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Determination of Different Parameters and Their Corelation with Sleep Disorder Breathing and Assessing the Viability of a Measuring Scale in Children

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ABSTRACT

Aim: The aim of the article is to identify viable and functional extra oral and intra oral features which might be associated with increased risk of sleep disturbances in paediatric patients and to develop a functional air way screening tool for easy diagnosis of paediatric sleep disordered breathing

Methods: A cross-sectional stud was conducted among 750 children aged 5-10 years Clinical examination which includes functional, extraoral, intraoral soft tissue, and intraoral hard tissues similar to SDSC and fairest scale. The present study includes few additional factors Like presence of day symptoms and night symptoms which were also recorded

Results: Include that there is association with the above findings and sleep disorder breathing in children

Conclusion: The Pediatric Sleep Breathing Assessment Scale (PSBA) Is Reliable and Provides a valuable information about behaviour patterns, sleep patterns of children, quality of life of children, symptoms of children who are suffering from sleep disorder breathing.

Keywords: *Pediatric Sleep Breathing Assessment Scale (PSBA), Obstructive sleep apnoea (OSA), Functional Airway Evaluation Screening Tool (FAIREST-15)*

1. INTRODUCTION

Sleep is defined as a sedentary state of mind and body. It is characterized by altered consciousness, relatively inhibited sensory activity, reduced muscle activity, and reduced interactions with surroundings.[1]. From early childhood to old age, sleep needs vary significantly. Sleep deprivation is defined as any deviation from the recommended amount of sleep, or a 2-day reduction.[2]

Many disorders accompanying with sleep, Obstructive sleep apnoea (OSA) is one among the most common and affected sleep related breathing disorder and it is characterized by frequent episodes of complete or partial upper airway obstruction during sleep which is leading to intermittent low oxygen levels in the blood (hypoxemia) and in organs and tissues (hypoxia)[1]

OSA in children typically appears between the ages of 2 and 7 years. Although it was thought that boys and girls were equally affected.

Sleep-disordered breathing (SDB) is defined by a range of breathing abnormalities and dysfunctions including primary snoring, upper airway resistance syndrome (UARS), and obstructive sleep apnea (OSA) syndrome[3]

There are many factors associated with OSA among which few factors such as Mouth Breathing, Enlarged Tonsils, presence of adenoids etc are found to be important factors predisposing to Obstructive Sleep Apnoea. Polysomnography is considered as gold standard for a sleep disorder There are various assessment tools that been developed as a diagnostic indicators. among them a tool named Functional Airway Evaluation Screening Tool which comprises of 15 item scale includes dental, otolaryngologic, and functional characteristics associated with increased risk of breathing related sleep disturbances in children.[4]

There are few factors that have been associated with high risk of sleep disorder breathing in children and those factors are being included in our study and the association has been quantified.

2. MATERIAL AND METHODS

Study Setting and Participants: After obtaining ethical clearance from institutional ethical committee a cross-sectional study was conducted among 750 healthy children of age 5 to 10 years to determine different parameters and their co relation with Sleep Disorder Breathing and assessing the viability of a measuring scale in children

Exclusion criteria: Include Patients having craniofacial defects with prior orthodontic therapy (functional myotherapy) prior tonsillectomy and children who underwent oral or maxillofacial surgical procedures such as jaw corrections due to RTA's, falls and contact injuries

Procedure: A clinical examination was carried out, Type III examination was performed using mouth mirror, probe.

The 14 elements in the pediatric version of the Functional Airway Evaluation Screening Tool (FAIREST-15) and along with that few factors like day symptoms, night symptoms were included in our study and evaluated.

1. Classification of sagittal dental growth profile (Class I, Class II, Class III);
2. Classification of vertical, normal, or horizontal facial growth pattern;
3. Classification of facial growth profile (normal, concave, convex);
4. The tongue range of motion ratio (TRMR), which can be graded one, two, three, or four;
5. The Kotlow free tongue measurement, which measures the distance between the tongue tip and the lingual frenulum's insertion (eight to twelve mm, four to eight mm, zero to twelve mm).
6. The mucosal connection of the Kotlow upper labial frenum gingival, palatine, and interdental papillae
7. Chin strain when closing the lips (none, mild, moderate-severe);
8. Mallampati Classification (Class 1, 2, 3, 4)
9. The Brodsky scale-measured tonsillar hypertrophy (less than 25 percent; 26–50 percent; 51–75 percent; over 75 percent)
10. The maximum inter canine distance, as determined between maxillary canine cusp tips (more than 37 mm, ranging from 31 to 37 mm, minus 31 mm;
11. The maxillary intermolar distance, which is greater than the maxillary first molar mesiobuccal cusp tips 46 to 52 mm, 52 mm, or less than 46 mm;
12. The symptoms of wear on teeth (bruxism, no wear identified, mild wear, moderate wear, severe wear);
13. The swallow tongue-thrust compensation test, which measures how easily or difficultly a person can swallow.
14. The nasal breathing test, which measures how long a person can breathe through their nose (three+ minutes, two to three minutes, one to two minutes, less than one minute).

Along with the above parameters there are other parameters like day symptoms, night symptoms, overjet, over bite which might be related to sleep disorder breathing are added in our study and results are quantified

After oral examination was completed upper and lower impressions were taken using alginate and casts were poured using

die stone and Inter canine width and intermolar width were calculated.

Data analysis: The collected is tabulated and sent for statistical analysis. Data was entered in Microsoft excel and analysed using IBM SPSS Statistics for Windows, Version 20 (IBM Corp., Armonk, N.Y., USA). ANNOVA test, independent sample t test and chi square tests were used and p value less than 0.05 was considered to be statistically significant

Results: The mean age in the study was 8.7 years (standard deviation 1.12 Table 1) among 211 boys and 539 Girls. SDSC Scores ranged from 25-86 Scores from 25-31 are considered to be normal and from 32-38, 39-45, > 45 were considered to be mild, moderate and severe respectively. There were 13(1.7percent) patients with SDSC scores within the normal range (less than or equal to 31), and 532 (70.9 percent) within mild range, 205 (27.30 percent) with moderate range (Table 2)

MEAN AGE: TABLE -1

	N	Mean	Std. Deviation
AGE	750	8.70	1.12

SDSC FREQUENCY TABLE -2

	Frequency	Percent
Normal	13	1.70%
Mild	532	70.90%
Moderate	205	27.30%
Total	750	100

TABLE -3 Corelation of Functional Findings with SDSC

	N	Mean	SD	Min	Max	% of total	F-value	P value
SWALLOW TONGUE – THRUST COMPENSATION TEST								
Swallow with ease	750	36.88	2.74	31	49	100		
Swallow with difficulty	0							
Unable to swallow	0							
TOTAL	750	36.88	2.74	31	49	100		
NASAL BREATHING TEST							7.560	0.001*
3 + min	27	34.89	3.30	31	40	3.6		
2-3 min	176	37.43	2.79	31	47	23.5		
1-2 min	527	36.82	2.68	31	49	70.3		
< 1 min	20	36.40	1.43	34	40	2.7		
TOTAL	750	36.88	2.74	31	49	100		
BREATHING ROUTE WHEN AWAKE								
Primary Nasal	508	36.07	2.44	31	43	67.7	85.594	0.001*
Sometimes mouth	237	38.56	2.57	32	49	31.6		
Often mouth	5	40.00	1.41	39	42	0.7		
Almost always mouth	0	0	0	0	0	0		
TOTAL	750	36.88	2.74	31	49	100		
BREATHING ROUTE WHEN ASLEEP							65.501	0.001*
Primary Nasal	466	36.07	2.40	31	43	62.1		
Sometimes mouth	274	38.16	2.77	31	49	36.5		
Often mouth	10	39.70	1.16	38	42	1.3		
Almost always mouth	0	0.00	0.00	0	0	0		
TOTAL	750	36.88	2.74	31	49	100		
SLEEP POSITION							32.114	0.001*
Primarily supine	521	36.28	2.49	31	49	69.5		
Supine > side/stomach	219	38.20	2.79	31	47	29.2		
Side/stomach>supine	6	38.00	2.97	34	42	0.8		
Primarily side>stomach	4	41.00	2.31	39	43	0.5		
Total	750	36.88	2.74	31	49	100		
POSTURE							12.870	0.001*
Rarely slouches	725	36.82	2.73	31	49	96.7		
Sometimes slouches	25	38.80	2.48	32	43	3.3		
Often slouches	0	0.00	0.00	0	0	0		
Almost always slouches	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		

Functional Finding Tests: Following Functional finding tests showed statistically significance association with higher SDSC scores: The swallowing tongue-thrust compensation test (swallow with ease, swallow with difficulty, or unable to swallow without tongue-thrust compensation), the nasal breathing test (less than one minute, one to two minutes, two to three minutes, and three or more minutes), the breathing route when awake (primarily nasal or sometimes, often, or almost always mouth), the breathing route when asleep (primarily nasal or sometimes, often, or almost always mouth), and the seated posture (rarely, sometimes, often, or almost always slouches) Sleep position (Primarily stomach Supine > side/stomach Side/stomach>supine Primarily side>stomach) all showed statistically significant (Table 3)

Extra Oral Findings: Among Extra oral patterns, There were statistically significant correlations between greater SDSC scores and mentalis strain (none, mild, moderate-severe) and facial pattern (dolichofacial versus mesofacial/brachyfacial) Facial profile (convex concave straight) Mentolabial sulcus Deviated nasal septum (Table 4)

TABLE - 4 : Corelation of Extra oral Findings with SDSC

	N	Mean	SD	Min	Max	% of total	F-value	P value
FACIAL PATTERN							6.971	0.001*
Dolichofacial	54	35.98	2.99	31	43	7.2		
Mesofacial	658	36.88	2.65	31	49	87.7		
Brachyfacial	38	38.13	3.46	33	44	5.1		
Total	750	36.88	2.74	31	49	100		
FACIAL PROFILE							16.372	0.001*
Convex	53	35.28	2.93	31	43	7.1		
Normal	662	36.92	2.63	31	49	88.3		
Concave	35	38.57	3.24	33	44	4.7		
Total	750	36.88	2.74	31	49	100		
MENTALIS STRAIN							45.593	0.001*
No chin strain	714	36.73	2.67	31	49	95.2		
Mild chin strain	36	39.81	2.45	35	44	4.8		
Severe chin strain	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		
MENTOLABIAL SULCUS							20.850	0.001*
Normal	213	35.89	2.68	31	43	28.4		
Narrow	36	37.58	2.75	32	44	4.8		
Deep	501	37.25	2.66	31	49	66.8		
Total	750	36.88	2.74	31	49	100		
DEVIATED NASAL SEPTUM							92.103	0.001*
Absent	495	36.23	2.42	31	47	66		
Present	255	38.15	2.89	31	49	34		
Total	750	36.88	2.74	31	49	100		

TABLE- 5 : Corelation of Intra Oral Soft Tissues with SDSC

	N	Mean	SD	Min	Max	% of total	F-value	P value
TONGUE RANGE OF MOTION RATIO							1.426	0.241
Grade 1	645	36.85	2.74	31	49	86		
Grade 2	98	36.97	2.75	33	44	13.1		
Grade 3	7	38.57	2.15	37	43	0.9		
Total	750	36.88	2.74	31	49	100		
KOTLOW FREE TONGUE MOVEMENT (in mm)							2.005	0.112
>12	696	36.89	2.72	31	49	92.8		
8-12	51	36.57	2.95	33	44	6.8		
4-8	2	38.00	0.00	38	38	0.3		
0-4	1	43.00	0	43	43	0.1		
TOTAL	750	36.88	2.74	31	49	100		
KOTLOW UPPER LABIAL FRENUM ATTACHMENT							20.377	0.001*
Mucosal	169	35.80	2.77	31	43	22.5		
Gingival	532	37.12	2.69	31	49	70.9		
Papillary	49	38.04	2.00	33	41	6.5		
Total	750	36.88	2.74	31	49	100		
TONSIL SIZE %							113.459	0.001*
<25	205	34.74	2.29	31	43	27.3		
25-50	526	37.65	2.48	32	49	70.1		
50-75	19	38.68	1.29	37	41	2.5		
Total	750	36.88	2.74	31	49	100		
MALLAMPATI							82.662	0.001*
M1	359	35.67	2.42	31	44	47.9		
M2	387	37.97	2.53	32	49	51.6		
M3	4	40.00	3.46	37	43	0.5		
M4	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		
PALATE							23.062	0.001*
Normal	676	36.67	2.66	31	47	90.1		
Narrow	10	39.90	2.60	37	44	1.3		
Deep	64	38.67	2.73	35	49	8.5		
Total	750	36.88	2.74	31	49	100		

Intra Oral Soft Tissue: Among Intra oral soft tissues the following variables showed statistically significant correlations with higher SDSC scores: tonsil size (less than 25 percent, 25 to 50 percent, greater than 50 percent). indicated a trend toward significance for Mallampati (M1, M2, M3/4) & Kotlow upper attachment. There was no statistically significant correlation found between SDSC scores and tongue range of motion ratio (grades one to four) (P=0.241), Kotlow free tongue measurement (more than 12 mm, eight to 12 mm, four to eight mm, zero to four mm), P=0.112, (Table 5)

TABLE -6 **Corelation of Intra Oral Hard Tissues with SDSC**

	N	Mean	SD	Min	Max	% of total	F-value	P value
DENTAL PROFILE							21.648	0.001*
Class I	677	36.67	2.60	31	49	90.3		
Class II	62	38.73	3.39	33	47	8.3		
Class III	11	39.36	1.96	36	42	1.5		
Mesial step	0	0	0	0	0	0		
Distal step	0	0	0	0	0	0		
Flush terminal plane	0	0	0	0	0	0		
Total	750	36.88	2.74	31	49	100		
INTER-CANINE DISTANCE (in mm)							20.410	0.001*
<31 mm	29	34.66	2.70	31	39	3.9		
>31 mm	721	36.97	2.71	31	49	96.1		
Total	750	36.88	2.74	31	49	100		
INTER-MOLAR DISTANCE (in mm)							16.059	0.001*
<46 mm	34	35.06	2.92	31	42	4.5		
>46 mm	716	36.97	2.70	31	49	95.5		
Total	750	36.88	2.74	31	49	100		
OVER JET							72.375	0.001*
0-3 mm	690	36.56	2.44	31	44	92		
4-6 mm	59	40.54	3.21	33	49	7.9		
>6 mm	1	44.00	.	44	44	0.1		
Total	750	36.88	2.74	31	49	100		
OVER BITE							67.960	0.001*
0-3 mm	690	36.57	2.45	31	44	92		
4-6 mm	59	40.44	3.28	33	49	7.9		
>6 mm	1	44.00		44	44	0.1		
Total	750	36.88	2.74	31	49	100		
DENTAL WEAR							3.075	0.08
Mild	744	36.87	2.69	31	49	99.2		
Moderate	6	38.83	6.52	33	47	0.8		
Severe	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		

Intra Oral Hard Tissues: Dental profile, molar relationship (Class II or III versus Class I), intercanine distance (less than 31 mm versus greater than 31 mm), intermolar distance (less than 46 mm versus greater than 46 mm), and Overjet and overbite showed statistically significant association with sleep disorder breathing in children. Dental wear (none versus mild versus moderate-severe) Showed no positive association. (Table 6)

TABLE -7 : **Corelation of Psycho social findings with SDSC**

	N	Mean	SD	Min	Max	% of total	F-value	P value
DIFFICULTY IN CONCENTRATING							61.577	0.001*
Rarely	520	36.20	2.64	31	49	69.3		
Sometimes	228	38.41	2.32	32	44	30.4		
Often	2	40.00	0.00	40	40	0.3		
Almost always	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		
STRESS/ANXIETY							165.866	0.001*
Rarely	531	36.13	2.55	31	49	70.8		
Sometimes	219	38.70	2.31	32	47	29.2		
Often	0	0.00	0.00	0	0	0		
Almost always	0	0.00	0.00	0	0	0		
Total	750	36.88	2.74	31	49	100		

Psychosocial Findings: Children who showed increased difficulties concentrating had higher SDSC scores. Highest mean value is seen in children who often feels difficulty in concentrating .and showed stastically significant with sleep disorder breathing Children expressing higher levels of stress/anxiety had a significant correlation with higher SDSC scores (Table 7)

TABLE -8 Corelation of Day Symptoms & Night Symptoms With SDSC

	N	Mean	SD	Min	Max	% of total	T-value	P value
PRESENCE OF DAY SYMPTOMS							-1.998	0.046*
Present	185	36.52	2.92	31	43	24.7		
Absent	565	36.96	2.53	30	44	75.3		
Total	750	36.88	2.74	31	49	100		
PRESENCE OF NIGHT SYMPTOMS							5.819	0.001*
Present	239	37.66	2.95	31	44	31.9		
Absent	511	36.48	2.39	30	44	68.1		
Total	750	37.66	2.95	31	49	100		

Among all the day symptoms and night symptoms children having atleast 3 symptoms are scored as present. Results of our study showed presence of day symptoms and night symptoms in children showed statically significant association with sleep disorder breathing. (Table- 8)

TABLE -9 Corelation of Day Symptoms With SDSC

DAY SYMPTOMS	Sleep Disturbance Scale for Children (SDSC)			Chi-square	P value
	Normal	Mild	Moderate		
Present (n=185)	9 (4.9%)	123 (66.5%)	53 (28.6%)	14.808	0.001*
Absent (n=565)	4 (0.7%)	410 (72.6%)	151 (26.7%)		
Total (n=750	13 (1.7%)	533 (71.1%)	204 (27.2%)		

TABLE -10 Corelation of Night Symptoms With SDSC

NIGHT SYMPTOMS	Sleep Disturbance Scale for Children (SDSC)			Chi-square	P value
	Normal	Mild	Moderate		
Present (n=239)	7 (2.9%)	132 (55.2%)	100 (41.8%)	42.916	0.001*
Absent (n=511)	6 (1.2%)	401 (78.5%)	104 (20.4%)		
Total (n=750)	13 (1.7%)	533 (71.1%)	204 (27.2%)		

The Presence of Day symptoms and Night symptoms were positively correlated with children's scores on the sleep disturbance scale, which ranged from mild to moderate (Table 9,10)

3. DISCUSSION

Obstructive Sleep Apnea (OSA) is a common type of sleep-disordered breathing (SDB) in children, characterized by repeated airway obstruction during sleep. Symptoms include snoring, restless sleep, behavioral issues, and craniofacial abnormalities. Untreated OSA can result in serious health and developmental consequences.

Mouth breathing in children is a significant risk factor for SDB and leads to distinct facial changes such as a narrow palate,

dental malocclusions, and altered tongue posture. Unlike adults, excessive daytime sleepiness (EDS) is not commonly reported in children with OSA; instead, behavioral problems like hyperactivity, inattention, and aggression are more prevalent.

Several studies, including those by Kim et al., James et al., and Lee et al., support that anatomical and functional features—such as enlarged tonsils, high Mallampati score, mentalis strain, deviated nasal septum, narrow palate, and specific sleeping positions (e.g., mouth open, supine)—are significantly associated with increased risk of SDB.

Our study confirms these associations using tools like the SDSC and FAIREST-15. Key findings included:

- **Functional findings**: Mouth breathing during sleep, poor nasal breathing test performance, and sleeping in a supine position showed strong links with SDB.
- **Extraoral findings**: Deviated nasal septum, mentalis strain, and high/narrow palate had significant associations.
- **Intraoral findings**: Class III molar relation, narrow intercanine and intermolar distances, increased overjet and overbite were significantly correlated with SDB.
- **Psychosocial impacts**: Children with SDB also showed concentration issues and anxiety, aligning with elevated SDSC scores.

The results support early identification of SDB-related features in pediatric dental evaluations to enable timely interventions and mitigate long-term consequences.

4. CONCLUSION

The Pediatric Sleep Breathing Assessment Scale (PSBA) is Reliable and Provides a valuable information about behaviour patterns, sleep patterns of children, quality of life of children, symptoms of children who are suffering from sleep disorder breathing. It can be used as an adjunct to SDSC and fairest scale in the assessment of children with sleep disorder breathing where Polysomnography is not possible

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