

COMPARISON OF MANUAL SCORING WITH AUTO GENERATED POLYSOMNOGRAPHIC SCORING IN OBSTRUCTIVE SLEEP APNOEA (OSA) PATIENTSVavilala Satish Kumar Rao¹, Methuku Narender², Auzumeedi Sai Kumar³, Subhakar Kandi⁴**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: Obstructive Sleep Apnea (OSA) is the most common unrecognized, Undiagnosed and undertreated presentation which represents a major Public health problem. It affects 2-6% of middle-aged men and 1-2% of middle-aged women. OSA is a condition characterized by the episodic cessation of breathing during sleep despite persistent ventilatory efforts, associated with sleep fragmentation, arousals, and reductions in oxygen saturation. OSA is a heterogenous disease process. Therefore polysomnography which is considered as the gold standard in diagnosis is useful in all individuals with OSA for initiation of therapy. **MATERIAL & METHODS:** Patients attended outpatient department of Pulmonary Medicine at Govt. General Chest Hospital, Osmania Medical College, Hyderabad from August 2013 to August 2014 with clinical features Suggestive of OSA. Patients having Snoring, sleep disturbance with EDS or Fatigue, un refreshing sleep and choking spells at night and age above 40yrs. were included in the study. Patients having Claustrophobia, Cor-pulmonale, uncontrolled seizures, medically unstable patients and who didn't complete sleep for 6 hours of PSG were excluded from the study. PSG is done by 54 multi-channel ALICE-5 system with whole night video recording. The entire testing process was done under the supervision of trained technicians following the specifications and the criterion established by the AASM guidelines. **RESULTS:** Total of 100 patients was studied. Sleep Efficiency has shown mean values of 72.96, 59.85 with manual and auto scoring systems. AHI has shown mean values of 18.92, 72.42 with manual and auto scoring systems. RDI has shown mean values of 19.24, 72.74 with manual and auto scoring systems. Arousal Index has shown mean values of 4.13, 8.29 with manual and auto scoring systems respectively. PLMI has shown mean values of 1.46, 6.14 with manual and auto scoring systems. **CONCLUSIONS:** Polysomnography is the gold standard for diagnosis of Obstructive Sleep Apnoea and based on the report patients is given appropriate treatment. Manual scoring is to be considered superior to Auto generated report in the diagnosis of Obstructive Sleep Apnoea and thereby avoiding over diagnosis of Obstructive Sleep Apnoea.

KEYWORDS: Obstructive sleep apnea (OSA), Polysomnography (PSG), Manual scoring system, Auto scoring system.

INTRODUCTION: Obstructive Sleep Apnea (OSA) is the most common unrecognized, Undiagnosed and undertreated presentation which represents a major Public health problem.¹ It affects 2-6% of middle-aged men and 1-2% of middle-aged women.² OSA is a condition characterized by the episodic cessation of breathing during sleep despite persistent ventilatory efforts, associated with sleep fragmentation, arousals, and reductions in oxygen saturation. The impaired sleep quality leads to excessive daytime sleepiness, deterioration of memory and judgment, altered personality, and reduced concentration.³ It is one of the leading cause of divorce in the west. Sleep apnea significantly increases the risk of ischemic

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heart disease.⁴ and cerebrovascular accidents and is associated with increased incidence of automobile accidents.⁵ indicating excessive mortality in the absence of treatment. The pathogenesis of OSA involves both an anatomic and a neurologic component. Though individuals with OSA have altered upper airway physiology during sleep, they tend to have narrower upper airways and there is considerable evidence that anatomic factors contribute to upper airway narrowing.⁶ The abnormal craniofacial characteristics include retrognathia, micrognathia, inferior positioning of hyoid bone, long and large soft palate, large tongue etc.^{7,8} Patients with OSA have increased adipose tissue deposition lateral to pharynx.⁹ OSA is a heterogenous disease process. Therefore polysomnography which is considered as the gold standard in diagnosis.¹⁰ is useful in all individuals with OSA for initiation of therapy.

AIM OF STUDY: To compare manual scoring with auto generated Polysomnographic scoring in Patients with clinical diagnosis of Obstructive sleep apnoea (OSA) and to Study over estimation/under estimation of the events. There is a paucity of literature regarding comparison of manual sleep scoring with auto generated Polysomnographic scoring in patients in general and in particular in India. As studies already done were giving variable results and conclusions we have conducted this study.

STUDY DESIGN: Double Blinded Prospective study. Study population included all patients suffering from the symptoms Suggestive of OSA like Excessive Daytime Sleepiness (EDS), Snoring and Choking spells at night.

MATERIAL & METHODS: Patients who attended outpatient department of Pulmonary Medicine at Govt. General Chest Hospital, Osmania Medical College, Hyderabad from August 2013 to August 2014 with clinical features Suggestive of OSA were clinically examined and were subjected to investigations like Chest X-ray PA view, Thyroid profile, 2D ECHO, PFT, ABG and ENT Evaluation. Patients having Snoring, sleep disturbance with EDS or Fatigue, unrefreshing sleep and choking spells at night and age above 40yrs were included in the study. Patients having Claustrophobia, Cor-pulmonale, uncontrolled seizures, medically unstable patients and who didn't complete sleep for 6hours of PSG were excluded from the study. All the patients (n=100) filled the Sleep symptoms questionnaire and Epworth Sleepiness Scale (ESS). These patients were advised to undergo whole night Polysomnography (PSG) after informed consent. This study was considered as minimum risk in human research and was approved by the ethics committee of the Institution. These 100 patients underwent anthropometry in which weight and height were measured to the nearest 500gms and 1 cm respectively and the BMI was calculated based on the formula

$BMI = \text{weight (kgs)} / \text{height}^2 \text{ (mts}^2\text{)}$

Neck circumference (cms) was measured at the level of crico-thyroid membrane. Patients have reported to the sleep laboratory of the department of Pulmonary Medicine at 8 P.M on the day of testing. All these patients underwent whole night Polysomnography. PSG is done by 54 multi-channel ALICE-5 system with whole night video recording. The entire testing process was done under the supervision of trained technicians following the specifications and the criterion established by the AASM guidelines.

In PSG the following montages were used:

1. EEG-7sites–for staging of sleep (Gold coated cup electrodes are used).

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2. EOG – 1cm upwards and outwards from the right outer canthus 1cm downwards and outwards from the left outer canthus.
3. CEMG – 2 sites – one above and one below to the chin for muscle tone Measurement and reorganization of Bruxism.
4. LEMG – 4 sites – two on each side – over shin and lower tibia – for the Measurement of muscle tone and identification of PLMI.
5. Abdominal and thoracic belts – For identification of efforts.
6. Nasal Cannula – For the measurement of air flow.
7. Positional sensor – For posture of patient.
8. Pulse oximeter – For SpO₂ Measurement.
9. EKG – For cardiac monitoring.
10. Video monitoring.

Patient was requested to sleep around 10 P.M. The recording of sleep study was started after ensuring the impedance of the electrodes was set to zero. Report is generated using computerized (Auto generated) method with Alice5 software for each patient. Same raw data of patients were given to three qualified RPSG Technologists for manual scoring. (Double blinded). Sleep stages are scored according to Rechtschaffen & Kales system rules and AASM rules (2007). Respiratory events are scored according to revised AASM task force recommendations. Five variables including Sleep Efficiency, Apnea Hypopnea Index (AHI), Respiratory Disturbance Index (RDI), Arousal Index (AI), Periodic limb movement index (PLMI) are compared between manual and Auto generated scoring reports and subjected for statistical analysis.

STATISTICAL ANALYSIS: Three double blinded RPSG Technologists were given same raw data and the mean of the five variables were taken as manual report. Student's paired t test was performed for the variables for both the groups and Blant Altman plots are used.

A "p" < 0.05 was taken as significant and less than 0.001 as highly significant.

RESULTS: Total of 100 patients was studied. Out 100 patients studied 76 were males and 24 were females. Out of 100 patients 28 were less than 40 years, 29 were aged between 40-50 years, 21 were aged between 50-60years, 12 were aged between 60-70 years, 6were aged between 70-80 years and 4 were above 80years. Sleep Efficiency has shown mean values of 72.96, 59.85 with manual and auto scoring systems respectively with p value of 0.0001. AHI has shown mean values of 18.92, 72.42 with manual and auto scoring systems respectively with p value of 0.0001. RDI has shown mean values of 19.24, 72.74 with manual and auto scoring systems respectively with p value of 0.0001. Arousal Index has shown mean values of 4.13, 8.29 with manual and auto scoring systems respectively with p value of 0.0002. PLMI has shown mean values of 1.46, 6.14 with manual and auto scoring systems respectively with p value of 0.0001.results were shown in Table 1.

DISCUSSION: OSA is a complex disease. In our study all the variables showed a considerable difference between the manual and auto generated groups which is of statistical significance (p<0.05). In our study in Auto generated group AHI is over reported which forms the basis for treatment and hence patients are given over treatment.

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In auto-generated scoring reports, Sleep AHI, RDI and arousal index, Periodic Limb Movement Index (PLMI) are over reported whereas Sleep Efficiency is under reported in the auto generated system.¹¹ Sleep stage W & REM sleep are difficult to differentiate because it heavily depends on quality of EMG signal which in turn depends upon proper electrode fixation. Sleep stages N1 & REM are difficult to differentiate due to similar EEG, EOG but for the subtle difference in EMG. N2 stage is often missed if person has only few sleep spindles or if spindle frequency is out of normal value. Auto analysis of respiration is highly dependent on the type of signal which in turn depends on type of transducers & signals. Results depend on quality of signal records. Artifacts produce wrong results. Electrode pop displays as a sharp positive or negative deflection, although it often looks like a high amplitude slow wave. Popping is often seen when the patient is moving, causing the electrode to be pulled away from the skin. Popping can occur if the conductive substance is drying, if the electrode is dirty, or when there is a minor break in the wire so that continuity is lost intermittently. The main oximetry artifact that occurs during a PSG is attributable to movement that dislodges the probe.

Small slip of the probe can easily go undetected however it can cause SpO₂ values to be read significantly lower than the true signal. Falsely low readings can also occur when the patient places the probe under his body, or when dark nail polish interferes with the sensor. Sucking and swallowing can elicit a glossokinetic artifact that resembles a slow wave because the tongue, like the eyeball, has a positive component and a negative component. As the negative tip of the tongue moves, the electrical field surrounding the head electrodes changes and is picked up in EEG electrode sites. Sweat sway is a slow-frequency artifact that can affect all AC channels (EEG, EOG, ECG, and EMG), especially those that allow slower frequencies. A sweat sway wave can look like a large delta wave, with a frequency less than 2 Hz. This artifact disappears in REM sleep, when there is no thermoregulatory response. Sweat sway may cause slow wave sleep (SWS, or N3) to be underestimated because some of the delta wave amplitude is attenuated. Computer generated report has an inherent disadvantage of being over sensitive to electrical signals as it uses (Fast Fourier Transform) FFT algorithms. This may lead to misjudging of sleep stages, arousals, respiratory events and artifacts are seen consistently.

The variations obtained in the reports may be out of the acceptable range. Delta waves are amplitude dependent but power given by FFT does not give amplitude hence underestimate stage N3. Manual scoring is done by seeing epoch by epoch and video recording of patients simultaneously and recognitions of artifacts become high resulting in accurate staging of sleep and its events. This enhances the inter scorer concordance. Though manual scoring takes almost three hours to generate a report, which is much longer than auto scoring, it gives a reliable and correct scoring report and hence the diagnosis and avoiding over diagnosis and over treatment of Obstructive Sleep Apnea. Summary of various studies were shown in table 2.

Limitations of the study: Study population includes only people with clinical diagnosis of OSA, but significance is not studied and compared with normal population.

CONCLUSIONS: Polysomnography is the gold standard for diagnosis of Obstructive Sleep Apnoea and based on the report patients is given appropriate treatment. Manual scoring is to be considered superior to Autogenerated report in the diagnosis of Obstructive Sleep Apnoea and thereby avoiding over diagnosis of Obstructive Sleep Apnoea.^{12,13,14,15,16,17,18} If Auto generated report is taken as standard the following events like Electrode popping which occurs due to pull of electrode, Oximetry artifacts which occur when pulse oximeter probe is slipped or dislodged causing sustained

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desaturation, Sucking and swallowing which cause glossokinetic artifact, Sweat sway which causes under reporting of sleep stage N3 sleep, give rise to inaccurate results. These results in turn lead to over treatment of Obstructive Sleep Apnoea-Hypopnoea syndrome (OSAHS) which will be a financial and psychological burden to the patients. Patient may be misdiagnosed and labeled as a patient of Obstructive Sleep Apnoea and there by delaying the actual diagnosis. All computer generated reports like ECG, EEG, and PFT etc. are analyzed by the Physician.

VARIABLES	MANUAL SCORING mean value	AUTO SCORING mean value	P VALUE
Sleep Efficiency	72.96	59.85	0.0001
AHI	18.92	72.42	0.0001
RDI	19.24	72.74	0.0001
Arousal Index	4.13	8.29	0.0002
PLMI	1.46	6.14	0.0001

Table 1: Mean Values of Variables in Manual and Auto Scoring Systems

Reference	No. of Patients	Observation
Stege G et al. ¹¹	50	Manual is accurate scoring method
Nigro et al. ¹²	96	Manual is accurate scoring method
OZ turko et al. ¹³	30	Manual is accurate scoring method
J.caffarel et al. ¹⁴	114	Manual is accurate scoring method
B. Barreiro et al. ¹⁵	28	Manual is accurate scoring method
Carrasco O et al. ¹⁶	36	Manual is accurate scoring method
N Schaltenbrand et al. ¹⁷	60	Manual is accurate scoring method
St.Kubicki et al. ¹⁸	34	Manual is accurate scoring method
A Malhotra et al. ¹⁹	70	Auto with manual editing
Stephen D et al. ²⁰	31	Auto with manual editing
Present study	100	Manual is accurate scoring method

Table 2: Comparison of Various Studies Regarding Accuracy of the Manual Scoring

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