



# Prevalence of childhood obstructive sleep apnoea syndrome and its role in daytime sleepiness in Syria: a large-scale school-based cross-sectional study

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**Background:** Obstructive sleep apnoea syndrome (OSAS) has become vastly conceded in the last decade as a possible reason for significant morbidity in childhood. This study aims to evaluate the prevalence of OSAS among school children and to assess the interrelationship between OSAS and daytime sleepiness.

**Methods and materials:** This cross-sectional study was conducted with 1029 children and adolescents aged 6–15 years attending elementary and secondary schools in Damascus, Syria. The questions involved 19 sleep problems items using the children sleep habits questionnaire, and 4 sleep disorder items (loud snoring, having snorts or gasps, breathing pauses, daytime sleepiness). Total sleep time (TST) was determined by sleep habits. Severe possible OSAS (p-OSAS) was addressed as having all OSA symptoms “frequently”, and mild p-OSAS was defined as having any of the symptoms “sometimes”. Severe and mild daytime sleepiness were rated as being very sleepy during the day “frequently”, and “sometimes”, respectively. Logistic regression was applied to predict risk factors of severe and mild daytime sleepiness.

**Results:** The prevalence of p-OSAS was 22.2%, of them 15.8% were mild, and 6.3% were severe. p-OSAS was more recognized in males 15.2% children ( $P < 0.05$ ). Most p-OSAS children sleep less than 6 h of TST; however; the mean TST was significantly lower at the secondary school level ( $P \leq 0.001$ ). Predicted risk factors for severe and mild daytime sleepiness were students’ grade level ( $P < 0.05$ ), severe and mild p-OSAS ( $P \leq 0.001$ ), and TST less than 6 h ( $P \leq 0.001$ ).

**Conclusions:** A significant number of children have p-OSAS, affecting daytime sleepiness in school age. Physicians should consider loud snoring, and breathing pauses as marked symptoms of severe daytime sleepiness. Moreover, raising parents awareness about OSAS and daytime sleepiness is essential to ensure early access to primary care.

**Keywords:** adolescence, daytime sleepiness, obstructive sleep apnoea, school children, sleep habits

## Introduction

Obstructive sleep apnoea syndrome (OSAS) is episodes of recurrent, sleep-related partial or complete obstruction of the upper airway, typically accompanied by a decrease in blood oxygen saturation due to its effect on normal ventilation<sup>[1]</sup>. The syndrome has primarily been studied in adults through literature.

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## HIGHLIGHTS

- High rates of possible obstructive sleep apnoea syndrome and excessive daytime sleepiness) were found in school-aged children in Damascus Syria.
- This study shows a significant association between obstructive sleep apnoea syndrome with mild and severe daytime sleepiness.
- Children with excessive daytime sleepiness were significantly affected by sex, school grade level, obstructive sleep apnoea syndrome, and total night sleep time.

Lately, OSAS began to have an increased interest among children<sup>[2]</sup>. Hence, it is now a common paediatric disease with an emerging health problem and recognized as a severe type of sleep-disordered breathing spectrum<sup>[3]</sup>.

Recent literature declared the prevalence of OSAS of one billion cases among adults worldwide. This goes along with a universal economic burden involving several challenges to compact the disease<sup>[4]</sup>. Furthermore, the global incidence of paediatric OSAS ranged between 1 and 5% in correspondence to The American Academy of Pediatrics (AAP), with debatable prevalence depending on the populace assessed and measures used<sup>[5]</sup>.

Multiple risk factors for OSAS have been determined, in particular adenotonsillar hypertrophy, obesity, craniofacial abnormalities, and upper respiratory tract infections<sup>[5]</sup>.

Habitual snoring is a prominent symptom of OSAS, in combination with apnoea, and disturbed sleep<sup>[6]</sup>. This manifestation can be present during the day through oral breathing, dry lips, difficulties in swallowing, and halitosis<sup>[3]</sup>. Regardless, isolated symptoms are neither sensitive nor specific indicators of the genuine problem<sup>[5]</sup>.

OSAS consequences predisposed differently in all body systems. Daytime sleepiness (DS) is one of the crucial OSAS outcomes that leads to severe psychosocial morbidities and poor quality of life, with high specificity incidence in suspected children<sup>[5]</sup>.

DS is a sleep that occurs inadvertently or under inappropriate conditions, with the inability to sustain awakeness and attention during the day<sup>[1]</sup>. Moreover, excessive daytime sleepiness (EDS), a severe pattern of DS, is detected when the functional impact is presented or subjective discomfort is aggregated<sup>[7]</sup>. The correlation between OSAS and DS is marked by various symptoms. The prevalence of DS in children with OSAS ranged from 8 to 84%<sup>[5,8–10]</sup>, however; the exact prevalence of EDS in paediatric OSAS is still unclear. The impact of sleep fragmentation on daytime behaviour in children presented in hyperactivity, anxiety, and depressive episodes. These lead to frequent classroom napping, social dysfunction, and poor standard of living for both parents and children<sup>[11,12]</sup>.

Few reports addressed sleep-related problems, such as OSAS and EDS in the Middle East<sup>[13,14]</sup>. Thus, the real burden and how common the disease is yet to be screened properly.

In Syria, rates of health problems such as diabetes, hypertension, and cardiovascular diseases were comparable to those of neighbouring countries. In a sample of Syrian adults, the prevalence of obstructive sleep apnoea was 29.1%<sup>[4]</sup>. Although there is an absence of conclusive research on the incidence of OSAS in younger individuals, widespread is expected, via the ongoing crisis.

A huge burden remains during the Syrian war crisis and Covid-19 as millions of Syrians suffer cataclysm on all fronts. About 11.1 million people are in need of humanitarian assistance and 2.7 million are dependent on it. In addition, more than 5.5 million individuals have fled the country, 6 million are internally displaced, and more than 80% of the population lives in poverty<sup>[15]</sup>.

Moreover, the high demand for medical services and medicine has sharply affected the quality of medical care for civilians. This was due to the adverse effects of economic sanctions, demolition of healthcare facilities, currency inflation, and an increase in the costs of conducting medical, laboratory, and surgical investigations.

However, OSAS remains an overlooked and treatable disorder in children<sup>[16]</sup>. Reports on the prevalence of childhood OSAS and DS have become scarce. Therefore, the objectives of this study were: (1) to assess the prevalence of OSAS and daytime sleepiness among Syrian children in Damascus city; (2) to address the correlations between daytime sleepiness and OSAS; (3) to determine the related risk factors for daytime sleepiness. This preliminary study investigates the spread of this syndrome among a group of children in the city of Damascus. The aim is to raise awareness and contribute to highlighting risk factors and activate the role of prevention.

## Methods

### Study methods, and participants

A questionnaire-based cross-sectional study was conducted among 1029 children aged 6–15 years attending 6 elementary and 3 middle schools in Damascus and its suburbs in Syria. In Syria, mandatory education is for 6 years in elementary school (grades 1–6), and 3 years in secondary school (grades 7–9). The survey was distributed using a convenience sampling method between March 2022 and May 2022 to the student's parents or guardians, who were asked to participate voluntarily. Written informed consent was obtained from all participants, and they were informed that they were allowed to opt-out of the survey at any time. Parents who contributed to the study were asked to sign the questionnaire to prove that it was filled by themselves not the students, and to return the questionnaire to the school administration office before the end of June 2022. The sample size was calculated as 383 to a population of 83 960 with a margin error of 5% and a confidence interval of 95% using a sample size calculator.

### Study instruments

Parents or guardians completed a paper-based questionnaire that was adopted from a previously published article<sup>[17]</sup>, about sleep habits and sleep-related problems during the last month. The survey was translated into Arabic language and then retranslated into the English language to evade translation problems. Reliability was assessed at Cronbach's alpha of 0.784. The questionnaire contained 3 sections:

- (1) Sociodemographic factors included six questions on school place, sex, grade level, child birth order, sleep position, and parents' consideration of child sleep.
- (2) Sleep problems were assessed using a standardized brief 19-item sleep based on the Children's Sleep Habits Questionnaire (CSHQ)<sup>[18]</sup>: 12 questions on behaviour occurring oversleeping, 5 on troubles related to morning awakening, 4 on nighttime behaviour, and 2 on daytime sleepiness.
- (3) Obstructive sleep apnoea syndrome and daytime sleepiness were assessed with four items on related symptoms including loud snoring, stopping breathing during sleep, having snorts or gasps, and seeming very sleepy in the daytime. Responding to these items was using a 3-point Likert scale: rarely, sometimes, and frequently<sup>[17]</sup>.

The work in this study complies with the principles laid down in the Declaration of.

Mathew G and Agha R, for the STROCCS Group. STROCCS 2021: Strengthening the Reporting of cohort, cross-sectional and case-control studies in Surgery. *Int J Surg* 2021; 96:106–165<sup>[19]</sup>.

### Possible obstructive sleep apnoea syndrome (p-OSAS) and daytime sleepiness interpretation

The presence of (p-OSAS) was identified as a response of sometimes or frequently to at least one of the three OSAS symptoms (loud snoring, snorts and gasps, and breathing pauses). Severe p-OSAS was defined as having at least one of three OSAS-related symptoms (loud snoring, snorts and gasps, and breathing pauses) 'frequently' ( $\geq 5$  episodes weekly), while 'mild' p-OSAS was defined as having any of these 'sometimes' (2–4 episodes weekly).

The severity of daytime sleepiness was determined by responses to the question, ‘Does your child seem very sleepy in the daytime?’ Severe daytime sleepiness was defined as a response of ‘frequently’ ( $\geq 5$  episodes weekly), and ‘mild’ daytime sleepiness as a response of ‘sometimes’ (2–4 episodes weekly).

### Statistical analysis

Data were displayed as frequencies and percentages for categorical variables, and means with SD for continuous variables. The Statistical Package for Social Sciences version 26.0 (SPSS Inc.) was used to analyse the study.

Over the preceding month, information was gathered on the child’s bedtime (BT), sleep onset latency (SOL), number and length of nocturnal awakenings (WASO), wake time (WT), and number and duration of daytime naps. Bedtime irregularity was also collected (on average, 90 minutes per week). Sleep onset time (SOT = BT + SOL), time in bed [time in bed (TIB) = interval from BT to WT], and total night sleep time [Total sleep time (TST) = TIB(SOL + WASO)] were all measured from the collected data. The *t*-test analysis was used to study the differences in TST among elementary and secondary school students. The  $\chi^2$  test was used to evaluate the differences in OSAS and daytime sleepiness between elementary and secondary school students. In addition, the  $\chi^2$  test was performed to examine the association between p-OSAS and students’ characteristics and their sleep habits. Multiple logistic regression was conducted to evaluate the presence of mild and severe daytime sleepiness as the dependent variable. Independent variables were sex, grade level, p-OSAS, and TST. Reference variables were set by the following: males, 9th grade, ‘no’ p-OSAS, TST ‘8–9’ h, respectively. Statistical significance was considered at *P* value less than 0.05.

## Results

### Sociodemographic characteristics

Of 3000 paper-based questionnaires distributed, only 1029 forms were fully completed with a response rate 34.3%. Around 62.4% were males, 37.6% were females, mean age was 9.9 ( $\pm 2.5$ ) years. Most of the students were at their 2nd 14.4% and 4th 14.8% grade level, while the majority of children were at elementary school 69.8%, and 30.2% were at secondary school. Approximately, all parents considered their child’s sleep as no big problem 90.8%, compared with 8.5% who rated their child’s sleep as a mild problem, and 0.8% as a severe problem (Table 1).

### Prevalence of p-OSAS and daytime sleepiness

The prevalence of p-OSAS was 22.2% among total school students with 15.8% being mild, and 6.3% were severe cases. Daytime sleepiness was prevalent in 29.5% of the students, of them 24.6% were mild, and 4.9% were severe. The majority of Daytime sleepiness mild cases presented in elementary school students was 16.3% compared with 8.3% in secondary school students ( $P < 0.001$ ).

The TST mean was 7.1 h; however, TST mean was lower in secondary school students at 6.3 h in comparison with 7.4 h in elementary school students ( $P \leq 0.001$ ) (Table 2).

**Table 1**

### Socio demographic characteristics: (n = 1029)

School place, n (%)	
City	417 (40.5)
Superb	612 (59.5)
Sex, n (%)	
Male	642 (62.4)
Female	387 (37.6)
Grade level, n (%)	
1st	64 (6.2)
2nd	148 (14.4)
3rd	127 (12.3)
4th	152 (14.8)
5th	114 (11.1)
6th	113 (11)
7th	113 (11)
8th	103 (10)
9th	95 (9.2)
Education level, n (%)	
Elementary	718 (69.8)
Secondary	311 (30.2)

### Association of p-OSAS and children characteristics

p-OSAS was presented in male students at 15.2% compared with females at 7% ( $P = 0.033$ ). The majority of students with p-OSAS significantly had less than 6 h of TST ( $P \leq 0.001$ ) (Table 3).

**Table 2**

### Prevalence of p-OSAS and daytime sleepiness in childhood and adolescence

	Grade		Total, N (%)	$\chi^2/t$	<i>P</i>
	Elementary, N (%)	Secondary, N (%)			
Child snores loudly					
Sometimes	81 (7.9)	33 (3.2)	114 (11.1)	3.484	0.175
Frequently	29 (2.8)	21 (2)	50 (4.9)		
Total	110 (10.7)	54 (5.2)	164 (16)		
Child seems to stop breathing during sleep					
Sometimes	42 (4.1)	19 (1.8)	61 (5.9)	1.336	0.513
Frequently	11 (1.1)	8 (0.8)	19 (1.8)		
Total	53 (5.1)	27 (2.6)	80 (7.7)		
Child snorts and/or gasps during sleep					
Sometimes	64 (6.2)	29 (2.8)	93 (9)	3.111	0.211
Frequently	16 (1.6)	13 (1.3)	29 (2.8)		
Total	80 (7.8)	42 (4.1)	122 (11.8)		
P- OSAS					
Mild	115 (11.2)	48 (4.7)	163 (15.8)	5.436	0.066
Severe	37 (3.6)	28 (2.7)	65 (6.3)		
Total	152 (14.8)	76 (7.4)	228 (22.1)		
Daytime sleepiness					
Mild	168 (16.3)	85 (8.3)	253 (24.6)	20.116	<b>0.000</b>
Severe	22 (2.1)	28 (2.7)	50 (4.9)		
Total	190 (18.4)	85 (11)	303 (29.5)		
Total sleep time hours (SD)	7.4 ( $\pm 2$ )	6.3 ( $\pm 2.4$ )	7.1 ( $\pm 2.2$ )	7.383	<b>0.001</b>

Bold values indicate that *p*-value is less than 0.05 or  $\leq 0.001$ .

Sometimes; 2–4 days per week; Frequently;  $\geq 5$  days per week.

Total sleep time is expressed as mean ( $\pm$ SD).

p-OSAS, possible obstructive sleep apnoea syndrome.

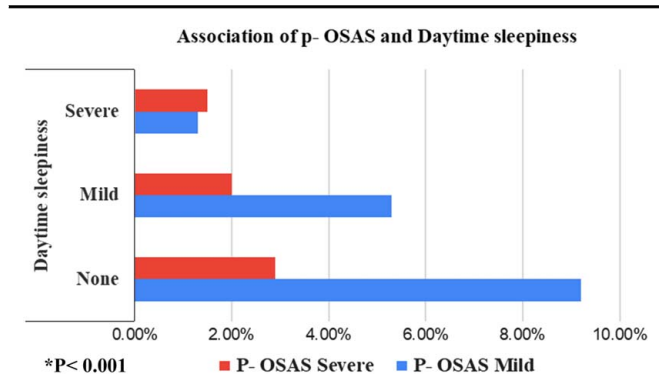
**Table 3**  
Association between p-OSAS and children characteristics

	p-OSAS		Total, N (%)	χ <sup>2</sup>	P
	No, N (%)	Yes, N (%)			
School place					
City	317 (30.8)	100 (9.7)	417 (40.5)	1.352	0.245
Supurb	484 (47)	128 (12.4)	612 (59.5)		
Total	801 (77.8)	228 (22.2)	1029 (100)		
Sex				4.539	0.033
Male	486 (47.2)	156 (15.2)	642 (62.4)		
Female	315 (30.6)	72 (7)	387 (37.6)		
Total	801 (77.8)	228 (22.2)	1029 (100)		
Total sleep time (h)				20.429	0.001
< 6	159 (15.5)	74 (7.2)	233 (22.6)		
6–7	177 (17.2)	35 (3.4)	212 (20.6)		
7–8	234 (16.2)	68 (6.6)	302 (29.3)		
8–9	167 (16.2)	33 (3.2)	200 (19.4)		
9–10	47 (4.6)	12 (1.2)	59 (5.7)		
≥ 10	17 (1.7)	6 (0.6)	23 (2.2)		
Total	801 (77.8)	228 (22.2)	1029 (100)		

Bold values indicate that *p*-value is less than 0.05 or ≤ 0.001, then it is significant.  
p-OSAS, possible obstructive sleep apnoea syndrome.

**Association of p-OSAS and sleep problems among children**

Around 10% of children with p-OSAS experienced mild and severe daytime sleepiness. In addition, children with severe p-OSAS were significantly associated with severe daytime sleepiness (*P* < 0.001) (Fig. 1). Loud snoring 13.6%, stopping breathing 6.4% and having snorts or gasps 10.7% were significantly presented symptoms in p-OSAS students during sleep (*P* < 0.001). Fall asleep with movements (*P* < 0.001), dependent on an object (*P* = 0.016), resistant to going to sleep (*P* = 0.004), talking during sleep (*P* < 0.001), moving during sleep (*P* < 0.001), grinding teeth during sleep (*P* = 0.002), awake screaming or sweating (*P* < 0.001), awake frightened (*P* < 0.001), wake up in negative mood (*P* < 0.001), difficulty getting out of bed (*P* < 0.001), take times to be alert (*P* < 0.001) were all sleep problems significantly associated with not having p-OSAS (Table 4).



**Figure 1.** The correlation between possible OSAS and Daytime sleepiness. p-OSAS, possible obstructive sleep apnoea syndrome.

**Factors associated with daytime sleepiness in childhood and adolescence**

Multiple logistic regression studied factors correlated to mild and severe daytime sleepiness. Significantly associated factors (*P* < 0.05) were the following: second, and seventh-grade students were a risk factor for severe daytime sleepiness compared with all other grade levels.

Mild and severe p-OSAS compared with ‘none’ was a risk factor for mild and severe sleepiness. Children with less than 6 h of TST were a risk factor for mild and severe sleepiness, and students with 6–7 h of TST were a risk factor for mild sleepiness compared with those with ‘TST 8–9 h (Table 5).

**Discussion**

The detection of OSAS among children is highly significant due to its diversity of consequences which can be neurocognitive, behavioural, cardiovascular, or metabolic. overnight polysomnography is the gold stander approach to investigate OSAS, nonetheless, the procedure is expensive and it is difficult to carried out to all suspected children, especially in a development country, such as Syria, where even no paediatric sleep centres are available. While, parental reported questionnaire considers a simple screening instrument to identify paediatric who are OSAS candidates. This study is the first in Syria that investigate the prevalence of OSAS among Syrian childrens using validated questionnaire.

Obstructive sleep apnoea syndrome, and its associated sleep-related complications, impact the affected children and adolescents in hazardous. This study assessed the prevalence of p-OSAS, and its relation with daytime sleepiness among school-aged children (6-15) years in Syria. The results revealed a significant correlation between p-OSAS described as the child had loud snoring, snorts, gasps, and breathing pauses in the previous month with mild and severe daytime sleepiness.

Many factors contribute to the prevalence rate of OSAS among children, AAP guideline suggests 1–5% were referred to OSAS as a relatively common problem<sup>[5]</sup>. On the other hand, the rate in parental perception reports was 4–11%<sup>[2,17,20,21]</sup>. However, the current study demonstrated a higher prevalence of p-OSAS of 22.1% in elementary and secondary school-age children.

OSAS is a multifactorial disease that could be influenced by several entities including; adenotonsillar enlargement, obesity, craniofacial anomalies, anomalous control of breathing, and a composite of the former disorders<sup>[3]</sup>. Obstructive hypoventilation is common in obese children, although the ongoing inactivity traits due to technology dependence in school children<sup>[22]</sup>. There is no reliable evidence in the aspect of the physical activity of the child and the development of sleep problems. Nevertheless, nutrition type seems to affect sleep habits in complexity, where obesity causes the upper respiratory tract to develop fat deposits that restrict the airway and decrease muscular activity, which in turn causes episodes of hypoxia and apnoea that eventually lead to sleep apnoea<sup>[13,23]</sup>. Previous Syrian research estimated a high prevalence of obesity among Syrian children as 20%, thus Syrian children are not spared of obesity as a risk factor<sup>[24]</sup>. Moreover, significant growth in unhealthy eating habits among adolescents was found during wartime compared with the period before the war started<sup>[25]</sup>. All of These suggest a persistent burden of OSAS in Syrian children.

**Table 4**  
**Association between p-OSAS and sleep problems**

Sleep problems	p-OSAS		Total, N (%)	$\chi^2$	P
	No, N (%)	Yes, N (%)			
Child falls asleep with rocking or rhythmic movements	63 (6.1)	47 (4.6)	110 (10.7)	30.215	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child needs special object to fall asleep	193 (18.8)	73 (7.1)	266 (25.9)	5.812	<b>0.016</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child resists going to bed at bedtime	442 (43)	150 (14.6)	592 (57.5)	8.175	<b>0.004</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child is afraid of sleeping in the dark	356 (34.6)	118 (11.5)	474 (46.1)	3.817	0.051
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child talks during sleep	207 (20.1)	115 (11.2)	322 (31.3)	49.938	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child is restless and moves a lot during sleep	345 (33.5)	137 (13.3)	482 (46.8)	20.639	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child sleepwalks during the night	59 (5.7)	18 (1.7)	77 (7.5)	0.072	0.789
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child grinds teeth during sleep	123 (12)	55 (5.3)	178 (17.3)	9.535	<b>0.002</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child snores loudly	58 (5.6)	140 (13.6)	198 (19.2)	335.054	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child seems to stop breathing during sleep	26 (2.5)	66 (6.4)	92 (8.2)	144.002	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child snorts and/or gasps during sleep	41 (4)	110 (10.7)	151 (14.7)	263.639	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child awakens during night screaming, sweating, and inconsolable	50 (4.9)	40 (3.9)	90 (8.7)	28.403	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child awakens alarmed by a frightening dream	197 (19.1)	95 (9.2)	292 (28.4)	25.452	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child wakes up in negative mood	231 (22.4)	117 (11.4)	348 (33.8)	40.061	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child has difficulty getting out of bed in the morning	260 (25.3)	119 (11.6)	379 (36.8)	29.706	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child takes a long time to become alert in the morning	262 (25.5)	111 (10.8)	373 (36.2)	19.600	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child wakes up very early in the morning	470 (45.7)	150 (14.6)	620 (60.3)	3.749	0.053
Total	801 (77.8)	228 (22.2)	1029 (100)		
Child has a good appetite in the morning	411 (39.9)	126 (12.2)	537 (52.2)	1.111	0.292
Total (%)	801 (77.8)	228 (22.2)	1029 (100)		
Child suddenly falls asleep in the middle of active behaviour	95 (9.2)	61 (5.9)	156 (15.2)	30.611	<b>0.000</b>
Total	801 (77.8)	228 (22.2)	1029 (100)		

Bold values indicate that *p*-value is less than 0.05 or  $\leq 0.001$ , then it is significant.  
 p-OSAS, possible obstructive sleep apnoea syndrome.

OSAS is correlated with a wide spectrum of sleep disturbances. It is well established that people with OSAS are more common to have short sleep time than others. However, the correlation between OSAS and TST differs through previous studies<sup>[26]</sup>. Snoring is a highly specific symptom of OSAS<sup>[5]</sup>. In addition, middle school-aged children with frequent snoring may have experienced OSAS at a younger age<sup>[27]</sup>. In the current study, loud snoring, snorts and gasps, and breathing pauses were symptoms markedly encountered in children with p-OSAS compared to others.

EDS is a severe health problem found in numerous sets of healthy populations. EDS could be proposed as a primary disorder, or secondary to different comorbidities, such as sleep disorders and OSAS. Furthermore, sleep deprivation is a common cause of EDS. The prevalence of EDS varies depending on many factors, such as how EDS is quantified<sup>[28]</sup>.

Over 29% of children experienced EDS in the last month, in line with the rates of other reports<sup>[29]</sup>. Children's circadian clock

disruption contributes to the emergence of EDS<sup>[29]</sup>. The administrative structure of the Syrian schools suggests either an early start time that lasts at least 6 hours per day or an after-midday school schedule that may interfere with students' circadian cycles. Leading to sleep disruption and the potential onset of EDS. In this study, TST decreased with the progression of the academic stages. Students who sleep less than 6 h at night are expected to conceive EDS in a lifetime. Psychological troubles are considered drastic agents involved in sleep problems such as EDS, particularly in light of the ongoing Syrian conflict<sup>[30,31]</sup>. Additionally, the urge to use contemporary media in childhood encourages putting off going to bed and getting less sleep at night<sup>[29]</sup>. The confirmed prevalence of social media addiction among Syrian students<sup>[32]</sup>, could explain the danger of EDS as a possible outcome of extreme media exposure.

OSAS is complicated by several nervous system conditions including; somnolence during the day, hyperactivity, learning ability, and deterioration of cognitive functions<sup>[6]</sup>. Hence, OSAS

**Table 5**  
**Factors associated with daytime sleepiness in childhood and adolescence**

	Mild sleepiness		Severe sleepiness	
	AOR	(95% CI)	AOR	(95% CI)
Sex				
Male	—	—	—	—
Female	1.354	(0.93–1.86)	1.012	(0.45–2.24)
Grade level				
1st	0.928	(0.42–2)	0.275	(0.05–1.45)
2nd	0.637	(0.32–1.23)	0.129*	(0.02–0.65)
3rd	1.357	(0.71–2.5)	0.230	(0.04–1.18)
4th	0.693	(0.35–1.34)	0.632	(0.22–1.79)
5th	0.993	(0.5–1.94)	0.310	(0.07–1.31)
6th	0.630	(0.31–1.25)	0.324	(0.09–1.15)
7th	0.794	(0.41–1.53)	0.057*	(0.007–0.48)
8th	1.2	(0.62–2.32)	1.431	(0.56–3.61)
9th	—	—	—	—
P-OSAS				
Mild	1.920**	(1.3–2.82)	2.941*	(1.36–6.32)
Severe	2.504*	(1.37–4.57)	14.184**	(6.04–33.28)
None	—	—	—	—
Total sleep time (h)				
< 6	2.793**	(1.71–4.56)	4.791*	(1.63–14.04)
6–7	1.731*	(1.05–2.84)	1.042	(0.29–3.69)
7–8	1.486	(0.93–2.36)	0.922	(0.28–3.02)
8–9	—	—	—	—
9–10	0.863	(0.38–1.94)	0.539	(0.05–5.33)
≥ 10	1.296	(0.43–3.86)	1.993	(0.19–19.95)

AOR, adjusted odds ratio; p-OSAS, possible obstructive sleep apnea syndrome.

Statistically significance.

\*( $P < 0.05$ ).

\*\*( $P \leq 0.001$ ).

is a prominent reason for EDS, particularly in young individuals<sup>[33]</sup>. According to the severity of OSAS, up to 50% of children with OSAS may have EDS<sup>[33,34]</sup>. The findings of this study revealed 10% of children who have screened for p-OSAS experienced EDS.

The pathophysiological characteristics of OSA, chronic intermittent hypoxia, and sleep fragmentation, might result in overlapping and possibly complimentary injury modes, such as oxidative injury, neuronal damage, and cell death in wake-promoting brain areas<sup>[33]</sup>.

Unfortunately, EDS remarkably involves cognitive function, mood, daily functioning, and quality of life<sup>[28]</sup>. Changes in behavioural sleep/wake rhythms have been linked to these neural abnormalities and waking deficits<sup>[33]</sup>. Snoring and OSA exacerbate the occurrence of EDS. Further, Loud snoring is related to the intensity of both OSA and EDS<sup>[35]</sup>.

Finally, the management of children with OSAS accompanied by EDS is a challenging approach, especially when recovering from EDS is uncertain<sup>[33]</sup>. This study remains preliminary to screen the syndrome among Syrian children, findings of this study encourage physicians to be more aware when investigating children with reported sleep problems, mainly snoring. In addition, giving parents information through books, articles, or internet resources might help them keep educated because they might not be up to date on the most recent studies or trends in children's health, raising parental and general awareness regarding this disease is essential.

More advanced studies for follow up of suspected children are required to be conducted, to address the most risk factors associated with the prevalence rate among the Syrian children including data on the children BMI, social and economic status, and recurrent upper respiratory tract infections, using further screening tools, specified OSAS investigation should be considered.

### Strengths and limitations

To the best of our knowledge, the study is the first to evaluate the prevalence of obstructive sleep apnoea syndrome among children in Syria. In addition, the results of this paper provide a preliminary investigation of the occurring rate of OSAS and EDS and support its intercorrelation, mainly among children under many linked- risks.

This screening was done under the supervision of the research team who were thoroughly aware of dealing with children, distributing the survey, and answering any inquiries from parents.

Like any study, there are a few limitations to be listed. Sampling method and sample size for each grade group and male to female ratio could be biased to the children attending school at the study period. In addition, the response rate is relatively low in general. Moreover, risk factors related to OSAS prevalence, such as BMI, were not collected from children. The results of this study reflect the prevalence of OSAS in one governmental area, thus; may not be generalized to the populace across the country.

The literature presents how results can diverge using subjective or objective measures, real numbers of affected cases cannot be exhibited in the current study design, and results may conceal a kind of bias in charge of the parent's answers. Finlay, the diagnosis of OSAS could not be confirmed by specific investigations such as polysomnography.

### Conclusion

This research is the first in Syria to investigate the prevalence of OSAS among children in Syria, the findings showed a high prevalence rate for p-OSAS, and EDS. The OSAS-related symptoms were loud snoring, and snorts or gasps, breathing pauses. Children with EDS were significantly affected by sex, school grade level, OSAS, and TST. Arousing parents, physicians, and school teachers' attention to the importance of prompt detection of OSAS and EDS symptoms is a critical approach to ensure early diagnosis and sufficient treatment.

### Ethics approval and consent to participate

The work in this study complies with the principles laid down in the Declaration of Helsinki (Recommendations guiding physicians in biomedical research involving human subjects. Adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964, amended by the 29th World Medical Assembly, Tokyo, Japan, October 1975, the 35th World Medical Assembly, Venice, Italy, October 1983, and the 41st World Medical Assembly, Hong Kong, September 1989). This study was approved by the Institutional Review Board (IRB) at SPU and Ministry of Education, and Damascus Health Directorate under registration number: 597 at 28/2/2022.

## Consent

Written consent was obtained from all participants. Participation in the study was voluntary and participants were assured that there would be no victimization of anyone who did not want to participate or who decided to withdraw after giving consent.

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## Author contribution

M.O.A. and M.H.S. did the statistical analysis of data, participated in the analysis and interpretation of data, and wrote the final draft; M.M.B.K. and K.K.A.A. were responsible for study design, literature search, and write up; S.A. and F.M. participated in data collection and writing the final draft; D.B., M.O.E., H.A., D.A., A.A., A.A., and L.Y. participated in data collection; L.D.N. participated in the study design and reviewed the final draft. All authors read and approved the final draft.

## Conflicts of interest disclosure

This study received no funds. There are no conflicts of interest, financial, or otherwise.

## Research registration unique identifying number (UIN)

1. Name of the registry: Prevalence of Childhood Obstructive Sleep Apnoea Syndrome and Its Role in Daytime Sleepiness in Syria: A Large-scale School-based study.
2. Unique Identifying number or registration ID: 8602.
3. Hyperlink to your specific registration: <https://www.researchregistry.com/browse-the-registry#home/>

## Guarantor

The Guarantors are Mhd Obai Alchallah, Mhd Homam Safiah, Mohamed Motsem Belah Kajjoun, Khaled Kalalib Al Ashabi, Sham Ataya, Fatema Mohsen, Duaa Bakdounes, Muhammad Omar ElHoms, Homam Alolabi, Dima Alistwani, Andrya Alzein, Ahmad Ayash, Lamaat Youzbashi, Louei Darjazini Nahas.

## Availability of data and materials

All data related to this paper's conclusion are available and stored by the authors. All data are available from the corresponding author upon reasonable request.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

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