International Journal of Otorhinolaryngology and Head and Neck Surgery
Athiyaman K et al. Int J Otorhinolaryngol Head Neck Surg. 2018 May;4(3):630-635
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20181470

A comparative study of adult and pediatric polysomnography

Athiyaman K.*, Gowri Shankar M., Suji G., Prabhu D.

Department of ENT, Govt. Stanley Medical College Hospital, Chennai, Tamil Nadu, India

Received: 10 March 2018
Revised: 06 April 2018
Accepted: 07 April 2018

***Correspondence:**
Dr. Athiyaman K.,
E-mail: drnatsmo@gmail.com

ABSTRACT

Background: Obstructive sleep apnea (OSA) also referred to as obstructive sleep apnea-hypopnea-is a sleep disorder that involves cessation or significant decrease in airflow in the presence of breathing effort. It is the most common type of sleep-disordered breathing and is characterized by recurrent episodes of upper airway collapse during sleep. Pediatric obstructive sleep apnea syndrome (OSAS), like adult OSAS, is characterized by intermittent upper airway collapse during sleep and is associated with anatomic and neuromuscular factors. However, the clinical manifestations, diagnostic criteria, and polysomnographic findings of OSAS in children are likely to be different from those in adults. Adult OSA and pediatric OSA though the pathogenesis is more or less same, the evaluation gives a significant difference in outcome.
Methods: 60 patients who meet the inclusion criteria were subjected to clinical evaluation and level 1 sleep study was done.
Results: Mean age group in adults was 39.86±8.42 yrs the most common cause in adults being obesity and the mean age group in pediatric was 7.63±1.71 yrs with adenotonsillar hypertrophy being the commonest cause. The gender distribution among affected is predominantly being male both in adults and in the pediatric population. The lowest mean desaturation was 81% in adults as compared to 73.23% in children.
Conclusions: Significant PSG findings were noted in gender distribution and in Mean desaturation, AHI in both adults and pediatric population.

Keywords: Obstructive sleep apnoea, Polysomnography, Apnoea hypopnoea index, Mean oxygen saturation

INTRODUCTION

Obstructive sleep apnoea (OSA) is characterised by repetitive episodes of shallow or paused breathing for at least 10 seconds during sleep due to complete/partial upper airway obstruction. It is usually associated with reduced blood oxygen saturation. It is commonly associated with snoring and common in both adults and pediatric age groups.[1,2] Complications of OSA in adults are cardiovascular disease-myocardial infarction, CCF (cor pulmonale), aortic aneurysm, hypertension, stroke, diabetes mellitus, depression and weight gain, whereas in pediatric population behavioral disturbances, learning defects, CVS morbidity (CCF, HT, COR PULMONALE), compromised somatic growth, depression and enuresis are reported. Clinical presentation of OSA in adult population includes snoring, headache and day time sleepiness. Difference between adult and pediatric obstructive sleep apnea syndrome given in Table 1. Investigations done in adults are polysomnography (PSG), diagnostic nasal endoscopy (DNE), drug induced sleep endoscopy (DISE) and videolaryngoscopy (VLS). Treatment of OSA in adult includes, for mild type, continuous positive airway pressure (CPAP) and Surgery are the options available. For moderate grade, surgery is advisable and for severe grade, lifestyle modification and bariatric surgery are the

valuable options. Clinical presentation of OSA in pediatric population includes Snoring, Mouth breathing, Sleep disturbances and Failure to thrive. Investigations done are X-ray nasopharynx, polysomnography (PSG) and diagnostic nasal endoscopy (DNE).[3-6]

Treatment options include surgery and if surgery is contraindicated, or persistence of symptoms after surgery, CPAP is preferred. Treatment of OSA in adults includes, for mild type, continuous positive airway pressure (CPAP) and surgery are the options available. for moderate grade, surgery is advisable and for severe grade, lifestyle modification and bariatric surgery are the valuable options.[6-9]

Table 1: Childhood versus adult obstructive sleep apnea syndrome.

Feature	Adults	Children
Presentation		
Excessive daytime sleepiness	Main presenting complaint	Infrequent complaint
Associated obesity	Majority of patients	Minority of patients
Underweight/failure to thrive	Not seen	Frequent finding
Daytime mouth-breathing	Not seen	Frequent finding
Gender	Male/female = 2:1	Male/female= 1:1
Enlarged tonsils and adenoids	Rarely seen	Frequent finding
Sleep pattern		
Obstructive	Obstructive apnea	Obstructive apnea or obstructive hypoventilation
Arousal with obstruction	Common	May be less frequent
Disrupted	Common	Not often seen
Management		
Surgical	Minority of patients with inconsistent results	Definitive in many
Medical (positive pressure)	Most common management	Only in selected patients

Adapted from Carroll Loughlin. Diagnostic criteria for obstructive sleep apnea syndrome in children.[10]

Polysomnography

Polysomnography is the best and the gold standard investigation for evaluation of Pediatric and Adult OSA, which confirms the diagnosis and severity of OSA. It is a nocturnal, laboratory based test. It is a continuous and simultaneous recording of multiple physiologic parameters related to sleep and wakefulness. 4 levels of sleep study are present. Normally Level 1 sleep study is the best and it is in the lab study.[7,8]

The parameters of PSG include, electroencephalography (EEG), electromyography (EMG) electrooculography (EOG) for assessment of sleep stage, nasal thermistor for evaluation of apnea and, nasal pressure transducer channel for airflow restriction to detect hypopnea, pulse oximetry, respiratory effort monitoring (thoracic and abdominal), End tidal and transcutaneous co_2 recording, Sound recordings to measure snoring and Electrocardiography and Continuous video monitoring

The categories for OSA in adults are well established. Abnormal values of adult PSG were Apnea–hypopnea (AHI) >5/hour, AHI 5 to 15= mild, AHI 16 to 30 = moderate, AHI >30= severe, minimum oxygen desaturation <90%. A standard definition of SDB disease severity does not exist for pediatric OSA. Thus study interpretation may differ in those criteria of mild, moderate and severe OSA. Abnormal values for pediatric PSG: Obstructive apnea index (AI)>1/hour, apnea–hypopnea (AHI) >1/hour, AHI 1 to 5= mild, AHI 5 to 10= moderate, AHI >10= severe, peak end tidal co2 >53 mmHg, End tidal Co_2 >50 mmHg for >10% of total sleep time, Minimum oxyhemoglobin saturation (SPo_2)< 92%. Apnea hypopnea index (AHI**)** is the outcome measure for PSG study. It is defined as the total number of obstructive apneas (including mixed apneas) plus hypopneas divided by total sleep time. AHI >1/hour as diagnostic for pediatric OSA and AHI >5/hour for Adult OSA.

METHODS

The prospective cohort study was done in 60 patients (30 adults and 30 children) one year (February 2017 to Jan 2018) at Department of Otorhinolaryngology, Stanley medical college, Chennai. The Inclusion criteria were adults (18-60 years) with symptoms of OSA like snoring, excessive daytime sleepiness, tiredness and headache, and pediatric age group 3-12 years with at least 3 symptoms of OSA like snoring, mouth breathing, sleep disturbances. The exclusion criteria were major congenital anomalies, neuromuscular diseases, previous upper airway surgery, and uncorrectable bleeding disorders. 60 patients who meet the inclusion criteria were subjected to clinical examination, relevant blood (CBC, RFT) and radiological investigations (X-ray nasopharynx) and DNE. Main Objective of this study was to identify the difference in polysomnographic findings of Obstructive Sleep apnea Syndrome in Adults and children. Ethical approval was **o**btained. Level 1 sleep study was done and the results were analysed by SPSS software (Software Package for Statistical Analysis).

Polysomnography (PSG)

The abdominal belt and nasal air flow pressure transducer are the only different measuring tools in PSG study in adult (Figure 1A) and Pediatric OSA (Figure

1B). However the procedure, polysomnogram tracings and report generation are remains the same (Figure 2A, 2B, 3A, 3B).

Figure 1A: Adult PSG.

Figure 1B: Pediatric PSG.

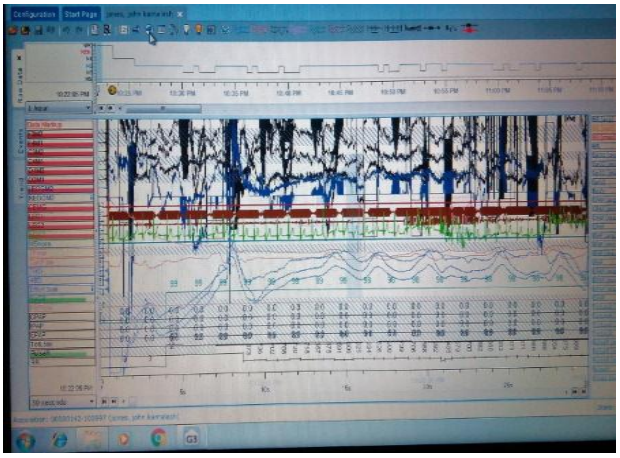


Figure 2A: Adult PSG tracing.

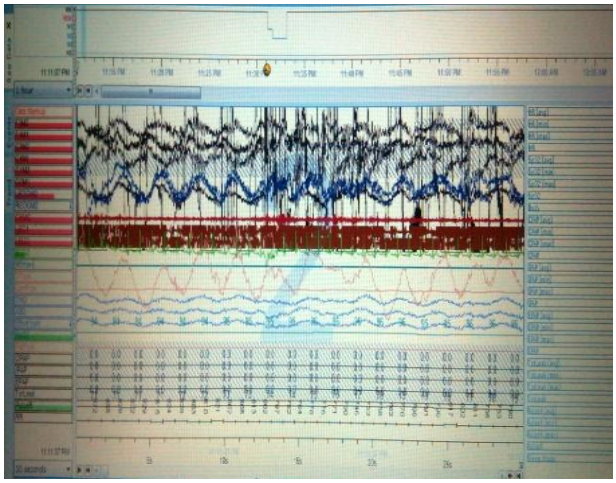
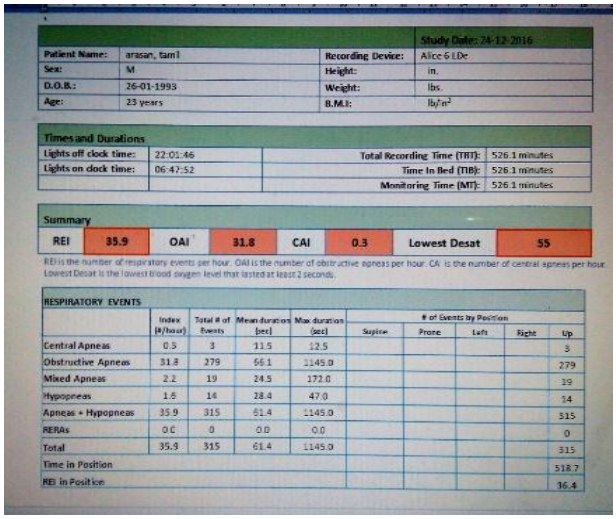


Figure 2B: Pediatric PSG tracing.



Patient Name:	arasan, tamil	Recording Device:	Alice 6 LDe
Sex:	M	Height:	in.
D.O.B.:	26-01-1993	Weight:	lbs.
Age:	23 years	B.M.I:	lb/in²

Study Date: 24-12-2016

Times and Durations			
Lights off clock time:	22:01:46	Total Recording Time (TRT):	526.1 minutes
Lights on clock time:	06:47:52	Time In Bed (TIB):	526.1 minutes
		Monitoring Time (MT):	526.1 minutes

Summary							
REI	35.9	OAI	31.8	CAI	0.3	Lowest Desat	55

REI is the number of respiratory events per hour. OAI is the number of obstructive apneas per hour. CAI is the number of central apneas per hour. Lowest Desat is the lowest blood oxygen level that lasted at least 2 seconds.

RESPIRATORY EVENTS	Index (#/hour)	Total # of Events	Mean duration (sec)	Max duration (sec)	# of Events by Position				
					Supine	Prone	Left	Right	Up
Central Apneas	0.5	3	11.5	12.5					3
Obstructive Apneas	31.8	279	66.1	1145.0					279
Mixed Apneas	2.2	19	24.5	172.0					19
Hypopneas	1.6	14	28.4	47.0					14
Apneas + Hypopneas	35.9	315	61.4	1145.0					315
RERAs	0.0	0	0.0	0.0					0
Total	35.9	315	61.4	1145.0					315
Time in Position									518.7
REI in Position									36.4

Figure 3A: Adult PSG report.

Patient Name:	lawrence, moris	Recording Device:	Alice 6 LDe
Sex:	M	Height:	in.
D.O.B.:	21-11-2008	Weight:	lbs.
Age:	8 years	B.M.I:	lb/in²

Times and Durations			
Lights off clock time:	22:40:52	Total Recording Time (TRT):	460.1 minutes
Lights on clock time:	06:20:58	Time In Bed (TIB):	460.1 minutes
		Monitoring Time (MT):	460.1 minutes

Summary							
REI	3.9	OAI	3.0	CAI	0.3	Lowest Desat	84

REI is the number of respiratory events per hour. OAI is the number of obstructive apneas per hour. CAI is the number of central apneas per hour. Lowest Desat is the lowest blood oxygen level that lasted at least 2 seconds.

RESPIRATORY EVENTS	Index (#/hour)	Total # of Events	Mean duration (sec)	Max duration (sec)	# of Events by Position				
					Supine	Prone	Left	Right	Up
Central Apneas	0.3	2	16.0	20.5		0		0	2
Obstructive Apneas	3.0	23	22.7	53.0		0		1	22
Mixed Apneas	0.7	5	16.8	25.0		0		0	5
Hypopneas	0.0	0	0.0	0.0		0		0	0

Figure 3B: Pediatric PSG report.

RESULTS

Mean age group affected among adults was 39.86±8.42 years and the most common cause among adults was obesity. Among the pediatric age group, mean age group was 7.63±1.71 years (Figure 4). The most common cause among children noted was adenotonsillar hypertrophy.27 patients were males and nine were females in adult category (Figure 5A). Among the pediatric population, 18 were males and 12 were females (Figure 5B). Males were affected more in adult and pediatric population.

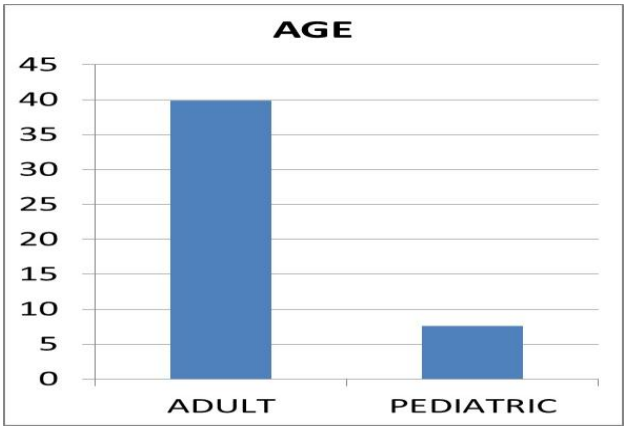


Figure 4: Adult and pediatric age is displayed as Mean±standard deviation.

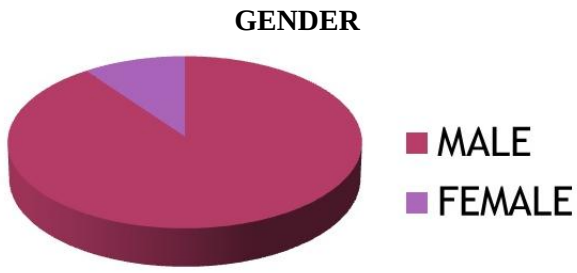


Figure 5A: Gender distribution in adult OSA subjects.

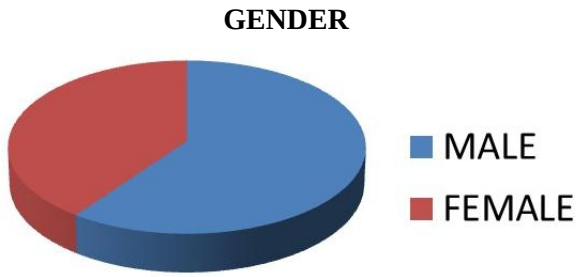


Figure 5B: Gender distribution in pediatric OSA subjects.

Mild (AHI 5-15) category was noted in 10 adults, moderate category (AHI 15-30) was noted in 12 adults and severe (AHI >30) category was noted in 8 adults (Figure 6A). AHI was predominantly of moderate severity in adults. Among pediatric age group, mild (AHI 1-5) category was noted in 14 children, moderate (AHI 5-10) category was noted in 10 children and severe (AHI >10) category was noted in 6 Children.(Figure 6b). Mean AHI in adults noted is 24.66±13.51 and the Mean AHI pediatric is 5.89±3.27 (Figure 7). Mean AHI predominantly was of mild severity in pediatric population. Mean AHI is more in adults compared to Pediatric population. Pediatric mean heart rate was 80.95±3.68 and adult mean heart rate was 69±8.48. Mean heart rate is more in pediatric population (Figure 8). Pediatric lowest mean SpO2 was 81.83±7.94 and adult lowest mean SpO_2 was 73.23±10.41 lowest mean oxygen saturation is more in adult population (Figure 9).

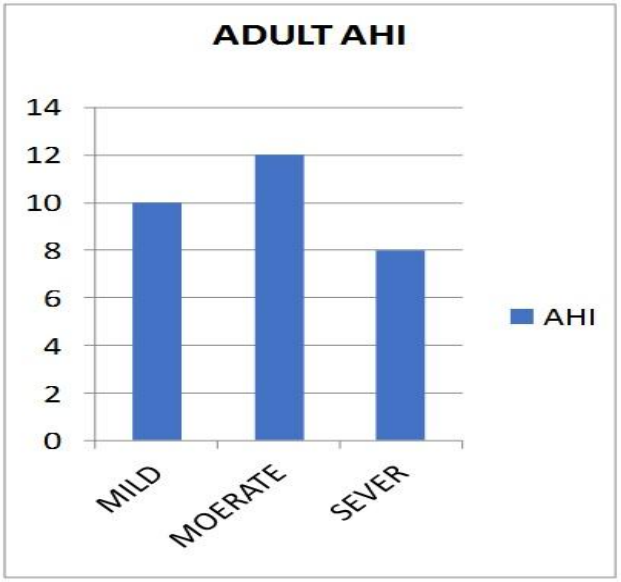


Figure 6A: Severity of adult AHI.

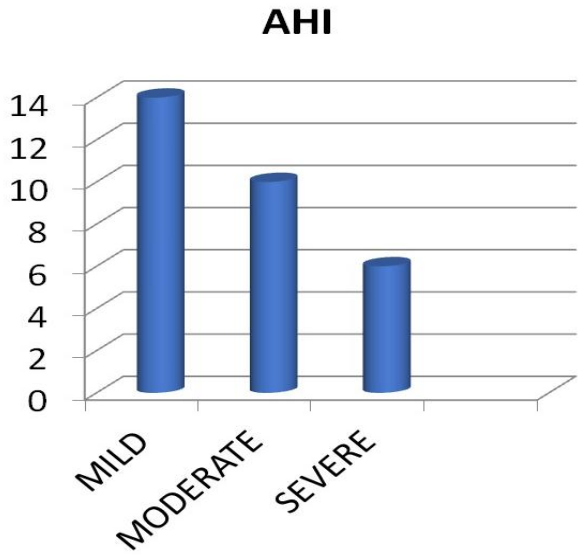


Figure 6B: Severity of pediatric AHI.

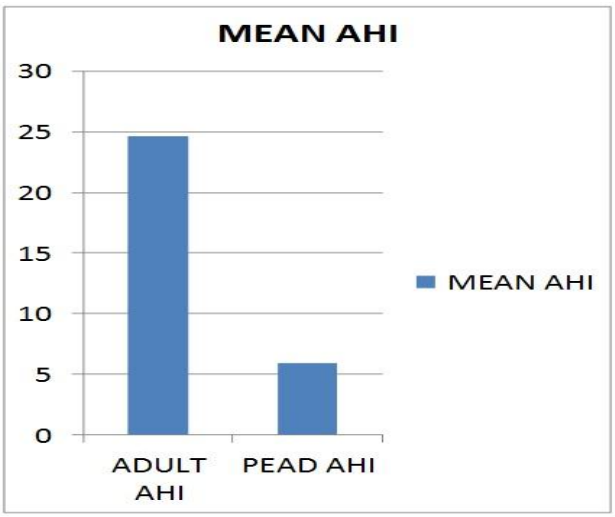


Figure 7: Adult and pediatric mean AHI.

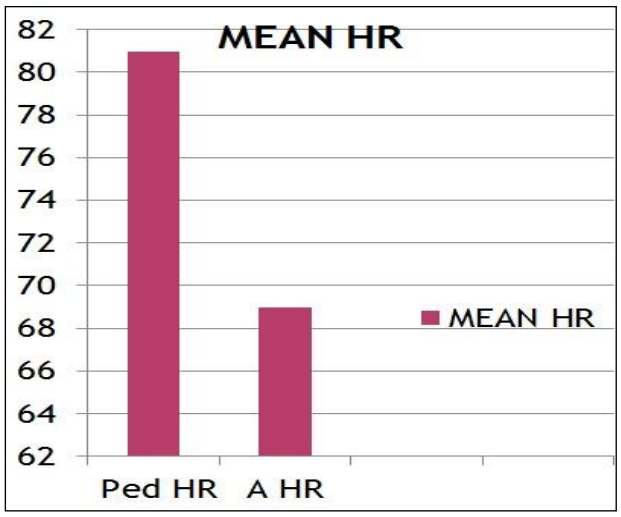


Figure 8: Adult and pediatric OSA subject's mean heart rate.

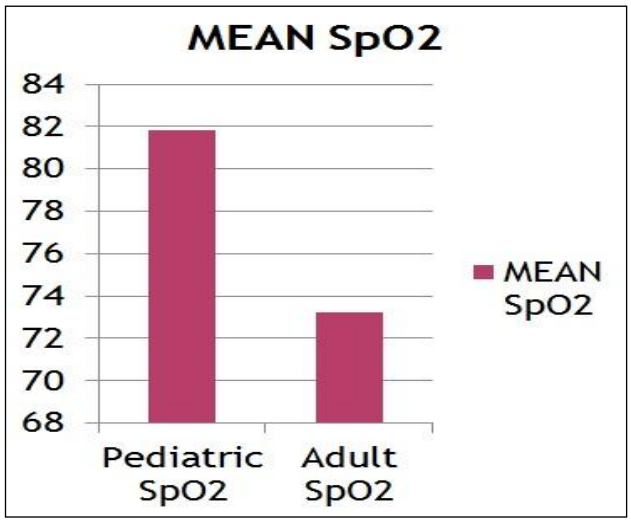


Figure 9: Adult and pediatric OSA subject's mean SPo_2.

DISCUSSION

A child is not a small adult- is the dictum followed in our teaching and that has been practiced since modern medicine evolved.[4] It holds true for evaluation and treatment of OSA. The pediatric OSA in contrast to adult OSA is a striking abnormality noticed by caregivers and makes them quite anxious to get earlier intervention. Conventional portrayal and habituation has often resulted in neglect of adult OSA evaluation at an early stage.[6] The protocols followed in evaluation and treatment of OSA hasn't differ much in last decade. Though the intervention to prevent secondary complications has been intensified to adapt to current trend of increasing incidence of OSA both in adults and in the pediatric population. In the past pediatric OSA was predominantly in malnourished children due to chronic tonsillitis. Now obesity is the common complaint for OSA in pediatric population.

In a study by Verhulst, et al, it was cited that, most children with obstructive sleep apnea were aged between 2-10 years (coinciding with adenotonsillar lymphatic tissue growth).[11] Our study also showed the Same results, where the mean age affected is 7.63±1.71 years. Mean age group affected among adults was 39.86±8.42 years.

Based on the study by Harding et al, OSAS occurs equally among boys and girls. In our study, among the children, 18 children were male and 12 children were female. Among adults 27 were male and 3 were female.[12]

Apnoea hypopnoea index (AHI) categories noted are Mild (AHI 5-15) was noted in 10 adults, Moderate (AHI 15-30)- noted in 12 adults and Severe (AHI >30) noted in 8 adults. Mean AHI noted is 24.66±13.51. The same view was echoed by Nishibayashi et al, in their study in 190 patients of OSAS approximately 55% of patients were belonging to severe AHI. Based on the study by Jinyeetal et al, in our study preoperative polysomnography was done to quantify the severity of OSA by calculating the apnoea hypopnoea index (AHI). AHI categories noted in pediatric population are, mild (AHI1-5) noted in 14 children, moderate (AHI 5-10) noted in 10 children and severe (AHI>10) noted in 6 children and mean AHI is 5.89±3.27. Based on the study by Tauman et al. Pediatric mean heart rate noted was 80.95±3.68 and adult mean heart rate was 69±8.48. Pediatric lowest mean oxygen saturation noted was 81.83±7.94 and Adult Lowest Mean SpO2 was 73.23±10.41.[13,14]

CONCLUSION

Thus adult PSG and pediatric PSG differ in certain aspect in the procedures used for interpretation. AHI and other important parameter's criteria for defining OSAS are reduced in pediatric age group when compared to adult age group. Caution should be undertaken while interpreting pediatric polysomnography. Thorough knowledge of scoring system in pediatric

polysomnography is essential before involving pediatric age group.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Rosen CL, D'Andrea L, Haddad GG. Adult criteria for obstructive sleep apnea do not identify children with serious obstruction. Am Rev Respir Dis. 1992;146(5):1231-4.
2. Goldstein NA, Sculerati N, Walsleben JA, Bhatia N, Friedman DM, Rapoport DM, et al. Clinical diagnosis of pediatric obstructive sleep apnea validated by polysomnography. Otolaryngol Head Neck Surg. 1994;111(5):611-7.
3. Marcus CL. Sleep-disordered breathing in children. Am J Respir Crit Care Med. 2001;164:16-30.
4. Choi JH, Kim EJ, Choi J, Kwon SY, Kim TH, Lee SH, et al. Obstructive sleep apnea syndrome: a child is not just a small adult. Ann Otol Rhinol Laryngol. 2010;119(10):656-61.
5. Pipers M, Poels PJ, Vaandrager JM, de Hoog M, van den Berg S, Hoeve HJ, et al. Undiagnosed obstructive sleep apnea syndrome in children with syndromal craniofacial synostosis. J Craniofac Surg. 2004;15(4):670-4.
6. Arens R, Marcus CL. Pathophysiology of upper airway obstruction: a developmental perspective. Sleep. 2004;27(5):997-1019.
7. Kennedy JD, Waters KA. Investigation and treatment of upper-airway obstruction: childhood sleep disorders. I Med J. 2005;182(8):419-23.
8. Jennifer A, Shults J, Leonard MB, Traylor J, Marcus CL. Differences in Overnight Polysomnography Scores Using the Adult and Pediatric Criteria for Respiratory Events in Adolescents. Sleep. 2010;33(10):1333-9.
9. Gozal D, Kheirandish-Gozal L. Obesity and excessive daytime sleepiness in prepubertal children with obstructive sleep apnea. Pediatrics. 2009;123(1):13-8.
10. Carroll JL, Loughlin GM. Diagnostic criteria for obstructive sleep apnea syndrome in children. Pediatr Pulmonol. 1992;14:7110.
11. Verhulst SL, Van Gaal L, De Backer W, Desager K. The prevalence, anatomical correlats and treatment of sleep disordered breathing in obese children and adolescents. Sleep Med Rev. 2008;12(5):339-46.
12. Harding SM. Prediction formulae for sleep-disordered breathing. Curr Opin Pulm Med. 2001;7(6):381-5.
13. Ye J, Liu H, Zhang GH, Li P, Yang QT, Liu X, et al. Outcome of adenotonsillectomy for Obstructive Sleep Apnea Syndrome in children. Ann Otorhinolaryngol. 2010;119(8):506-13.
14. Tauman R, Gulliver TE, Krishna J, Montgomery-Downs HE, O'Brien LM, Ivanenko A, et al. Persistence of obstructive Sleep apnea syndrome in children after adenotonsilectomy. J Pediatr. 2006;149:803-8.

Cite this article as: Athiyaman K, Gowri Shankar M, Suji G, Prabhu D. A comparative study of adult and pediatric polysomnography. Int J Otorhinolaryngol Head Neck Surg 2018;4:630-5.