severity group: AI<1 (n=51), 1≤AI<5 (n=45), AI≥5 (n=20). Note that the y axis has been broken and that different y scale ranges have been used.

(3·3) kg/m^2. The mean anthropometric measures of the M− group, as well as their mean sleep log measures, did not differ significantly (p>0·05, *t* tests and χ^2 analyses) from those of the 116 completely analysed subjects (group M+) (table 2). Statistical comparisons of the mean apnoea index (M− group: mean (SD) AI=3·2 (5·6); *t*=0·41, p>0·5) as well as the distribution of both groups across the three apnoea index severity groups (M− group: AI<1: 20; AI 1–<5: 15, and AI≥5: 7; χ^2=0·29, p>0·5), revealed no significant differences between the groups. The results obtained in the analysed group regarding the activity monitoring, subjective sleep, and respiratory characteristics and their mutual relation are therefore representative for the original sample of 168 subjects.

RESPIRATION MEASURES

The overall mean apnoea index and the mean apnoea index across the various groups are provided in table 2. TIB and TIB_c, which was used for the computation of the apnoea index, did not vary significantly across the three severity groups. Within groups, TIB and TIB_c did not differ significantly (paired *t* test, p>0·05). Fifty one (44%) subjects were non-apnoeic snorers (AI<1), but most (83%) of the subjects had an AI of <5. Within the AI≥5 group nine of the 20 subjects had an AI of ≥10. The apnoea index differed significantly between each of the three severity groups.

SLEEP MEASURES: SLEEP LOG

On average the subjects went to bed at 23:17 hours (SD 0:43), turned off the light at 23:29 hours (SD hours 0:44), had their definitive awakening at 06:40 hours (SD 0:53), and arose from bed at 06:54 hours (SD 0:55). Problems with sleep initiation (self estimated sleep latency >30 minutes) were reported by 18% of the subjects, whereas 32% of all subjects reported disturbed sleep maintenance (number of awakenings after sleep onset ≥3) (table 2). Nycturia (34%) was the most frequently reported cause of night time awakening; 25% of the subjects reported no cause for their night time awakenings. Seventeen subjects complained about poor sleep or headache after definitive awakening (14 subjects). None of the subjects reported disturbed sleep as a result of the recording procedure. The subjects with an apnoea index of ≥5 had a significantly larger intake of alcoholic drinks before going to bed and longer self estimated sleep latency. All other sleep log measures showed no significant difference across the groups.

SLEEP MEASURES: ACTIVITY MONITOR

In contrast with the other motor activity measures which are all expressed relatively to TIB, the DAP and DIP (min) are non-standardised measures. However, correlation analyses of TIB with DAP and DIP revealed no significant correlations so DAP and DIP were entered in the analysis as non-standardised activity monitoring measures.

The movement index (p=0·01) and the fragmentation indices F_{30}–F_{60} (p=0·01, p=0·005, and p=0·001, respectively) were significantly greater in the AI≥5 group than the two other groups (figure; F_{15}–F_{45} not shown). The DIP decreased as the apnoea index increased and differed significantly (p=0·001) between the three groups. No significant effect for the apnoea index groups emerged with regard to the activity level, adjusted activity level, DAP, and F_{15}.

Alcohol consumption before going to sleep and disturbed sleep initiation (table 2) varied significantly across the apnoea index groups. Hence, for all activity monitoring measures an ANOVA was performed with the sleep log measures alcohol consumption (no of glasses) and disturbed sleep initiation (1=yes; 2=no) as covariates. Disturbed sleep initiation covaried significantly across the apnoea index groups for the movement index, DIP, and all fragmentation indices F_{15}–F_{60} (all measures p<0·005) but not for the activity level, adjusted activity level, and DAP. Alcohol consumption covaried significantly (p=0·02) only with the DIP. After controlling for alcohol consumption and disturbed sleep initiation a significant main effect for apnoea index group emerged only for the DIP (p=0·01) and F_{60} (p=0·02). The DIP differed significantly between the apnoea index groups, whereas the F_{60} was significantly greater in the AI≥5 group than in the other two groups (figure).

PREDICTORS OF APNOEA INDEX

To identify the measures that are related to the apnoea index scores all sleep log measures (table 2; except for self reported sleep latency, number of awakenings after sleep onset, and TIB); sex (1=male; 2=female), sleep disturbances (1=present, 0=not present), and the activity monitoring measures were entered

as independent variables into a multiple linear regression analysis. As the distribution of the dependent variable apnoea index across subjects was skewed (Kolmogorov-Smirnov test; $p<0{\cdot}05$), the apnoea index scores were $\log_{10}$ transformed, after which a normal distribution was obtained.

Only the DIP showed a significant relation with the apnoea index scores ($R^2=0{\cdot}11$, $F=14{\cdot}4$, $p=0{\cdot}0002$). The multiple regression analysis yielded the following multiple regression equation: $\log_{10}\ AI=0{\cdot}6326-0{\cdot}0631\times(DIP)$. Although the proportion of variance explained by the DIP was small (11%), we retrospectively tested this model with apnoea index cutoff scores of 1 and 5 to distinguish non-apnoeic snorers (AI<1) and apnoeic snorers with an AI of $\geqslant 5$. This resulted in sensitivity and specificity values of 75% and 43% (AI<1) and 5% and 100% (AI$\geqslant$5), respectively.

Discussion

The results of this study show that combined subjective and actigraphic assessment of sleep in community based subjects reporting habitual snoring combined with excessive daytime sleepiness and/or nocturnal respiratory arrests fails to identify reliably those suffering from obstructive sleep apnoea. Only the mean duration of immobility periods (DIP) was a significant predictor of the apnoea index, accounting for only a small percentage of the variance (11%) of the apnoea index. Measures reflecting the self assessment of sleep showed no relation with the apnoea index. Unsatisfactory values for sensitivity and specificity were found for the DIP, particularly at the AI$\geqslant$5 level which is commonly regarded as being clinically relevant.[3]

Our results are not in line with those of two previous activity monitoring studies in which patients with polysomnographically confirmed severe apnoea (AI$\geqslant$10) were compared with healthy controls.[5,6] In these studies relatively high sensitivity and specificity values up to 89% and 95% respectively were reported. In addition, Sadeh *et al*[6] found a significant correlation between two activity monitoring measures and the number of polysomnographically recorded apnoeas, which eventually explained 30% of the variability in the apnoea index. Based on their results Sadeh *et al*[6] finally concluded that activity monitoring may serve as a valuable tool in the assessment of obstructive sleep apnoea in preliminary large scale screening studies as well as in clinical field studies. However, it should be noted that the use of a test as reflected by its sensitivity and specificity depends on the prevalence of the disease within the studied population. Consequently, measures of the validity of a test obtained in patients in a sleep clinic cannot be generalised for measurements in the general populations and vice versa. The discrepancy between the current data and the results of the aforementioned activity monitoring studies[5,6] is therefore most probably explained by different pretest probabilities of obstructive sleep apnoea. Our group of subjects comprised relatively few cases (nine) with severe obstructive sleep apnoea but, contrary to the other studies, comprised a relatively high number (44%) of non-apnoeic snorers (AI<1). Interestingly, even in the non-apnoeic snorers nocturnal motor activity is increased,[7] contributing to the observed limited value of activity monitoring measures as independent predictors of obstructive sleep apnoea.

It might be argued that a feasibility study should include healthy control subjects. On the other hand, by including a control group one may have been able to show that community based subjects with non-apnoeic snoring and symptomatic sleepiness had objective sleep disturbances equivalent to subjects with mild sleep apnoea, but greater than that observed in non-snoring healthy controls. This would emphasise the importance of non-apnoeic snoring as a cause of excessive daytime sleepiness ("the upper airway resistance syndrome").[17] This issue, however, has already been addressed by Polo.[7] On the other hand, the results of Kronholm *et al*[18] indicated that a feasibility study of activity monitoring and obstructive sleep apnoea in a random community sample would have been of little value since nocturnal breathing disturbances as assessed by a comparable motor activity based methodology – for example, the static charge sensitive bed method[7] – accounted for only 6·3% of the variance in nocturnal motor activity.

Nocturnal respiration was measured with an oronasal thermistor connected to a portable modified four channel Medilog recorder.[11,12] Thermistry yields a qualitative and therefore limited measurement of airflow so episodes of hypoventilation which may resemble apnoeas in terms of sleep disruption and hypoxaemia are difficult to recognise and may go undetected.[19] Nevertheless, Mössinger *et al* showed that thermistry accurately identified patients with an apnoea frequency of more than 35 events per night.[20] Moreover, visual inspection of numerous routinely scored polysomnograms in our sleep laboratory including oronasal thermistry invariably revealed close correlations between the determination of apnoeas on the polysomnogram and those scored on the basis of our ambulatory single channel thermistor.[11] Obviously, for our large scale epidemiological study on the prevalence of obstructive sleep apnoea syndrome the choice of ambulant oronasal thermistry was a compromise. The alternative would have been a complete polysomnographic recording in our sleep laboratory but this would have been too costly and probably would have reduced the participation rate of our subjects.

Surprisingly, in our study clinical features often reported to be related to the apnoea index such as age, body mass index, snoring, and alcohol consumption[1,9,21] did not emerge as predictors of the apnoea index. In addition, subjects with an apnoea index of $\geqslant 5$ had remarkably normal body mass indices (table 2). A similar finding was reported by Lavie[22] in a sample of male industrial workers. In fact, Lavie noted that none of his subjects with an apnoea index of $\geqslant 10$ was obese. The high male prevalence among our subjects is consistent with earlier reports.[1,3,8,9,21,22] With regard to the lack

of relation between the apnoea index and some of its associated clinical features, three possible explanations should be considered. Firstly, our subjects were already highly suspected of suffering from obstructive sleep apnoea syndrome whereas in most studies, such as those of Stradling[21] and Jennum[1] larger random samples were considered. Secondly, some of the clinical data were obtained from sleep logs which, compared with general sleep questionnaires (also used by Stradling[21] and Jennum[1]), provide only momentary findings as they are primarily designed for day-to-day assessment. Within subject differences between long term (sleep questionnaires) and short term (sleep log) characteristics of comparable items may distort the outcome of the multiple regression analysis. Thirdly, the statistical method used and the modelling of the variables of interest may influence the results. In this study this is well illustrated by the low correlations of subjective and objective measures of sleep with the apnoea index as obtained with the multiple regression analysis. Post hoc comparisons of apnoea index groups, on the other hand, revealed a significantly higher movement index and F_{15}–F_{60} and lower DIP values for those patients with an apnoea index of $\geqslant 5$ compared with the other two groups. However, these measures had an insufficient predictive power to serve as reliable discriminators between the apnoea index severity groups.

Post hoc comparisons also revealed an increased self esteemed sleep latency period, particularly in subjects with an apnoea index of $\geqslant 5$. Disturbed initiation of sleep accompanied by increased self estimated sleep latency was associated with higher values for the movement index and fragmentation indices F_{15}–F_{60}, and smaller values for the DIP across the apnoea index groups. Whether this disturbed sleep initiation was primarily due to obstructive sleep apnoea associated (movement) arousals remains unclear since we only evaluated mean nocturnal measures instead of time locked events. Nevertheless, during sleep low activity levels and, particularly, prolonged episodes of uninterrupted immobility, as reflected by high DIP values, are associated with increasing slow wave sleep, whereas high activity levels are related to intermittent wakefulness during sleep.[23] Polysomnographic studies of obstructive sleep apnoea syndrome invariably demonstrate increasing sleep fragmentation and decreasing sleep depth with increasing levels of obstructive sleep apnoea.[3 5 7 8 24] Hence, our findings most probably reflect the polysomnographic characteristics of obstructive sleep apnoea, particularly in subjects with an apnoea index of $\geqslant 5$. Furthermore, our results also support the commonly accepted assumption that a threshold apnoea index of $\geqslant 5$ should be considered as clinically significant.[3 25]

In conclusion, our results show that in community based subjects reporting habitual snoring combined with excessive daytime sleepiness and/or nocturnal respiratory arrests, the combination of self assessment and actigraphic assessment of sleep is not reliable as a simple screening test for obstructive sleep apnoea. Further studies should be performed to determine whether the value of activity monitoring in the obstructive sleep apnoea syndrome might be enhanced by combining it with other simple physiological monitoring techniques to satisfy the increasing need for low cost diagnostic tools for sleep related breathing disorders, especially in large populations.[26]

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