Obstructive sleep apnea and association with poor school performance in primary school children, Taif city, in KSA, 2020

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Abstract

Background: Studies have found an association between obstructive sleep apnea (OSA) and children's academic performance.

Objectives: The aim of this study was to assess the prevalence of pediatric OSA and its association with school performance among Saudi children.

Methods: A cross sectional study was done on 340 primary school children. A questionnaire was filled in by parents that included items on sociodemographic variables, nocturnal enuresis, sleeping habits, child academic level. The sleep related breathing disorder scale (SRBD) was used to assess the risk of pediatric SRBD which is an indicator of OSA.

Results: The prevalence of OSA was 9%, with children > 12 years; obese children, those having RTI, and allergy had a significantly higher percentage of those having OSA. A non-significant difference was found between the presence of OSA and children's overall academic level or their levels in different school subjects. A highly significant negative correlation was found between general academic level and SRBD scores.

Conclusion: The prevalence of OSA was 9%, where children > 12 years, obese, those having RTI, and allergy had a significantly higher percentage of having OSA. On the other hand, a non-significant difference was found between the presence of OSA and children's overall academic level. There is a need for future school-based studies done on a larger sample to confirm the observed associations found in the present study.

Key words: Obstructive, sleep, apnea, association, school, performance, Saudi Arabia

Introduction

Obstructive sleep apnea (OSA) is a common chronic illness worldwide which could lead to sleep-disordered breathing (SDB) in adults and children (1). Recently, OSA causes have been divided into "anatomical compromise" episodic upper airway collapse and narrowing during sleep, and "non-anatomical causes" including impaired function of pharyngeal dilator muscle, poor breathing control (high gain loop) and low aerosol threshold. However, patients may have variable degrees of upper airway impairment (2,3,4,5). Most frequent symptoms of OSA are headache, memory loss, excessive sleepiness during the daytime, nocturia and fatigue (6,7). The prevalence in children is estimated in the range of 2%–4% in western countries (8). The prevalence is increasing and is probably underrepresented in the view of the pediatric obesity epidemic (9). The American Academy of Pediatrics recently reiterated its recommendations that children with symptoms and signs suggestive of OSA should be investigated with polysomnography (PSG), and treated accordingly (10). However, treatment decisions should not only be guided by PSG results, but should also integrate the magnitude of symptoms and the presence or absence of risk factors and signs of OSA morbidity [10], and metabolic disorders and cardiovascular disease (11,12,13).

A previous meta-analysis was done in 2015 to evaluate the strength of the relationships between sleep disorder breathing (SDB) and school performance. The study showed a significant association between SDB and poorer academic performance in school-age children (14). Another study done in 2016 in India to assess the prevalence of primary mono-symptomatic nocturnal enuresis (PMNE) in children aged 5-10 years and to find its association with sleep disordered breathing (SDB) by using a 22-item pediatric sleep related breathing disorder (SRBD) scale. Results showed sleep disordered breathing, inappropriate toilet training and a history of childhood NE in fathers were found to be significant risk factors for PMNE (15).

In 2016, a prospective study was done and found that tonsillectomy and/or adenoidectomy significantly improved health-related quality of life in all children with SDB and NE(16). Another study was done to estimate the prevalence of OSA in school children aged 5–10 years and its association with academic performance. This study found that students with positive SRBD questionnaire were more probable to have poorer grades than their counterparts with negative SRBD (17). Also among university students, self-reported snoring and being at high risk for OSA were associated with poor academic performance in a previous study (18).

In the Kingdom of Saudi Arabia, a study was done in 2018 to assess excessive daytime sleepiness which is a common symptom of undiagnosed OSA in Saudi Arabia. The study found that 5.5% were diagnosed with OSA and 44% felt that they had sleep problems (19). Another study done in 2019 found that obesity was a considerable risk factor for developing OSA (20). Among Saudi children, a study was done in 2019 to evaluate associations between sleep-disordered breathing and respiratory conditions/ orofacial symptoms among primary school children in Riyadh city. The study found that 21% of Saudi children are at risk of sleep-disordered breathing, and there was a strong association between sleep-disordered breathing symptoms and the presence of respiratory conditions or orofacial symptoms (21).

A careful literature search has found that no Saudi study has been done to assess the relationship between OSA and the academic performance among Saudi children. That is why this study aimed to assess the prevalence of pediatric OSA and its association with enuresis, obesity, socioeconomic factors, and school grades among children in Taif city, Saudi Arabia.

Methods

Study design, time frame and setting: a cross sectional study was done between May to August 2019 in Taif city, Saudi Arabia

Sampling and population: One primary school in Taif city was selected by simple random sampling methodology and a sample of 340 primary school children in all grades wer the study participants. The inclusion criteria were Saudi children aged 6 - 12 years of both genders, and the exclusion criteria were non-Saudi children, any child with an age outside the previous range, and children with known syndromes or compromised craniofacial anomalies.

Tool of data collection: A self-administered questionnaire filled in by children's parents was used for data collection. The questionnaire sought information regarding sociodemographic variables, NE frequency, sleeping habits. The questionnaire included items on the child's general academic level and his grades in various subjects (Mathematics, Science, Arabic language, Drawing) in the first semester. Their level was graded and given scores: excellent (a score of 4), good (a score of 3), fair (a score of 2), and failing (a score of 1). The questionnaire included the sleep related breathing disorder scale (SRBD) that contains 22 symptom items regarding snoring frequency, loud snoring, difficulty in breathing during sleeping, observed apneas, daytime sleepiness, inattentive, or hyperactive behavior. Each of these items was found to correlate with child OSA that was confirmed by polysomnography (22,23) Every item in the scale has three options: yes = 1, no = 0, or don't know = missing. The number of symptom-items that were reported as positive ("yes") was divided by the number of all 22 items. Items with missing responses and items answered as don't know were excluded. Thus the result of the scale is a proportion ranging from 0.0 - 1.0. Scores more than 0.33 are considered positive and suggest a high risk for a pediatric SRBD and taken as an indicator of OSA (2,23).

Ethical considerations: the study was approved by the research ethics committee of Taif university and written consents were taken from all children's parents.

Statistical analysis: Data were coded, tabulated and analyzed using (SPSS) version 20 (Armonk, NY: IBM Corp.). Qualitative data was expressed as numbers and percentages, and Chi- squared test ($\chi 2$) was applied to test the relationship between variables. Quantitative data was expressed as mean and standard deviation (Mean ± SD). A p-value of <0.05 was considered as statistically significant.

Results

Table 1 shows that 52.1% of the participants were males, 50.9% of fathers had a bachelor's degree of education, 65.9% had a mother with a bachelor's degree of education, and 89.7% and 45.9% of fathers and mothers were employed, respectively. The age of 37.6% of children ranged from 6-< 9 years, 5.9% had Down syndrome, 24.7% were obese, 72.9% were in a governmental school, 30% had a school in the northern region of Taif city, and 24.7% were in the 1st grade.

Table 2 shows that 85.9% of children had a sleep duration of 9 hours or below, 56.5% were sleeping after 22 pm (10pm), 10.9% had RTI, 17.4% had allergy, and 7.9% had tonsillectomy. Most children (50.9%) had no episodes of stopped breathing during sleep (more than 10 seconds) per hour, and 5.6% had previous sleep planning. Of the children, 5.6%, 9.1%, 2.6%, 12.1% and 5% were talking, gnashing teeth, walking, sweating and having restless legs during sleep respectively.

Figure 1 shows that the prevalence of a score of SRBD >0.33 is suggestive of high risk pediatric SRBD which is an indicator of OSA, was in 9%.

Table 3 shows that children > 12 years old, obese children, those having RTI, and allergy, had a significant higher percentage of those having OSA. At the same time, children who walk and sweat during sleep had the same significantly higher percentage of those having OSA (P=< 0.05). On the other hand, a non-significant difference was found between OSA presence and children's school type and position, grade level, sleep duration and time, number of episodes of stopped breathing during sleep and walking during sleep, previous tonsillectomy, previous sleep planning, talking, gnashing teeth and having restless legs during sleep (P=> 0.05). Table 4 shows that a non-significant difference was found between the presence of OSA and children's overall academic level or their levels in different school subjects (p=> 0.05).

Figure 1 shows that Spearman correlation analysis between general academic level and SRBD scores showed a highly significant negative correlation between them NB: (r= -0.199, p=< 0.001).

Table 1: Distribution of the studied participants according to their characters and child age, obesity, school type and location, grade level and presence of Down syndrome

Variable	No (%)
Gender	
Male	163 (47.9)
Female	177 (52.1)
Father education	
Illiterate	7(2.1)
Primary ed.	18 (5.3)
Preparatory edu.	29 (8.5)
Secondary edu.	84(24.7)
Bachelor degree	173(50.9)
Higher then bachelor edu.	29 (8.5)
Father employment	
Employed	305(89.7)
Unemployed	35 (10.3)
Mother education	
Illiterate	16 (4.7)
Primary ed.	14(4.1)
Preparatory edu.	12 (3.5)
secondary edu.	65(19.1)
Bachelor's degree	224 (65.9)
Higher then bachelor edu.	9 (2.6)
Mother employment	
Employed	156 (45.9)
Unemployed	184(54.1)
Age of child:	
<6	54 (15.9)
6-< 9	128 (37.6)
9-12	112(32.9)
>12	46 (13.5)
Child having Down syndrome	
Yes	20(5.9)
No	320 (94.1)
Obese child	
No	84 (24.7)
Yes	256 (73.3)
School type	
Private	92 (27.1)
Governmental	248(72.9)
School location	
eastern region	88 (25.9)
western region	93 (27.4)
northern region	102 (30)
southern region	57(16.8)
Grade level	
1st	84 (24.7)
2nd	46 (13.5)
3rd	53 (15.6)
4th	46 (13.5)
5th	45 (13.2)
6th	66(19.4)

Table 2. Distribution of the studied children according to parameters related to their sleep, having RTI, allergy previous tonsillectomy and mean score of SRBD scale

Variable	No (%)
Sleep duration	
9 hours or below	231 (58.9)
Above 9 hours	109 (32.1)
Sleep time	
Before or at 22 p.m.	148 (43.5)
After 22 p.m.	192 (56.5)
RTI	
Yes	37(10.9)
No	303 (89.1)
Allergy	
Yes	59 (17.4)
No	281 (82.6)
Tonsillectomy	
Yes	27(7.9)
No	313(92.1)
Number of episodes of stopped breathing during sleep (more than 10 seconds) per hour	173 (50.9)
0	27(7.9)
<5	5 (1.5)
5-15	2 (0.6)
15-30	6 (1.8)
>30	127(37.4)
I Don't Know	
Previous sleep planning	
Yes	19 (5.6)
No	321 (94.4)
Talk during sleep	
Yes	19(5.6)
No	213 (6 2.6)
I don't know	108 (31.8)
Gnashing teeth during sleep	
Yes	31 (9.1)
No	246 (72.4)
I don't know	63 (18.5)
Walk during sleep	
Yes	9 (2.6)
No	300 (88.2)
I don't know	31 (9.1)
Sweat during sleep	
Yes	41 (12.1)
No	213 (62.6)
I don't know	86 (25.3)
Restless leg during sleep	
Yes	17(5)
No	233 (68.5)
I don't know	90 (26.5)
Mean (SRBD) scale	0.12 ± 0.13

Table 3. Relationship between the presence of OSA and children's characteristics (age, obesity, school type and location, grade level and presence of Down syndrome), parameters related to their sleep, having RTI, allergy and previous tonsillectomy)

Variable	OSA		χ^2	p-value
	Present No (%)	Absent No (%)		
Age of child				
<6	7 (13)	47 (87)	11.68	0.009
6-< 9	5 (3.9)	123 (96.1)		
9-12	9 (8)	103 (92)		
>12	9 (13.6)	37 (80.4)		
Obese child				
No	9 (18.4)	40 (81.6)	6.48	0.01
Yes	21 (7.2)	270 (92.2)		
School type				
Private	7 (7.2)	85 (92.4)	0.23	0.63
Governmental	23 (9.3)	225 (90.7)		
School location				
eastern region	6 (6.8)	82 (93.2)	1.22	0.74
western region	10 (10.8)	83 (89.2)		
northern region	10 (9.8)	92 (90.2)		
southern region	4 (7)	53 (93)		
Grade level				
1st	5 (6)	79 (94)	4.38	4.8
2nd	2 (4.3)	44 (95.7)		
3rd	4 (7.5)	49 (92.5)		
4th	5 (10.9)	41 (89.1)		
5th	6 (13.3)	39 (86.7)		
6th	8 (12.1)	58 (87.9)		
Sleep duration				
9 hour or below	19 (8.2)	212 (91.8)	0.32	0.57
Above 9 hours	11(10.1)	98 (89.9)		
Sleep time				
Before or at 22 p.m.	8 (5.4)	140 (94.6)	3.8	0.05
After 22 p.m.	22 (11.5)	170 (88.5)		
RTI				
Yes	6 (16.2)	31 (83.8)	2.82	0.009
No	24 (7.9)	279 (92.1)		
Allergy				
Yes	10 (16.9)	49 (83.1)	5.85	0.01
No	20 (7.1)	261 (92.9)		
Tonsillectomy				
Yes	4 (14.8)	23 (85.2)	1.3	0.25
No	26 (8.3)	287 (91.7)		
Number of episodes of stopped breathing during sleep (more than 10 seconds) per hour				
0	11 (6.4)	162 (93.6)	4.82	0.43
<5	4 (14.8)	23 (85.2)		
5-15	1 (20)	4 (80)		
15-30	0 (0.0)	2 (100)		
>30	0 (0.0)	6 (100)		
I Don't Know	14 (11)	113 (89)		
Previous sleep planning				
Yes	3 (15.8)	16 (84.2)	1.21	0.27
No	27 (8.4)	294 (91.6)		

Table 3. Relationship between the presence of OSA and children's characteristics (age, obesity, school type and location, grade level and presence of Down syndrome), parameters related to their sleep, having RTI, allergy and previous tonsillectomy) (continued)

Talk during sleep				
Yes	2 (10.5)	7 (89.5)	1.22	0.45
No	16 (17.5)	197 (92.2)		
I don't know	12 (11.1)	96 (88.9)		
Gnashing teeth during sleep				
Yes	6 (19.4)	25 (80.6)	5.8	0.05
No	17 (6.9)	229 (93.1)		
I don't know	7 (11.1)	56 (88.9)		
Walk during sleep				
Yes	3 (33.3)	6 (66.7)	12.23	0.002
No	21 (7)	279 (93)		
I don't know	6 (19.4)	25 (80.6)		
Sweat during sleep				
Yes	7 (17.1)	34 (82.9)	9.82	0.007
No	11 (5.2)	202 (94.8)		
I don't know	12 (14)	74 (86)		
Restless legs during sleep				
Yes	4 (23.5)	13 (76.5)	5.4	0.07
No	17 (7.3)	216 (92.7)		
I don't know	9 (10)	81 (90)		

Figure 1: Prevalence of OSA among studied children

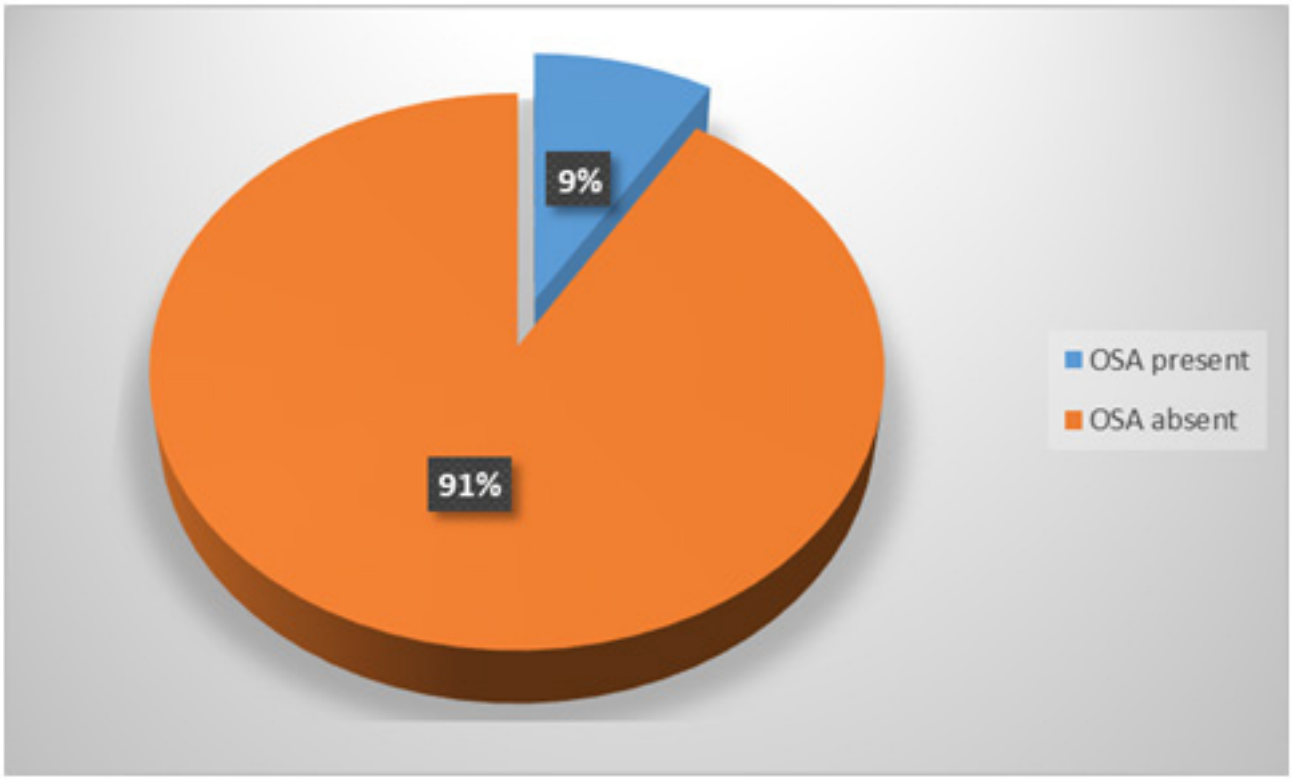

Figure 1. Spearman correlation between general academic level and SRBD scores

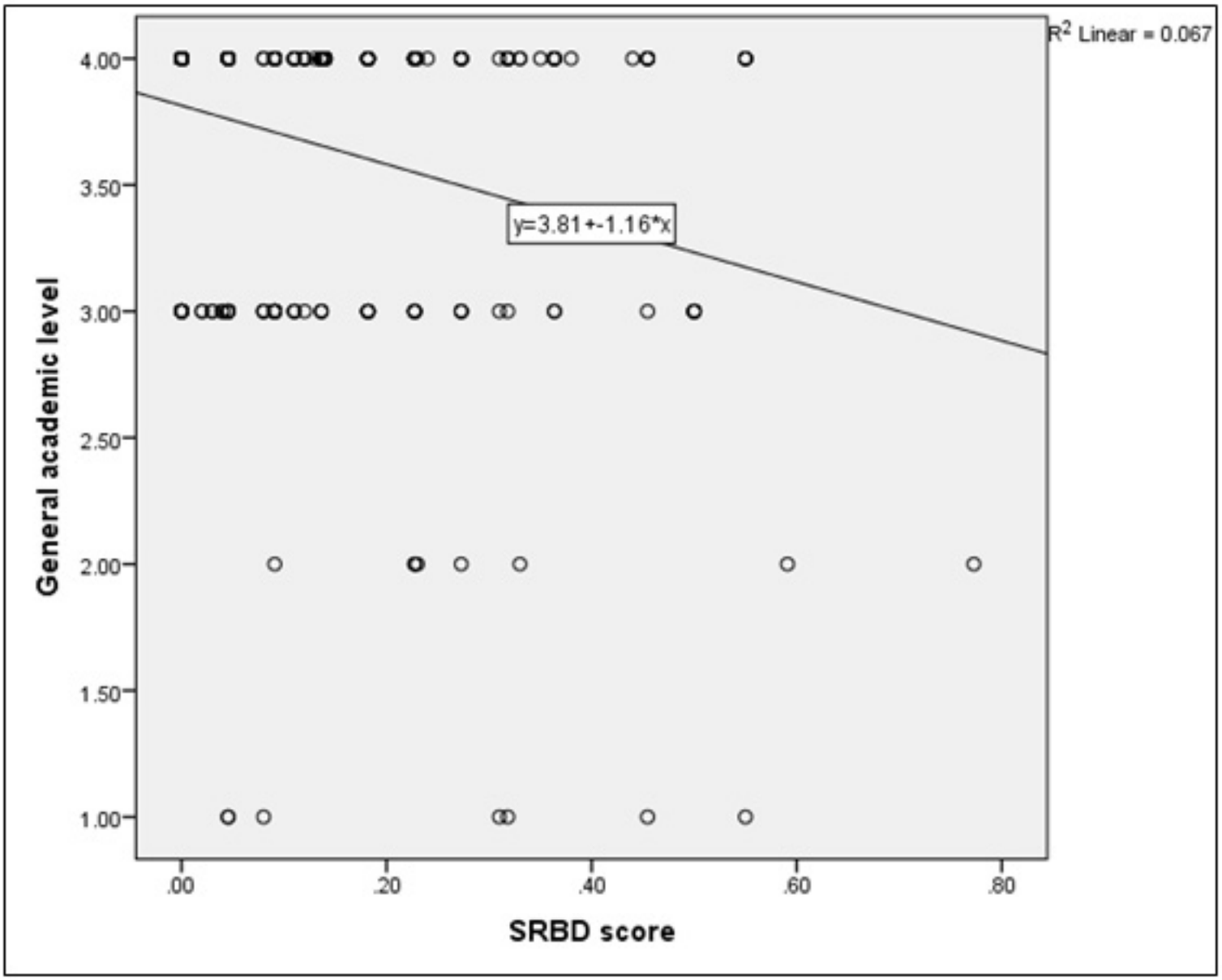

Table 4. Relationship between the presence of OSA and children's general academic level and level in school subjects

Variable	OSA		χ^2	p-value
	Present No (%)	Absent No (%)		
Overall school grade				
Excellent	2 (28.6)	5 (71.4)	6.52	0.08
Good	2 (25)	6 (75)		
Fair	7 (9.5)	67 (90.5)		
Failing	19 (7.6)	232 (92.4)		
Mathematics				
Excellent	16 (7.2)	206 (92.8)	5.82	0.12
Good	10 (11.6)	76 (88.4)		
Fair	3 (10)	27 (90)		
Failing	1 (50)	1 (50)		
Science				
Excellent	20 (7.9)	232 (92.1)	2.15	0.54
Good	9 (13)	60 (87)		
Fair	1 (5.9)	16 (94.1)		
Failing	0 (0.0)	2 (100)		
Arabic language:				
Excellent	17 (7.4)	213 (92.6)	3.01	0.39
Good	10 (10.8)	83 (98.2)		
Fair	2 (15.1)	11 (84.6)		
Failing	1 (25)	3 (75)		
Drawing				
Excellent	20 (8.4)	219 (91.6)	1.54	0.67
Good	9 (11.7)	68 (88)		
Fair	1 (4.5)	21 (95.5)		
Failing	0 (0.0)	2 (100)		

Discussion

The present cross-sectional study aimed to assess the prevalence of pediatric OSA and its association with enuresis, obesity, socioeconomic characters and school performance among children in Taif city, Saudi Arabia. In this study, the prevalence of OSA was 9% in studied children which was assessed by a score of SRBD >0.33. This result is lower than that reported from a study done in Riyadh, Saudi Arabia (21), where the prevalence of children who were at high risk of sleep disordered breathing was 21% by using pediatric sleep questionnaire. Also, in another study done in Kirkuk in Iraq, 25% of children were at high risk of having at least one type of sleep disorder(24).

Regarding obesity, the normal BMI among children varies according to age and gender thus it is difficult to identify and label the weight status (25,26). This study revealed that children > 12 years old, obese children, those having RTI, and allergy, had a significantly higher percentage of those having OSA. At the same time, children who walk and sweat during sleep had the same significantly higher percentage of those having OSA. Previous studies agreed with our results as it showed that overweight children have high risk to develop OSA compared to normal weight children (25,27). At the same time, it was found that OSA can induce obesity pathogenesis by increasing ghrelin secretion and leptin resistance; these hormones play major role in appetite regulation (10,28).

Our finding demonstrated that a non-significant association was found between the presence of OSA among studied children and the overall school performance or their grades in Mathematics, Science, Arabic and Arts. There have been numerous studies on the association between pediatric SRBD and school performance (14,29,30,31,32,33). These studies found different results as some of them revealed an association between SDB and poor school performance (14,29,30,31), and some did not (32,33). Despite the predominance of studies that proved the association, the difference could be attributed to the different settings. Previous studies observed the association between sleepwalking in children and obstructive sleep apnea (34). In the present study, children with positive OSA were more probable for sleep walking; this could be explained by the lack of sleep due to OSA (34).

Quite a number of children with OSA were found to have nocturnal enuresis (NE) (35). In this study we found a strong relationship between NE and children with OSA. It has been assumed that increased enuresis may be due

to the diminishing effects of OSA on arousal responses, to changes in bladder pressure, or potentially associated with hormonal changes involved in fluid regulation. In a meta-analysis of 14 studies, NE was significantly associated with OSA (36). So, it is essential to ask any patient suspected of having OSA about history of NE and vice versa.

A limitation of this study could be the cross-sectional study used that can reveal the association between variables without revealing the causal relationship

Conclusion

This study found that the prevalence of a score of SRBD >0.33 was suggestive of high risk pediatric SRBD which as an indicator of OSA was 9%. Children > 12 years, obese children, those having RTI, and allergy, had a significantly higher percentage of those having OSA. On the other hand, a non-significant difference was found between the presence of OSA and children's overall academic level or their levels in different school subjects. A highly significant negative correlation was found between general academic level and SRBD scores. There is a need for future school-based studies done on a larger sample to confirm the observed associations found in the present study.

References

1. Dehlink E, Tan HL. Update on paediatric obstructive sleep apnoea. Journal of thoracic disease 2016;8(2):224-2135.
2. Heinzer R, Vat S, Marques-Vidal P, Marti-Soler H, Andries D, Tobback N, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. The Lancet Respiratory medicine 2015;3(4):310-318.
3. Eckert DJ. Phenotypic approaches to obstructive sleep apnea - New pathways for targeted therapy. Sleep medicine reviews 2018;37:45-59.
4. Eckert DJ, White DP, Jordan AS, Malhotra A, Wellman A. Defining phenotypic causes of obstructive sleep apnea. Identification of novel therapeutic targets. American journal of respiratory and critical care medicine 2013;188(8):996-1004.
5. Neelapu BC, Kharbanda OP, Sardana HK, Balachandran R, Sardana V, Kapoor P, et al. Craniofacial and upper airway morphology in adult obstructive sleep apnea patients: A systematic review and meta-analysis of cephalometric studies. Sleep medicine reviews 2017;31:79-90.
6. Antic NA, Catcheside P, Buchan C, Hensley M, Naughton MT, Rowland S, et al. The effect of CPAP in normalizing daytime sleepiness, quality of life, and neurocognitive function in patients with moderate to severe OSA. Sleep 2011;34(1):111-119.
7. Romero E, Krakow B, Haynes P, Ulibarri V. Nocturia and snoring: predictive symptoms for obstructive sleep apnea. Sleep Breath 2010;14(4):337-343
8. Lumeng JC, Chervin RD. Epidemiology of pediatric obstructive sleep apnea. Proceedings of the American Thoracic Society 2008;5(2):242-252.
9. Muzumdar H, Arens R. Physiological effects of obstructive sleep apnea syndrome in childhood. Respiratory physiology & neurobiology 2013;188(3):370-382.
10. Tan H-L, Gozal D, Kheirandish-Gozal L. Obstructive sleep apnea in children: a critical update. Nat Sci Sleep 2013;5:109-123.
11. Drager LF, Togeiro SM, Polotsky VY, Lorenzi-Filho G. Obstructive sleep apnea: a cardiometabolic risk in obesity and the metabolic syndrome. Journal of the American College of Cardiology 2013;62(7):569-576.
12. Kapur VK, Resnick HE, Gottlieb DJ. Sleep disordered breathing and hypertension: does self-reported sleepiness modify the association? Sleep 2008;31(8):1127-1132.
13. Walia HK, Li H, Rueschman M, Bhatt DL, Patel SR, Quan SF, et al. Association of severe obstructive sleep apnea and elevated blood pressure despite antihypertensive medication use. Journal of Clinical Sleep Medicine. 2014;10(08):835-843.
14. Galland B, Spruyt K, Dawes P, McDowall PS, Elder D, Schaughency E. Sleep Disordered Breathing and Academic Performance: A Meta-analysis. Pediatrics 2015;136(4):e934-e46.
15. Choudhary B, Patil R, Bhatt GC, Pakhare AP, Goyal A, P A, et al. Association of Sleep Disordered Breathing with Mono-Symptomatic Nocturnal Enuresis: A Study among School Children of Central India. PloS one 2016;11(5):e0155808.
16. Kovacevic L, Wolfe-Christensen C, Lu H, Lulgjuraj M, Abdulhamid I, Thottam PJ, et al. Adenotonsillectomy improves quality of life in children with sleep-disordered breathing regardless of nocturnal enuresis outcome. Journal of pediatric urology 2015;11(5):269.e1-5.
17. Goyal A, Pakhare AP, Bhatt GC, Choudhary B, Patil R. Association of pediatric obstructive sleep apnea with poor academic performance: A school-based study from India. Lung India : official organ of Indian Chest Society 2018;35(2):132-136.
18. Khassawneh BY, Alkhatib LL, Ibnian AM, Khader YS. The association of snoring and risk of obstructive sleep apnea with poor academic performance among university students. Sleep and Breathing 2018;22(3):831-836.
19. Jamal B, Eskandrani R, Al-YahyaA. Undiagnosed Obstructive Sleep Apnea in the Population of Saudi Arabia. OHDM 2018; 17 (4):1-4
20. Alshehri KA, Bashamakh LF, Alshamrani HM, O. Alghamdi I, A. Mahin B, A. Alharbi A, et al. Pattern and severity of sleep apnea in a Saudi sleep center: The impact of obesity. J Family Community Med 2019;26(2):127-132.
21. Baidas L, Al-Jobair A, Al-Kawari H, AlShehri A, Al-Madani S, Al-Balbeesi H. Prevalence of sleep-disordered breathing and associations with orofacial symptoms among Saudi primary school children. BMC Oral Health 2019;19(1):43-51.
22- Chervin RD, Weatherly RA, Garetz SL, Ruzicka DL, Giordani BJ, Hodges EK, et al. Pediatric sleep questionnaire: Prediction of sleep apnea and outcomes. Arch Otolaryngol Head Neck Surg 2007;133:216 222
23- Chervin RD, Hedger KM, Dillon JE, Pituch KJ. Pediatric Sleep Questionnaire (PSQ): validity and reliability of scales

for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep Medicine 2000;1:21-32.
24-Muhe-Aldeen AL, Ibrahim RH. Prevalence of Sleep Disorders among Children in Elementary Schools in Kirkuk City. Mosul Journal of Nursing 2015;1(1):1-11.
25-Kang, K., Lee, P., Weng, W. et al. Body weight status and obstructive sleep apnea in children. Int J Obes 2012; 36: 920–924.
26-Xu Z, Jiaqing A, Yuchuan L, Shen K. A case-control study of obstructive sleep apnea-hypopnea syndrome in obese and nonobese Chinese children. Chest 2008; 133: 684–689
27-Wing YK, Hui SH, Pak WM, Ho CK, Cheung A, Li AM, et al. A controlled study of sleep related disordered breathing in obese children. Arch Dis Child 2003; 88: 1043–1047
28- Spruyt K, Sans Capdevila O, Serpero LD, Kheirandish-Gozal L, Gozal D. Dietary and physical activity patterns in children with obstructive sleep apnea. J Pediatr. 2010;156(5):724–730.
29- Perez-Chada D, Perez-Lloret S, Videla AJ, Cardinali D, Bergna MA, Fernández-Acquier M, et al. Sleep disordered breathing and daytime sleepiness are associated with poor academic performance in teenagers. A study using the Pediatric Daytime Sleepiness Scale (PDSS). Sleep 2007;30(12):1698-1703
30- Gozal D. Sleep-disordered breathing and school performance in children. Pediatrics 1998;102:616-620
31-Kim JK, Lee JH, Lee S-H, Hong S-C, Cho JH. School performance and behavior of Korean elementary school students with sleep-disordered breathing. Ann Otol Rhinol Laryngol 2011;120:268-272.
32- Sahin U, Ozturk O, Ozturk M, Songur N, Bircan A, Akkaya A. Habitual snoring in primary school children: prevalence and association with sleep-related disorders and school performance. Med Princ Pract 2009;18:458-465.
33- Chervin RD, Clarke DF, Huffman JL, Szymanski E, Ruzicka DL, Miller V, Nettles AL, Sowers MR, Giordani BJ. School performance, race, and other correlates of sleep-disordered breathing in children. Sleep Med 2003;4(1):21-27.
34-Goodwin JL, Kaemingk KL, Fregosi RF, Rosen GM, Morgan WJ, Smith T, et al. Parasomnias and sleep disordered breathing in Caucasian and Hispanic children - the Tucson children's assessment of sleep apnea study. BMC Med 2004; 28;2:14-23.
35- Butler RJ. Management of nocturnal enuresis. Curr Paediatr 2001;11: 129–132
36-Jeyakumar A, Rahman SI, Armbrecht ES, Mitchell R. The association between sleep-disordered breathing and enuresis in children. Laryngoscope. 2012;122(8):1873–1877.