

The Effect of Sleep Disordered Breathing on Health Related Quality of Life and Depressive Symptoms in Children

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ABSTRACT

During a 30-month long study period, 120 children (that included 60 cases with snoring or sleep disordered breathing and 60 controls) were studied. The mean age was 8.62 yrs in the test group. Parameters like BMI and presenting symptoms were recorded. A detailed upper airway examination was performed. Complete polysomnography of the clinical group was conducted. Parameters of health related quality of life (HRQOL) and depressive symptoms were studied by utilizing duly filled up questionnaires (Peds QL™ 4 and CDI respectively). Parent and child reported health related quality of life as derived from the Pediatric Quality of Life Inventory™ 4 (Peds QL™ 4) was significantly lower in the clinical group as compared to that in the control group. Depressive symptoms as derived from Children's' Depression Inventory (CDI) were significantly higher in the clinical group as compared to controls in all the subscales. Children in 7-12 yrs age group who snore were found to have a substantially impaired quality of life that appeared to be unrelated to the severity of OSA. While the pathophysiologic mechanisms that mediate this facet of sleep-disordered-breathing (SDB) - associated morbidity remains to be defined, the present study results suggest that all school children with symptoms of snoring should have a through assessment of their QOL and emotional functioning and necessary intervention should be done at the earliest to remove the causative factor.

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Introduction

There is increasing evidence that childhood sleep disordered breathing (SDB) is associated with behavioral problems that include hyperactivity, inattention and aggression^(1,2). Many studies have reported increased behavioral morbidity for children with primary snoring compared with children who have obstructive sleep apnea, thereby suggesting that snoring alone may be

associated with adverse behavioral outcomes^(3,4). Sleep disruption associated with sleep disordered breathing may cause fatigue and a general irritability that may impair regulation of impulsivity and control of emotions, all of which could facilitate hyperactivity and other externalizing acting out behaviors⁽⁵⁾. In addition, intermittent SDB-associated airflow obstructions causing sleep disruption and intermittent hypoxemia may have a broad negative impact on learning and academic performance; flexibility and intelligence having been found to be markedly affected in children with OSAS⁽⁶⁾.

For over two decades, clinical studies have been conducted which suggest the existence of a relationship between depression and sleep apnea^(7,8). The two main factors suspected to be responsible for depressive

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symptoms in OSA are sleep fragmentation and oxygen desaturation during sleep. OSA and depression share common risk factors, such as obesity, which may partly explain their high co-morbidity in the general population^(9,10). Very frequently in studies of the impact of OSA on cognitive and psychological functioning, a conglomeration of disorders is shown to contribute to the overall neuropsychological outcome.

The impact of sleep disordered breathing on a child's quality of life is poorly understood and has seldom been reported in literature^(11, 12). As outlined earlier, some researchers have found an association between sleep disordered breathing and overall psychological distress including an increased level of depressive symptoms, while others have attributed the clinical depression to be due to associated obesity per se^(9,10). Although some studies have assessed the quality of life and depressive symptoms of children having sleep-disordered breathing who are overweight, very few have included a control group of normal weight children in their assessment⁽¹³⁾.

A study was therefore designed to overcome the aforementioned lacunae in available literature and to examine the relationship among sleep disordered breathing, body mass index and psychosocial variables. It was hypothesized that the presence of sleep-disordered breathing in children would independently lead to increased depression and decreased health related quality of life in comparison to healthy children. The aims and objectives firstly included an assessment of health related quality of life & depressive symptoms in children with suspected sleep disordered breathing and in controls; secondly to study the features of polysomnography in children having sleep disordered breathing.

Materials & Methods

This study was cross-sectional prospective in nature and was conducted in the Department of Pulmonary, Critical Care & Sleep Medicine, Safdarjang Hospital, New Delhi. Sixty children in the age group of 7 to 12 years with complaints of snoring with/without other symptomatology of OSA (frequent arousals during sleep, daytime sleepiness, morning headache, restless sleep) were selected. Those with any co-morbid condition like asthma, cystic fibrosis or any other severe systemic illness that might affect the quality of life as well as adenotonsillectomized children were excluded from the study. Sixty additional age & gender matched children

served as controls.

Following a detailed analysis of symptoms, parents of the clinical and control groups of children were asked to complete validated questionnaires. Parents completed the parent version of the Pediatric Quality of Life Inventory: version 4 (Peds QL™ 4) and the children completed the Children Depression Inventory (CDI) and the child's version of Peds QL™ 4. A standard overnight multichannel polysomnography was performed for the children in the clinical group.

Obstructive apnea was defined as cessation of airflow at the nose and mouth, as measured by thermistor while the respiratory effort continues for at least two breaths. Hypopnea was defined as more than or equal to 50% decrease in the amplitude of the nasal / oral airflow signal accompanied by hypoxemia or arousal⁽²⁹⁾. Clinically significant hypoxemia was diagnosed by the presence of any event associated with oxyhemoglobin desaturation greater than 4% from the baseline sPO₂ or any sPO₂ values less than or equal to 92%. Snoring children with an apnea-hypopnea index (AHI) of less than or equal to one per hour of total sleep time (TST) with no clinically significant hypoxemia, hypercapnia or excessive daytime sleepiness were considered to have primary snoring (PS).

Descriptive statistics consisting of mean and SD was used for initial assessment of data and was followed by computation of t-test for equality of means, ANOVA and linear regression. Statistical significance was set up at p value of < 0.05.

Children's Depression Inventory (CDI) is a validated questionnaire that quantifies depressive symptomatology based on reports from children/adolescents, teachers and parents⁽³²⁾. It is a 27 item self-rated symptom – oriented scale suitable for school children & adolescents. It measures depression i.e. the extent and severity of depressive symptoms in children aged 7 to 17 years. Combined with other sources of verified information, the CDI can aid in the identification and treatment of childhood depression.

Peds QL™ 4 (Pediatric Quality of Life Inventory) is a modular questionnaire-based instrument measuring health related quality of life (HRQOL) in children and adolescents between 2 and 18 years^(30,31). It comprises 23 items encompassing physical functioning, emotional functioning, social functioning and school functioning.

Observations & Results

The mean age of the children was 8.62±1.2 years in cases (range 6-12 years) and 8.01±1.4 years (range 7-12 years) in controls respectively. Seventy-eight of all the children studied were male (65%) and 42 were female (35%). The two groups differed significantly in BMI (t=2.651, p = 0.01). All cases had symptoms of snoring and mouth breathing. Other common symptoms included poor attention, aggressive/hyperactive behaviour, poor growth, nasal discharge, frequent cold and sweating during sleep. Enuresis, nocturnal choking, excessive sleepiness and sleep walking were less commonly noted (Table-1). Majority of study population was underweight

Table 1: Symptomatology of cases

Symptoms	No. of cases	Percentage
Snoring	60	100
Mouth breathing	60	100
Restless sleep	35	59.3
Breathing pause	41	68.3
Frequent cold	33	55
Excessive sleepiness	5	8.3
Nocturnal choking	7	11.6
Nasal discharge	39	65
Mood swings	28	46.6
Poor attention	52	86.6
Enuresis	22	36.6
Aggressive / hyperactive behaviour	52	86.6
Poor growth	52	86.6
Sleep talking	28	46.6
Moving in bed	39	65
Sweating in sleep	37	61.6
Drooling of saliva	24	40
Bruxism	5	8.3
Sleep walking	5	8.3

(BMI <18.5) (85.8 %). Amongst the clinical group, 14.3 % cases constituted healthy weight (BMI 18.5 – 24.9) and 3.5 % were overweight (BMI 25-29.9). No patient in the study group had craniofacial anomaly. Majority of children had both adenoid and tonsillar enlargement.

Patients were classified as primary snorers, those with AHI 2-5 and those with AHI 5-15. AHI and arousal index (AI) were noted to vary very significantly among the three groups namely primary snorers, mild SDB and moderate to severe SDB. (Table 2).

Table 2: Polysomnography findings among snoring children

Polysomnography indices	Primary snorers (n=22)	AHI 2-5 (n=22)	AHI 5-15 (n=16)
Total sleep time (hr)	6.6	6.84	6.51
Sleep efficiency (%)	93.28	91.62	91.06
Sleep latency (min)	6.4	5.8	3.7
Slow wave sleep (% of total sleep time)	32.64	31.4	38
REM sleep (% of total sleep time)	20.27	21.96	20.93
Arousal Index (per hour of total sleep time)	13.42	16.39	27.79
Apnea Hypopnea Index (per hour of total sleep time)	4.02	9.9	21.6
SpO2 (%)			
Mean	97	96.2	88.4
Nadir	89.1	92.1	81.3

Data are presented as mean

Table 3: Health related quality of life (Peds QL™ 4) scores (HRQOL) as derived from the in snoring children and controls

Peds QL™ 4	Cases (n=60)	Control (n=60)
Total		
Parent report	65.3±9.5*	83.68±6.96
Child report	66.02±10.2*	88.67±8.32
Physical functioning		
Parent report	61.94±20.58*	83.98±11.4
Child report	60.93±21.02*	86.69±10.78
Emotional functioning		
Parent report	58.82±15.24*	77.42±11.01
Child report	57.01±15.72*	83.04±7.86
Social functioning		
Parent report	79.83±16.69*	94.01±7.18
Child report	78.1±11.58*	91.08±8.62
School functioning		
Parent report	58.92±14.9*	78.84±11.98
Child report	59.07±12.88*	78.78±11.34

Data are presented as mean ± standard deviation
*p<0.01 versus control

The clinical group had significantly lower ($p < 0.01$) score on Peds QL™4 in total parent versus child reports HRQOL compared to children in the control group, indicating a greater degree of impairment of quality of life in the clinical sample (Table 3).

Depressive symptoms as derived from CDI were significantly higher (i.e. more depressive symptoms) in the clinical case group compared to control in total as well as all subscales except for negative self esteem subscale as compared by t-test for equality of two means (Table 4). No significant difference was observed among boys and girls in parent and child reported HRQOL as assessed by t-test for equality of mean. Ineffectiveness was found to be significantly higher ($t=2.957$, $p<0.01$) among girls as compared to boys. No significant difference emerged among girls and boys in the rest of the child reported symptoms of depression as assessed by t-test for equality of means. There was no significant difference in all the subscales of quality of life as reported by parents and children in sleep disordered breathing group and primary snoring groups as assessed by t-test for equality of means. There was no significant difference in depressive symptoms as reported in child depression inventory by children in between primary snorers and patients of sleep disordered breathing as assessed by t-test for equality of means.

Table 4: depression T scores as derived from the children's depression inventory in snoring children and controls

CDI	Cases (n=60)	Controls (n=60)
Total	54.1 ± 6.98*	42.03 ± 3.11
Negative mood	52.97 ± 11.03*	43.05 ± 3.98
Interpersonal problems	63.95 ± 11.04*	49.07 ± 6.03
Ineffectiveness	51.44 ± 6.77*	44.91 ± 3.62
Anhedonia	52.9 ± 8.77*	41.09 ± 4.17
Negative self esteem	45.01 ± 6.24*	41.03 ± 2.21

Data are presented as mean ± standard deviation
* $p<0.01$ versus control

Children were subdivided into three groups, namely primary snoring, mild and moderate to severe sleep disordered breathing based on criteria mentioned earlier. No significant difference emerged among groups in parent and child reported health related quality of life or child reported symptoms of depression.

HRQOL was compared amongst underweight, normal weight and overweight children using one way ANOVA. Significant difference in parent reported total quality of life ($F=4.291$, $p<0.05$) and child reported school functioning ($F=3.733$, $p< 0.05$) was observed among the groups. No significant difference emerged in other subscales of quality of life as reported by parents and children among the groups.

Depressive symptoms between underweight, normal weight and over weight children was also compared using one way ANOVA. No significant difference emerged among the groups as reported in children depression inventory.

A positive correlation was found to exist between, arousal index (AI) and CDI along with health related quality of life...

Discussion

Although the clinical picture of OSAS and sleep disordered breathing (SDB) is easily recognized, the impact of OSAS and SDB on a child's quality of life is poorly understood. Attention deficit hyperactivity disorder (ADHD) and disturbances in cognitive development in the age group of school going children are important consequences of SDB. Since these children are more likely to experience co-morbid chronic illnesses, cumulative evidence clearly indicates that SDB is an important and frequent condition and that timely diagnosis and treatment are imperative to prevent its deleterious consequences.

There are several limitations in the previous studies about SDB and its effect on children. Most of the earlier studies have been carried out in obese children⁽¹⁰⁾ and none in normal weight or underweight children who have been more commonly found to have SDB⁽²⁷⁾. All the studies that used obese children to establish a relationship between depression, health related quality of life (HRQOL) and SDB have obesity as a major confounding factor⁽¹⁰⁾. Moreover previous studies lack objective measures of OSA in all patients^(14,15,16). Many studies have used history given by parents and clinical examination as the sole evidence of SDB in children without using objective measures like polysomnography (PSG)^(17,18,19). Many of the previous studies have used non-validated measures of behavior outcome and depression in children^(14,16,20). Also, some of them have taken up only referred cases of SDB as sample, which

may have resulted in over-sampling of children with severe forms of SDB.

In sharp contrast to previous studies, the present one has attempted to overcome the aforementioned lacunae. Firstly, it has used an objective measurement, namely polysomnography, for assessment of SDB, which has not only diagnosed SDB but also quantified its severity. Also, equal numbers of age matched cases and controls were utilized. Assessment of controls has made diagnosis and evaluation of severity of depression & impaired HRQOL in children with SDB more authentic. The present study utilized Peds QL™4 and CDI questionnaires, for assessment of HRQOL and depression in children with SDB. These questionnaires are validated measures of HRQOL and depression respectively in children. Moreover, the present study has measured the HRQOL with SDB as reported by both the child and its parents, thus adding to the authenticity of measurement of HRQOL.

Children with SDB in the present study had significantly impaired quality of life as compared to controls as suggested by total score on parent and child reported Peds QL™4 questionnaire. This is similar to findings in earlier studies.⁽²¹⁾

As evident in several other studies cited earlier, a positive correlation was found in this study between variables like arousal index (AI), with depression and health related quality of life as assessed by CDI and Peds QL™4 questionnaires. This may suggest that sleep fragmentation may be an important factor in the genesis of depression and poor HRQOL. Snoring should not be viewed as a harmless and funny symptom since its presence may interfere with the child's psychosocial functioning significantly. This observation is consistent with earlier studies in which primary snorers with normal PSG findings demonstrated significant deficits in specific areas of behavior and cognitive ability.

Underweight children with SDB were found to have a poorer parent reported total HRQOL and emotional functioning and child-reported school functioning. It would thus seem to suggest that SDB can result into impairment in HRQOL independently of obesity.

Several studies have found a positive correlation between depression and obstructive airway symptoms^(7,8,23,24) unlike others who have not found any such association^(25,26,27). The present study also documents significant depression (based on CDI) in children with

SDB. Depressive symptoms including interpersonal problems were significantly higher in snoring patients compared to controls, except for negative self-esteem (as compared by t-test for equality of means). No significant difference between parent and child reports of HRQOL and depressive symptoms among girls and boys have been observed in this study, except "ineffectiveness related depressive symptoms" which was found to be significantly higher among girls than in boys. This is in contrast to findings in an earlier study which reported better HRQOL and less depressive symptoms in girls⁽²⁸⁾. Underweight children with SDB were found to have a higher CDI (more depressed) than those in the control group, thus suggesting that SDB can result into impairment in depression score independently of obesity.

SDB has been found to have an effect on neuro-cognitive skills like memory, immediate recall, visual spatial functions, attention and vigilance, mental flexibility and intelligence⁽⁶⁾. Poor attention has been reported by majority of the clinical cases (86.6%) in this study also. Poor memory has also been reported by majority of cases. In one study, children diagnosed as OSAS were found to have an aversion to bedtime, resulting in behavioral difficulties⁽²²⁾. The group of children that had both obstructive symptoms and bedtime resistance had the highest incidence of behavioral problems. In contrast, no significant bedtime resistance was seen in the present study group. Children with OSAS have sometimes been reported to have excessive daytime sleepiness (EDS); in the present study EDS was not found to be a major problem (8.3%).

While the present study has shed light on the impairment of HRQOL and depressive symptoms in children with SDB, limitations do exist. Importantly, sample selection was dictated by age constraints imposed by the depression instrument used in this study; such a direct sleep report of mood would not have been possible in younger children.

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