Original Article

Quality of Life in Obstructive Sleep Apnoea: A Role for Oxygen Desaturation Indices?

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Abstract

Introduction: This study aimed to determine the impact of obstructive sleep apnoea (OSA) on quality of life (QOL) and evaluate the utility of polysomnographic parameters in reflecting QOL. Materials and Methods: Eighty-eight patients who underwent polysomnography (PSG) between December 2010 and November 2012 consecutively were recruited and they completed the 36-Item Short-Form Health Survey (SF-36) and Epworth Sleepiness Scale (ESS) questionnaires. Based on the apnoea-hypopnoea index (AHI), patients were classified as primary snorers (AHI <5), suffering from mild (5 ≤15), moderate (15 ≤30) or severe OSA (≥30). Results: Seventy-nine male and 9 female patients with a mean age of 41 years were recruited. OSA patients scored significantly lower on 7 domains of SF-36 compared to the population. As AHI increased, only Physical Function (PF) and Physical Component Summary (PCS) but not ESS scores significantly worsened. PSG parameters correlated poorly with all QOL measures except PF, PCS and ESS. After adjusting for age, sex and body mass index (BMI), multiple linear regression revealed that only the oxygen desaturation parameters, but not sleep architecture indices or AHI were significant predictors of PF and ESS. For every fall in the lowest oxygen saturation (LSAT) by 1%, there was a decrease in PF by 0.59 points, and an increase in ESS by 0.13 points. Conclusion: OSA patients have a poor QOL compared to the population. The amount of physical impairment and daytime sleepiness they experience is better predicted by severity and duration of hypoxia and not AHI.

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Key words: Apnoea-hypopnoea index, Polysomnography, Sleep-disordered breathing

Introduction

Obstructive sleep apnoea (OSA) is a disease with significant morbidity affecting up to 10% of adults.[1] It is characterised by recurrent episodes of upper airway obstruction, leading to oxygen desaturations, arousals and sleep fragmentation.[2] This non-restorative sleep produces daytime symptoms of excessive sleepiness, poor concentration and memory, and mood changes, resulting in poorer productivity, job losses, disrupted social relationships and an increased risk of motor vehicle accidents.[3-5] The disease has also been associated with the development of hypertension, stroke and type 2 diabetes mellitus.[6-10] Collectively, patients experience a poor quality of life (QOL), which can be defined as the overall state of well-being that individuals experience as assessed by subjective and objective measures of functioning, health, and satisfaction with the important dimensions of their lives.[11]

The diagnosis of OSA requires both self-reported symptoms and polysomnography (PSG) evidence of an apnoea-hypopnoea index (AHI) of 5 or greater.[12] The absolute value of the AHI further indicates the severity of the disease.[13] However, PSG parameters are reported to be discordant with patients' reports of their symptoms.[14,15] Validated questionnaires have therefore been used to better reflect QOL. These include the 36-Item Short-Form Health Survey (SF-36) and the Epworth Sleepiness Scale

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(ESS).[16,17] The former, a generic questionnaire, permits the comparison of QOL among various diseases[18] whereas the latter, a disease-specific questionnaire, reflects the impact of a particular disease on functioning.[19]

To the best of our knowledge, studies evaluating QOL in OSA have mostly been performed in the Caucasian population,[15,20,21] with fewer studies being conducted in Asians,[22,23] in spite of the differences in disease epidemiology and manifestations between the 2 groups. Yamagishi et al reported that the prevalence of sleep-disordered breathing is lower among Japanese compared to white men.[24] Li et al suggested that for the same body mass index (BMI), Asians may have more severe disease compared to whites due to craniofacial skeletal characteristics.[25] The first aim of our study is therefore to determine the impact of OSA on QOL in Singaporeans using SF-36 and ESS.

In local clinical practice currently, patients with suspected OSA are worked up primarily via sleep studies with lesser attention being paid towards QOL. This is reasonable as the diagnosis of OSA requires PSG evidence of an elevated AHI. Ideally, we feel that QOL questionnaires should be routinely used to complement sleep studies in the initial investigation and follow-up of patients with OSA. Until this becomes common practice however, disease assessment will be principally limited to objective parameters. This then raises the question of whether PSG parameters can potentially be used as surrogate markers for QOL, despite them having been established to be imperfect.[14,15] The second aim of our study is therefore to evaluate the utility of PSG parameters in reflecting QOL in Singaporeans.

Materials and Methods

We conducted a retrospective study of patients who had PSG and completed SF-36 and ESS questionnaire in Singapore General Hospital Sleep Disorders Unit between December 2010 and November 2012.

Polysomnography

The PSG was conducted overnight in the hospital under monitoring. It recorded sleep architecture (4-lead electroencephalogram, bilateral electrooculogram, submental and bilateral leg electromyogram), breathing (oronasal airflow, thoracic and abdominal movement), pulse oximetry, electrocardiogram, infrared video, microphone and video. When split-night studies (combined diagnostic and continuous positive airway pressure titration) were performed (n = 3), only data from the diagnostic portion (mean ± SD, 132.3 ± 9.6 minutes) was analysed for the study.

PSG parameters were scored by trained sleep technicians and reviewed by a sleep physician. Sleep stages and respiratory events were defined according to the American Academy of Sleep Medicine 2007 guidelines.[26] The AHI was used to stratify patients as primary snorers (AHI <5), suffering from mild (5 ≤15), moderate (15 ≤30) or severe OSA (≥30).[13] Other PSG parameters studied included sleep architecture and the severity and duration of hypoxia. All the PSG parameters were analysed as continuous variables.

Questionnaires

Within 60 days prior to the PSG, patients completed a self-administered questionnaire that was distributed to them when they came for their booking visit for the PSG, consisting of the SF-36 and ESS.

The SF-36 is a validated 36-item generic questionnaire which evaluates QOL in 8 domains: physical functioning (PF), role limitations due to physical health problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitations due to emotional health problems (RE), and mental health (MH).[16] It has been validated in Singaporeans, fulfilling assumptions for Likert scale scoring, internal consistency-reliability, test-retest reliability, factor structure and construct validity.[18,27] The results of these 8 domains can be represented by 2 measures, Physical Component Summary (PCS) and Mental Component Summary (MCS), without substantial loss of information.[28] Scores on all scales ranged from 1 to 100, with a higher score indicating a better QOL.

The ESS is a validated questionnaire that is commonly used for assessing the impact of sleep disorders.[17] It asks patients how likely they are to fall asleep in 8 different scenarios. Higher scores indicate greater sleepiness.

Statistical Methods

The 8 SF-36 scales were scored as recommended by the original distributor.[29] PCS and MCS scores were however calculated using scale means and factor coefficients for the Singapore population.[30] All scales and summary scales of SF-36 were analysed as continuous variables, and means compared against normative data for Singaporeans with adjustment for age, sex and ethnicity using the method proposed by Thumboo et al, except for PCS and MCS scales, which were adjusted only for ethnicity as data was unavailable.[18] Adjustment was necessary because age and male sex are risk factors for OSA, so comparing SF-36 scores directly between OSA patients and the Singaporean population may not be meaningful due to differing demographics. By a similar method, the scores of OSA patients were compared against that for patients with other chronic diseases.[18,31,32]

The ESS was analysed as a continuous variable and also as an ordinal variable. The latter implies stratification of patients into 3 clinical categories based on their ESS, with

Table 1. Sample Description

	Primary Snorer (n = 21)	Mild OSA (n = 22)	Moderate OSA (n = 15)	Severe OSA (n = 30)	*P* Value*
Age	38.1 (12.1)	38.5 (12.9)	41.8 (12.6)	45.2 (11.5)	0.142
BMI	26.2 (4.9)	26.6 (4.3)	26.2 (2.8)	30.2 (4.4)	0.001
Neck circumference	39.3 (3.9)	39.8 (3.6)	41.6 (2.5)	42.8 (3.3)	0.002
Sex					0.080
Male	17	18	15	29	
Female	4	4	0	1	
Race					0.174
Chinese	20	17	11	25	
Malay	0	0	1	2	
Indian	1	2	3	3	
Others	0	3	0	0	
AHI	1.8 (1.6)	9.5 (2.5)	21.0 (4.5)	64.3 (24.2)	-

AHI: Apnoea-hypopnoea index; BMI: Body mass index; OSA: Obstructive sleep apnoea
**P* value indicates the statistical difference across all 4 study groups.

those who score 0-10 being normal, 11-15 having excessive daytime sleepiness and 16-24 having severely excessive daytime sleepiness.[17]

Fisher's exact test and Kruskal-Wallis test were used to compare differences in categorical and continuous variables respectively across the patient groups. One-sample t-test was used to compare the difference in sample mean for SF-36 scores against the population mean.[18]

Spearman correlation coefficients between PSG parameters and QOL measures were also calculated. All associations with |r| >0.200, significant or otherwise, were further analysed using multiple linear regression or ordinal regression depending on the nature of the variable. For linear regression, the residuals were visually inspected to confirm that the assumptions of linearity and homoscedasticity were met. For ordinal regression, the proportional odds assumption was satisfied. All regression models were adjusted for age, sex and BMI. These co-variables were chosen based on their known association with OSA and QOL.[33] Regression analysis in which comorbidity was included as a fourth variable was also performed. Comorbidities were selected based on their association with OSA and have likewise been used by other authors.[20,34] The most prevalent comorbidities in our study were diabetes, cardiovascular diseases and musculoskeletal symptoms. However, given that visual inspection of the results revealed no significant differences

Table 2. SF-36 Scores of OSA Patients Compared Against the Population, Adjusted for Age, Sex and Ethnicity

SF-36 Scale	OSA Patients (n = 62)*		Singaporean Population (n = 5503)		Difference in Means	*P* Value‡
	Mean	SD	Mean†	SD		
PF	72.1	25.2	81.4	24.8	-9.3	0.003
RP	72.7	37.6	83.8	34.4	-11.1	0.012
BP	74.6	23.2	80.7	22.0	-6.1	0.021
GH	54.5	20.7	69.2	17.2	-14.7	<0.001
VT	53.2	19.5	63.7	16.9	-10.5	<0.001
SF	79.6	21.7	82.0	20.8	-2.3	0.198
RE	78.5	36.3	82.1	35.2	-3.7	0.214
MH	72.3	17.2	72.7	17.0	-0.4	0.433
PCS	27.3	0.9	52.4	-	-25.1	<0.001
MCS	15.2	2.3	49.7	-	-34.5	<0.001

BP: Bodily pain; GH: General health; MCS: Mental component summary; MH: Mental health; OSA: Obstructive sleep apnoea; PCS: Physical component summary; PF: Physical function; RE: Role emotional; RP: Role physical; SF: Social functioning; VT: Vitality
*For this analysis, primary snorers were excluded so as to demonstrate the effect of OSA on QOL. Additionally, only OSA patients aged 21 to 65 years who were Chinese, Malay and Indians were considered. This is because SF-36 scores for the Singaporean population are only available for these subgroups.
†Adjusted for age, sex and ethnicity except for PCS and MCS scales, which were only adjusted for ethnicity as data was unavailable.
‡One-tailed.

Table 3. SF-36 Scores of OSA Patients Compared Against Patients With Other Chronic Diseases

SF-36 Scale	OSA (n = 62)*	Systemic Lupus Erythematosus (n = 69)†	Differentiated Thyroid Carcinoma (n = 144)‡	Anxiety Disorders (n unreported)§
PF	-9.2	-13.9	-5.8	-8.3
RP	-11.0	-21.0	-12.8	-35.8
BP	-6.0	-14.8	-5.6	-22.7
GH	-17.7	-20.0	-7.3	-18.4
VT	-10.5	-11.0	-6.4	-19.2
SF	-2.3	-12.6	3.6	-29.3
RE	-3.6	-14.4	-10.0	-47.1
MH	-0.4	-6.3	-4.5	-23.4
PCS	-25.0	-	-	-
MCS	-34.4	-	-	-

BP: Bodily pain; GH: General health; MCS: Mental component summary; MH: Mental health; OSA: Obstructive sleep apnoea; PCS: Physical component summary; PF: Physical function; RE: Role emotional; RP: Role physical; SF: Social functioning; VT: Vitality

*For this analysis, primary snorers were excluded so as to demonstrate the effect of OSA on QOL. Additionally, only OSA patients aged 21-65 years who were Chinese, Malay and Indians were considered. This is because SF-36 scores for the Singaporean population are only available for these subgroups.

†Thumboo J, Chan SP, Machin D, Soh CH, Feng PH, Boey ML, et al. Measuring health-related quality of life in Singapore: normal values for the English and Chinese SF-36 Health Survey. Ann Acad Med Singapore 2002;31:366-74.

‡Tan LG, Nan L, Thumboo J, Sundram F, Tan LK. Health-related quality of life in thyroid cancer survivors. Laryngoscope 2007;117:507-10.

§Luo N, Fones CS, Thumboo J, Li SC. Factors influencing health-related quality of life of Asians with anxiety disorders in Singapore. Qual Life Res 2004;13:557-65.

between whether adjustment was performed for 3 or 4 variables, and the rule of thumb that 1 coefficient in the model needs a sample size of 20 to reduce fitting bias, only results adjusted for age, sex and BMI are presented.[35] Data was analysed using SPSS version 20 software. A *P* value less than 0.05 was considered significant.

Results

Eighty-eight patients were recruited, most of whom were middle-aged Chinese males (Table 1). OSA patients scored lower on all domains of SF-36 compared to the average Singaporean (Table 2). The score differences were significant in all domains except for SF, RE and MH.

The QOL of OSA patients was comparable to that of patients with other chronic diseases, such as systemic lupus erythematosus (SLE), differentiated thyroid carcinoma (DTC) and anxiety disorders (Table 3). OSA patients perceived their VT and GH domains as being impaired to the same extent as SLE patients did. As OSA severity increased, PF ($P = 0.011$) and PCS ($P = 0.036$), but not ESS scores, worsened (Fig. 1).

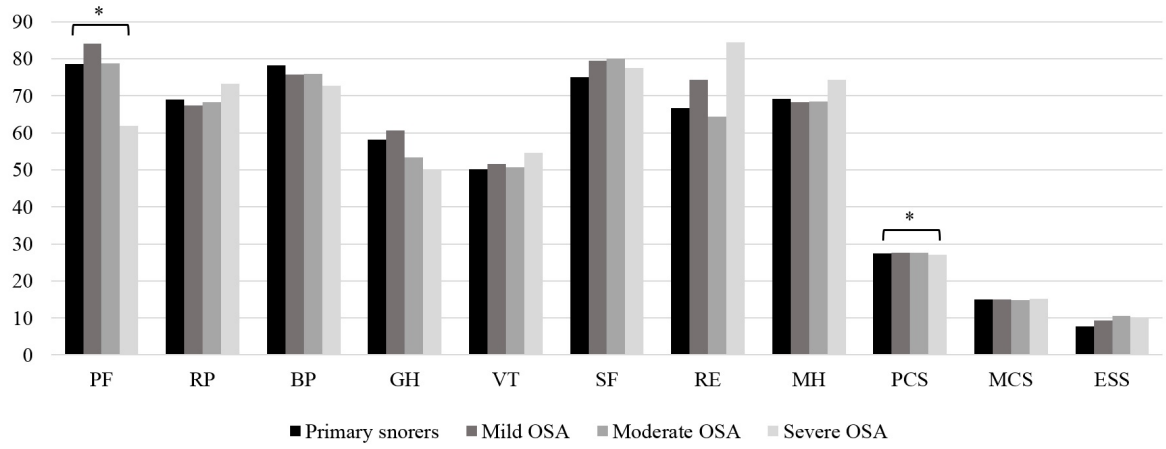

Fig. 1. SF-36 scores of primary snorers and OSA patients.
OSA: Obstructive sleep apnoea

Table 4. Correlation between PSG Parameters and QOL Measures

	Sleep Architecture		Respiratory Events		Oxygen Desaturation			
	N3	REM	ArI	AHI	LSAT	O_2 <95*	O_2 <90*	O_2 <85*
SF-36								
PF	0.316†	0.218†	-0.282†	-0.352†	0.397†	-0.441†	-0.399†	-0.439†
RP	-0.022	0.113	-0.021	0.065	0.059	-0.110	-0.034	-0.077
BP	0.008	0.035	0.014	-0.078	-0.002	-0.181	-0.067	-0.046
GH	0.218†	0.132	-0.119	-0.203	0.148	-0.248†	-0.202	-0.164
VT	0.045	-0.023	0.045	0.051	-0.029	0.019	0.053	0.045
SF	0.000	0.101	0.085	0.038	-0.063	-0.057	0.028	-0.001
RE	-0.023	0.047	0.108	0.156	-0.135	0.068	0.159	0.081
MH	-0.025	0.066	0.061	0.078	-0.063	0.056	0.081	0.067
PCS	0.148	0.103	-0.184	-0.231†	0.307†	-0.357†	-0.300†	-0.366†
MCS	0.081	0.051	0.017	-0.004	-0.011	-0.036	0.001	0.016
ESS	-0.051	-0.001	0.078	0.150	-0.255†	0.063	0.233†	0.233†

AHI: Apnoea-hypopnoea index; ArI: Arousal index; BP: Bodily pain; ESS: Epworth sleepiness scale; GH: General health; LSAT: Lowest oxygen saturation; MCS: Mental component summary; MH: Mental health; N3/REM: Percentage of total sleep time (% TST) spent in N3/REM sleep respectively; O_2: Oxygen; PCS: Physical component summary; PF: Physical function; RE: Role emotional; RP: Role physical; SF: Social functioning; VT: Vitality

*O_2 <95/90/85: percentage of total sleep time (% TST) for which SpO_2 <95/80/85% respectively.

†P <0.05.

PSG parameters generally correlated poorly with QOL measures (Table 4). However, PF correlated significantly with all the PSG parameters studied. PCS correlated significantly with AHI and the severity and duration of hypoxia. ESS correlated significantly with the severity and duration of hypoxia but not with AHI.

Multiple linear regression revealed that only the severity and duration of hypoxia remained as significant predictors of QOL measures (Table 5), especially PF and to a lesser extent ESS. For every fall in lowest oxygen saturation (LSAT) by 1%, there was a decrease in PF by 0.59 points, and an increase in ESS by 0.13 points. Ordinal logistic regression showed that the severity of hypoxia was a marginally significant predictor of one's ESS score (P = 0.053). For every increase in LSAT by 1%, the odds of moving up one clinical category decreases by 5%. In other words, every percentage increment in LSAT makes one 5% less likely to have excessive daytime sleepiness (ESS score 11-15) compared to being normal (ESS 0-10). One is also 5% less likely to have severely excessive daytime sleepiness (ESS 16-24) compared to having excessive daytime sleepiness (ESS 11-15). The duration of hypoxia below 95% (P = 0.088) and 90% (P = 0.082) were marginally significant predictors of the ESS score. For every increase in the duration of total sleep time for which SpO_2 <95% by 1 minute, the odds of moving up one clinical category increases by 2%.

AHI was not a good predictor of any QOL measure. Although AHI initially correlated significantly with PF and PCS (Table 4), these associations failed to achieve statistical significance after performing linear regression (Table 5).

Table 5. Regression Results

	AHI	LSAT	O_2 <95*	O_2 <90*	O_2 <85*
Linear Regression					
PF	B = -0.124	B = 0.588†	B = -0.158	B = -0.496‡	B = -0.669†
PCS	B = -0.002	B = 0.015	B = -0.006	B = -0.010	B = -0.016
ESS	B = 0.012	B = -0.129†	B = 0.034	B = 0.074	B = 0.080
Ordinal Regression					
ESS	OR = 1.009	OR = 0.954§	OR = 1.02	OR = 1.03	OR = 1.03

AHI: Apnoea-hypopnoea index; ESS: Epworth sleepiness scale; LSAT: Lowest oxygen saturation; O_2: Oxygen; PCS: Physical Component Summary; PF: Physical Function

*O_2 <95/90/85: percentage of total sleep time (% TST) for which SpO_2 <95/80/85% respectively.

†P <0.05.

‡P ≤0.01.

§P = 0.053.

The previously observed lack of correlation between AHI and ESS (Table 4) was again noted on regression analysis (Table 5), when AHI failed to predict ESS, regardless whether a linear or ordinal model was used.

Finally, BMI (P = 0.001) and neck circumference (P = 0.002) were noted to be significantly different across OSA severity groups (Table 1). Patients with severe OSA had significantly different BMIs from primary snorers (P = 0.007), mild OSA (P = 0.032) and moderate OSA (P = 0.023) groups. They also had significantly different neck circumferences from primary snorers (P = 0.004) or mild OSA (P = 0.014), but not moderate OSA (P = 0.683) groups. There were no significant differences in age, sex or ethnicity across the groups.

Discussion

OSA Patients Have Lower QOL Compared to the Population – Impairment Appears More Physical than Mental

It has been well established that sleep-disordered breathing negatively impacts QOL. Gliklich et al found that both primary snorers and OSA patients scored significantly worse than the population for all SF-36 domains, with the largest decrease being in RP and VT.[20] Bennett et al reported that their study group comprising both primary snorers and OSA patients had significantly lower PF and VT scores than the population.[21] Weaver et al noted that OSA patients have a significant deficit in MH score compared to the population and are at a higher risk of depression, although their group did not use the entire SF-36.[15] Banhiran et al found that primary snorers and OSA patients only had significantly lower scores than the Thai population in the RP and GH domains.[22] Wang et al reported that OSA patients scored significantly lower in all SF-36 domains compared to the Taiwanese population.[23] In our study, we found that OSA patients scored significantly lower than the average Singaporean in all domains of SF-36 except the SF, RE and MH domains (Table 2). OSA patients were therefore not at a higher risk of having mood disturbances. Given that the PF and RP domains reflect physical health and activity limitations, and MH and RE reflect mental health and activity limitations, it appears that OSA impairs patients more in the physical, rather than mental health aspect, at least locally. It is not entirely clear why only some of our results overlap with those of other studies, but this may be attributable to differences in sample characteristics, in particular age, sex and ethnicity. In our study, the mean age was 41 years, males comprised 89.8% of the sample and our patients were mostly Chinese (83.0%). These demographics are more similar to those reported by Wang et al, whose patients had a mean age of 44.8 years, were mostly male (86.2%) and all of Chinese ethnicity.[23] In contrast, the Caucasian studies tended to have a higher average age[15,21] and a lower proportion of males.[15,20]

QOL Decline is Similar to Patients with Other Diseases

VT reflects energy and fatigue levels and has been suggested as the domain most relevant to sleep disorders.[4] It asks participants if they "have a lot of energy, feel worn out or tired".[29] Bennett et al reported that out of the 8 SF-36 scales, it exhibited the greatest improvement after nasal continuous positive airway pressure (CPAP) treatment.[21] We found that OSA patients had significantly lower VT scores compared to the general population. The magnitude of this decrease was comparable to that observed in SLE (Table 3).

As AHI Increases, Physical Impairment and Daytime Sleepiness Do Not Increase

Yang et al noted that OSA patients fared poorer on the PF, RP and VT scales compared to primary snorers.[34] They did not analyse the PCS and MCS domains. Gliklich et al stated that a higher AHI was significantly correlated with poorer PF scores.[20] We initially found that as OSA severity increased, patients had worse PF and PCS but not ESS scores (Fig. 1, Table 4). This inability of ESS to correlate well with AHI in clinical studies but not population-based studies has been previously described.[3,15,36-40] Pack et al suggested that there may be a component of inter-individual variation, with different individuals requiring different amounts of sleep to feel refreshed.[41] Weaver et al posited that this may be due to the presence of selection bias in clinical cohorts and the fact that there are many other factors contributing to excessive daytime sleepiness for which complete adjustment may be difficult.[15] After performing regression analysis, we found that AHI was not a significant predictor of PF, PCS or ESS (Table 5).

Hypoxia Severity and Duration Better Predict Physical Impairment and Daytime Sleepiness

The inability of AHI to reflect QOL effectively in clinical populations has led to the search for other PSG parameters as an indicator of a patient's health. Guilleminault et al reported that patients with Multiple Sleep Latency Test <5 minutes have more sleep fragmentation (higher arousal index) and less rapid eye movement (REM) and slow wave sleep.[42] Hypoxemia is also known to be associated with impaired cognitive function.[43-45] Our study revealed that the severity and duration of hypoxia exhibit better correlation with and prediction of PF and ESS than AHI (Tables 4 and 5). Similarly, Gliklich et al reported that the number of oxygen desaturations to below 85% correlates more strongly with PF than AHI does.[20] Weaver et al noted that self-rated health

was significantly correlated with the percentage of sleep time for which oxyhaemoglobin saturation was less than 90% (r = 0.24, *P* = 0.02) but not AHI.[15] Collectively, these findings imply that oxygen desaturation indices may be more appropriate than AHI in the use of objective parameters as surrogate markers of QOL. Weaver et al suggested that OSA may produce 2 relatively different types of effects: one on daily functioning, and one on long-term health risk.[15] AHI may therefore be a better indicator of morbidity in the long run[6-9] and LSAT a better reflection of day-to-day QOL.

PF Complements ESS in Evaluation of QOL

Our regression analysis (Table 5) revealed that hypoxia severity and duration are useful predictors of both ESS and PF. This suggests that apart from ESS, PF may also be useful in evaluating QOL. Firstly, patients with OSA are known to have elevated basal and sleep energy expenditure, possibly secondary to increased sympathetic output and work of breathing.[46-48] Consequently, this may result in them having less energy available to perform activities such as "carrying groceries, climbing stairs" which are assessed by the PF domain of SF-36. Secondly, among studies that have used SF-36 to assess QOL, differences in PF scores between primary snorers and OSA patients have been consistently noted.[20-23,34] Thirdly, a fraction of OSA patients who undergo CPAP also exhibit an improvement in their PF scores following therapy. Tsara et al found that after using CPAP, the SF-36 scores of 120 patients with severe OSA improved significantly in all domains except pain, and their scores were now similar to that of the Greek population.[49] However, in 15 patients with mild to moderate OSA, SF-36 scores only increased in the PF domain, and this was not statistically significant. They attributed this to the smaller sample size in this subgroup. Hida et al noted that after CPAP therapy, obese OSA patients exhibited an improvement in scores in all domains of SF-36 whereas in non-obese OSA patients, all domains except for PF and RE significantly improved.[50] Banhiran et al reported that there was improvement in all domains of SF-36 after CPAP treatment.[22]

Given that OSA is a cardiovascular risk factor, it could be argued that the decline in PF with more severe disease may be attributable to comorbidities. However, adjusting for comorbidity in our regression analysis did not change our results (data not shown).

Obesity and Neck Circumference are Strongly Associated with OSA

We also found that patients with more severe disease were more likely to have higher BMI and wider neck circumference (Table 1). These are known risk factors for OSA.[33]

Limitation 1 – Time Interval between Questionnaire Distribution and PSG

One limitation of this study is the interval of 60 days between questionnaire distribution and PSG. This is because the severity of OSA might worsen with time. Patients with severely deranged AHI might have therefore under-reported their deterioration in QOL initially. However, we undertook this protocol because based on experience, patients who turn up for PSG are often anxious given the new environment and not particularly keen to fill up lengthy questionnaires. A compromise was thus made to ensure data integrity.

Limitation 2 – Questionnaire Validity

Despite ESS being the most commonly used questionnaire in sleep research, Kendzerska et al reported that it still suffers from problems of redundancy and vague item descriptions.[51] Abma et al found that there was conflicting evidence for the internal consistency of the ESS and suggested that OSA-related QOL questionnaires such as the Maugeri Obstructive Sleep Apnea Syndrome (MOSAS), the Obstructive Sleep Apnea Patient-Oriented Severity Index (OSA-POSI), the Quebec Sleep Questionnaire (QSQ) and the Sleep Apnea Quality of Life Index (SAQLI) should instead be adopted because the target population (patients with OSA) was involved in the development of these 4 questionnaires.[52]

Despite the SF-36 fulfilling assumptions for Likert scale scoring, internal consistency-reliability, test-retest reliability, factor structure and construct validity in the Singaporean population,[18,27] Abma et al noted that the mental health component, in particular the vitality domain (VT) may be more useful for measuring outcomes in OSA patients.[52] The authors also favoured the use of disease-specific questionnaires over generic ones in clinical practice where available.[52] Moving forward, it may therefore be more prudent to restrict the use of SF-36 to academic comparisons in QOL between diseases. ESS and 1 of the 4 aforementioned OSA-related QOL questionnaires should instead be utilised routinely in the clinical setting to evaluate the impact of OSA on daily functioning.

Conclusion

OSA patients have a poor QOL compared to the population. The amount of physical impairment and daytime sleepiness they experience is better predicted by severity and duration of hypoxia and not AHI. Ultimately, assessment of QOL is best achieved through OSA-related QOL questionnaires and not PSG findings. However, until the use of these questionnaires becomes routine in local clinical practice, disease assessment will be chiefly limited to objective parameters, in which case there should be a move towards considering oxygen desaturation indices and not just AHI in the appraisal of sleep studies.

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