


Mouth Breathing and Its Impact on Sleep Breathing Disorders in Children: A Cross-Sectional Study in Bandung, Indonesia

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Purpose: Mouth breathing is an associated or characteristic feature of sleep-disordered breathing (SDB), not a direct cause. This study aims to investigate whether mouth-breathing children in Indonesia have a higher risk of SDB, as assessed by the Pediatric Sleep Questionnaire (PSQ) questionnaire.

Patients and Methods: A cross-sectional study was conducted in three public elementary schools in Bandung (SDN 001 Merdeka, SDN 062 Ciujung, and SDN 054 Tikukur), involving 343 children aged 8–9 years (193 boys, 150 girls). Clinical examinations were performed to identify mouth breathing habits, followed by administration of the PSQ questionnaire completed by parents. Prior to questionnaire completion, parents received standardized guidance via standardized online briefing sessions.

Results: Mouth breathing was observed in 95 children (27.7%). PSQ scores were significantly higher in mouth breathers compared to non-mouth breathers (mean: 25.45% vs 7.93%; median: 19.05% vs 4.54%; range: 4.54–58.82 vs 0.0–45.46; $p < 0.001$). Furthermore, 41.1% of mouth-breathing children were identified as having SDB, in contrast to 9.7% of non-mouth breathers. The relative risk (RR) for SDB in mouth breathers was 4.24 (95% CI: 2.70–6.65; $p < 0.001$).

Conclusion: Mouth breathing in school-aged children is significantly associated with a higher risk of developing sleep-disordered breathing. These findings highlight the importance of early screening and timely intervention to prevent adverse health outcomes linked to SDB.

Keywords: mouth breathing, sleep-disordered breathing, children, pediatric sleep questionnaire

Introduction

Breathing is a vital function of the human body, typically performed through the nose. Mouth breathing is considered pathological and typically occurs as a compensatory mechanism when nasal breathing is impaired.¹ The etiology of mouth breathing includes genetic factors, poor habits, nasal obstructions caused by polyps, a deviated nasal septum, enlarged adenoids and tonsils, allergies, or chronic respiratory diseases such as asthma.² Mouth breathing accompanied by nasal obstruction predisposes individuals to airway collapse and sleep-disordered breathing. The altered muscle activity in the oral cavity due to mouth breathing affects the stomatognathic system, leading to impaired speech function, swallowing, and mastication, as well as long-term effects on the body's postural muscles.³

The prevalence of mouth breathing in children ranges from 5% to 75% and is primarily caused by nasal airway obstruction.^{4,5} Disruptions in nasal respiratory function alter tongue posture, leading to a lower mandible position. This change affects neck and facial muscle activity, contributing to abnormalities in the growth and development of the teeth

and face.⁶ Previous studies report a wide range of mouth breathing prevalence in children, varying from 10% to over 55% depending on region, age group, and diagnostic criteria.^{7–10}

Children with mouth-breathing habits tend to have longer-looking faces, narrower jaw sizes, lip incompetence, hyoid bone retroposition, mandibular incisor retroposition, an increased mandibular plane angle, and backward mandibular rotation.² Another impact of mouth breathing is the development of breathing disorders during sleep, which pose a risk factor for growth and development disorders, especially in childhood.³ Sleep disorders can serve as an early warning of underlying pathological conditions in the body. Early detection and appropriate treatment can help prevent sleep disorders caused by mouth breathing habits, reducing the risk of SDB.¹¹

SDB is relatively frequent in the pediatric population, with a prevalence ranging from 3.3% to 42%.^{3,12} SDB encompasses a wide clinical spectrum, such as snoring, upper airway resistance syndrome (UARS), and obstructive sleep apnea (OSA).¹³ Mouth breathing is one of the most commonly cited characteristics and etiological factors of SDB during childhood, often persisting as a habit even after airway obstruction is resolved.¹⁴ Mouth breathing, particularly during sleep, is closely linked to snoring, which is considered the most prominent warning sign of SDB. It has also been associated with more severe cases of OSA and increased pharyngeal compliance in children. Research by Bokov et al showed 38 from 93 children (41%) of otherwise healthy children with moderate to severe OSA were found to be mouth breathers.⁵ Other symptoms of SDB include night sweats, nocturnal enuresis, and irregular sleep. As a result, children with SDB may become easily tired, hyperactive, and temperamental and experience decreased concentration and school performance during the day.¹⁵ Children with SDB can experience growth and development disorders, as well as complications such as pulmonary heart disease and hypertension, which can lead to a decrease in the child's quality of life.^{16–18}

Polysomnography (PSG) is the gold standard for diagnosing SDB. Still, the need to install the device while the child is asleep and the high cost are limitations in assessing the risk of SDB in children in Indonesia. Questionnaires are an alternative instrument for detecting SDB in children. One commonly used questionnaire is the PSQ, which is in English, has been translated into Indonesian, and has been tested for validity and reliability.¹⁹ However, in Indonesia, research on the prevalence and clinical impact of mouth breathing in pediatric SDB has not yet been conducted. This lack of research results in a significant gap in local data needed to develop clinical guidelines, preventive strategies, and educational programs that are tailored to the country's environmental and cultural context. Considering the long-term impact of SDB on a child's growth and overall quality of life, the need for region-specific and contextually relevant studies is increasingly urgent. Based on this, the researchers are interested in conducting a study to analyze the impact of mouth breathing on sleep-disordered breathing in children. This study aims to investigate whether mouth-breathing children in Indonesia have a higher risk of SDB, as assessed by the PSQ.

Materials and Methods

Study Design

This quantitative study was conducted on elementary school children in Bandung City using a descriptive, cross-sectional observational design, and survey techniques. The target population in the study consisted of all elementary school students aged 8–9 years, while the accessible population was elementary school students in Bandung City. The sampling technique used in this study was multistage random sampling. The first step was to select one area from six areas in Bandung City (including Tegalega, Bojonagara, Cibeunying, Gedebage, Karees, and Ujungberung). Then, three sub-districts were selected from the chosen area, followed by randomly selecting one elementary school from each sub-district. Samples in each elementary school were selected randomly, with the number corresponding to the sample size calculated statistically. Our study was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Eligibility Criteria

Based on the above random sampling group technique, a population of 343 children attending elementary schools in Bandung was examined, and subjects matching the inclusion criteria were selected using the cluster random sampling

technique. The chosen subjects met the inclusion criteria and the selected subjects met both the inclusion and exclusion criteria:

Inclusion criteria: (1) Parents/guardians of students who signed an informed consent as approval to participate in the study. (2) Bandung City Elementary School (SD) students were selected from multistage random sampling. (3) Children not currently undergoing orthodontic treatment (ie, not wearing any orthodontic appliances), regardless of the presence or absence of malocclusion.

Exclusion criteria: (1) Parents/guardians of elementary school (SD) students who did not complete the questionnaire. (2) Children with cleft lip and palate. (3) Children with syndromes, disorders, serious medical conditions, or other congenital abnormalities.

Data Collection

Subjects/research samples that meet the inclusion and exclusion criteria are asked to fill in their data and informed consent. Subjects/research samples are then asked to sit upright and undergo a clinical examination, which is the initial stage to obtain patient data on mouth breathing. Mouth breathing examination can be done with the Mirror test, Massler's water holding test, and butterfly/cotton test.

(1) The mirror test uses a two-sided intraoral mirror placed between the child's nose and mouth and observed for 2–3 minutes to assess fogging. If fogging is found on the upper side of the mirror, it indicates that the child is breathing through the nose, but if fogging is found on the lower side, it means that the child has a habit of mouth breathing.

(2) Massler's water-holding test is done by instructing the child to have 15 mL of mineral water in their mouth for 2–3 minutes. If there is a flow through the gap between the child's lips, the child has a habit of mouth breathing.

(3) Butterfly/cotton test is done by placing a piece of cotton measuring 5.5×5 cm between the child's nose and mouth, then observing it for 2–3 minutes. If the cotton moves downwards, it can be said that the child is breathing through the nose, but if the cotton moves upwards, it can be said that the child has the habit of mouth breathing. Assessment of mouth breathing in children is based on a positive result in one of the three components, with the nominal measurement scale.

Parents of children exhibiting symptoms of mouth breathing were asked to complete the PSQ. Sleep-disordered breathing is a clinical spectrum of breathing disorders during sleep, ranging from snoring to apnea.¹³ The PSQ consists of 22 dichotomous items (Yes = 1, No = 0). The PSQ score was calculated as the percentage of affirmative responses using the following formula: (number of "Yes" responses ÷ 22) × 100. In accordance with the original scoring method by Chervin et al in 2000, a score of 33% or more (equivalent to 8 or more "Yes" answers) was considered indicative of a positive risk for SDB.²⁰

Ethical approval for this study was obtained from the Health Research Ethics Committee of Universitas Padjadjaran, Bandung (Komisi Etik Penelitian Universitas Padjadjaran), under approval number 324/UN6.KEP/EC/2022.

Data Analysis

The collected data were processed descriptively and analytically. Descriptive data processing involved calculating the number and percentage of categorical and numerical data and presenting the average, standard deviation, median, and range. The Kolmogorov–Smirnov test was used to test the normality of the numerical data. The Mann–Whitney test was used to compare the difference in PSQ scores (%) between MB (+) and MB (-). The Chi-square test or Fisher's exact test was used to analyze the relationship between two categorical variables if there was a cell expectation value <5. RR was calculated to estimate the magnitude of the association. The statistical significance of the results was determined using a p-value threshold of <0.05. Data processing and analysis were conducted using SPSS version 20.0.

Results

Clinical examination was conducted on 343 elementary school children in Bandung, with a prevalence of 6.7% for 8-year-old children and 93.3% for 9-year-old children. Regarding the gender of the subjects, there were 193 boys and 150 girls. Among the research subjects, 95 children (27.7%) were detected with mouth breathing, while 248 children (72.3%) did not have the habit of mouth breathing (Table 1).

Table 1 Characteristics of Research Subjects
(n = 343)

Characteristics	Frequency (Person)	Percentage (%)
I. Age (years):		
8	23	6.7
9	320	93.3
I. Gender		
Male	193	56.3
Female	150	43.7
I. Mouth breathing		
Positive	95	27.7
Negative	248	72.3

Sleep-disordered breathing was detected in children by distributing the PSQ to the parents of all children who participated in the study. The PSQ consists of 22 questions, providing that if there are 8 “Yes” answers or more than 33% positive answers, the subject is considered to have SDB. The examination results using the PSQ can be seen in Table 2. Table 2 shows that question 18 has the highest positive incidence (65.3%), while questions 5, 6, 14, and 15 have the lowest positive incidence (0%).

PSQ scores were calculated as percentages based on the number of “Yes” responses out of the 22 items. For example, a score of 25.45% indicates that, on average, children in the MB (+) group answered “Yes” to approximately 5.6 out of 22 items. The mean PSQ score among MB (+) subjects was 25.45% (SD: 15.55), with a median of 19.05% and a range of 4.54%–58.82%. In contrast, the mean score among MB (–) subjects was 7.93% (SD: 9.63), with a median of 4.54% and

Table 2 PSQ Overview in Children with MB (+) and MB (-)

PSQ Statement Items (Yes Answers)	Mouth Breathing			
	Positive (Person)	Percentage (%)	Negative (Person)	Percentage (%)
1. Children usually snore while sleeping.	52	54.7	44	17.7
2. The child always snores while sleeping	28	29.5	14	5.6
3. The child snores loudly while sleeping.	6	6.3	9	3.6
4. The child breathes heavily while sleeping.	5	5.3	10	4.0
5. The child has difficulty struggling to breathe while sleeping.	0	0	4	1.6
6. The child is observed to stop breathing at night.	0	0	0	0
7. The child tends to breathe through the mouth throughout the day.	2	2.1	5	2.0
8. The child has a dry mouth upon waking up in the morning.	50	52.6	20	8.1
9. The child sometimes wets the bed.	31	32.6	12	4.8
10. The child wakes up feeling unrefreshed in the morning.	12	12.6	15	6.0

(Continued)

Table 2 (Continued).

PSQ Statement Items (Yes Answers)	Mouth Breathing			
	Positive (Person)	Percentage (%)	Negative (Person)	Percentage (%)
11. Your child has trouble staying asleep during the night.	3	3.2	1	0.4
12. Teachers or other supervisors' comment that your child seems sleepy during the day.	9	9.5	0	0
13. It is difficult to wake your child up in the morning.	61	64.2	65	26.2
14. Your child wakes up with a headache in the morning.	0	0	0	0
15. Your child has stopped growing at a normal rate since birth.	0	0	6	2.4
16. The child is overweight.	20	21.1	19	7.7
17. The child often does not seem to listen when spoken to directly.	17	18.1	16	6.5
18. The child often has difficulty organizing tasks and activities.	62	65.3	54	21.8
19. The child is often easily distracted by external stimuli or stimulation.	47	49.5	37	14.9
20. The child often feels restless, moving their hands or feet, or is restless while sitting.	3	3.2	12	4.8
21. The child is often always active or cannot concentrate.	59	62.1	45	18.1
22. The child often interrupts or disturbs others.	37	38.9	44	17.7

Notes: Adapted with permission from University of Michigan (USA). © 1999 The Regents of the University of Michigan Sleep-Related Breathing Disorder Scale from Pediatric Sleep Questionnaire (PSQ-SRBD).

a range of 0.00%–45.46%. The difference in PSQ scores between the two groups was tested using the Mann–Whitney test, as the data were not normally distributed (see Table 3).

The difference in PSQ scores (%) between MB (+) and MB (-) was analyzed using the Mann–Whitney test because the data was not normally distributed. A p-value of <0.01 was obtained, which indicates statistical significance, as shown in Table 3. In the case of MB (+), the median PSQ score is higher than that of MB (-). Based on the average value, the PSQ score in subjects with mouth-breathing habits is higher (15.55) compared to the PSQ score in subjects without mouth-breathing habits (9.63). Similarly, the median PSQ score in subjects with mouth-breathing habits shows higher results (19.05) compared to the PSQ score in subjects without mouth-breathing habits (4.54). The PSQ score range in

Table 3 Percentage of PSQ Scores in Children with MB (+) and MB (-)

PSQ Score (%)	MB		
	Positive (n = 95)	Negative (n = 248)	p value**
Average (SD)	25.45 (15.55)	7.93 (9.63)	<0.001
Median	19.05	4.54	
Range	4.54–58.82	0.0–45.46	
Data normality test (p* value)	<0.001	<0.001	

Notes: *Based on the Kolmogorov–Smirnov test; **Mann–Whitney test.

Table 4 Mouth Breathing with Sleep-Disordered Breathing in Children

MB	MSDB			RR (IK 95%)
	Positive (n = 63)	Negative (n = 280)	p value **	
Positive	39 (41.1%)	56 (58.9%)	<0.001	4.24 (2.70–6.65)
Negative	24 (9.7%)	224 (90.3%)		

Notes: SDB is positive if PSQ score >33%. **Chi-square test.

Abbreviation: RR (95% CI), Relative risk and 95% confidence interval.

subjects with mouth-breathing habits also shows higher results (4.54–58.82) compared to the PSQ score in subjects without mouth-breathing habits (0.0–45.46).

The analysis test used was the Mann–Whitney test with $p < 0.01$, indicating that this study was statistically significant. In the case of MB (+), the median PSQ score was higher than that of MB (-). Based on the PSQ score criteria, where above 33% is considered bad, the relationship between MB and SDB, as presented in Table 4, shows that in the case of MB (+), 41.1% of children were in the positive SDB category. In contrast, in MB (-), only 9.7% of children experienced positive SDB. Based on the magnitude of the relative risk (RR) = 4.24, it means that children with MB (+) have a 4.24 times higher risk of SDB (+) compared to children with MB (-).

Discussion

The study conducted in 3 elementary schools in Bandung involved 343 children as research subjects. Clinical examinations to detect mouth breathing in children included mirror tests, water-holding tests, and cotton tests. Based on research conducted by Pacheco et al in 2015, the mirror test and water-holding test were the most frequently used breathing tests to detect mouth breathing, followed by the cotton test, with prevalences of 56.8%, 34.5% and 5.4%, respectively.¹³ According to research by Menezes et al in 2006, conducting at least two types of examinations, including mirror tests and water-holding tests, is recommended to minimize errors in detecting children's breathing patterns and mouth breathing habits.²¹

Based on the clinical examination conducted, it was found that 85 children could not hold water in their mouths for about 3 minutes, so they could not pass the water-holding test. Additionally, 24 children's clinical examination results showed fogging at the bottom of the mirror in the mirror test, and 19 children showed upward cotton movement in the cotton test. The study's results showed that 95 out of 343 children (27.7%) had mouth-breathing habits and showed at least one positive clinical examination result. Gildasya's survey in 2006 showed that three children (3.26%) had mouth-breathing habits from a total of 92 children. A similar survey conducted by Damayanti et al in 2014 stated that the prevalence of mouth breathing in children aged 6–12 years was 10.1%.^{10,22} The results of the study showed a much smaller number when compared to the survey conducted by Septuaginta et al in Palu, which reported that 52 out of 137 children (40.2%) had mouth breathing habits, and the study by Abreu RR et al, which reported that 204 out of a total of 307 children (55%) had mouth breathing habits at the age of 6–9 years in Brazil.^{8,23}

Based on the research results, 95 out of 343 children had mouth-breathing habits, with more boys (58) than girls (37). This occurred because the subjects in this study were more boys (193 children) than girls (150 children). This is in line with research by Kukwa et al, which found that the prevalence of mouth breathing was 18.7%, with the incidence occurring more often in boys.⁹ Based on gender, more boys have the habit of mouth breathing, and this is likely due to gender differences affecting the way children breathe.²¹ Research conducted by Abbasi et al in Riyadh in 2017 stated the higher prevalence of mouth breathing in boys may be influenced by behavioral and physiological differences.²¹

Boys prefer outdoor activities and playing with their friends, such as running or playing ball, often during sports lessons or recess. Boys are also generally more active in class, struggle to sit still, and are curious about new things. This usually leads to higher levels of fatigue in boys, which can affect their breathing habits, making them more likely to develop the habit of mouth breathing to inhale more oxygen.²⁴ In addition to higher activity levels, boys also experience more psychological stress than girls. They face relatively high expectations from their parents, both academically and non-academically.²¹

The study results showed that the highest prevalence of mouth-breathing habits occurred at the age of 9 years. Research by Zicari et al in Rome in 2009 stated no significant difference between mouth breathing habits and the child's age. Mouth breathing habits can be experienced by children at various ages.²⁵ Research by Ikavalko et al in 2017 revealed that breathing patterns in children can be influenced by the formation of lymphoid tissue, which is a structure that forms adenoids and tonsils, generally developing rapidly from birth to age 12 years. The size of the adenoids and tonsils peaks at 5–6 years, and nasal resistance decreases from 9 to 13 years. Hormonal changes during this period can affect nasal resistance, and during the first 8 years of a child's life, microbial stimulation can also influence the proliferation of lymphoid tissue cells.²⁶ Children with excessive adenoid tissue development or those with certain systemic conditions that cause adenoid tissue swelling may be at an increased risk of upper airway obstruction.²⁷

In this study, the majority of the sample consisted of 9-year-old children (93.3%). Accordingly, the highest prevalence of mouth-breathing habits was observed in this age group. This distribution is likely due to the age composition of the study sample rather than an inherent age-related increase in mouth breathing prevalence. Sleep-disordered breathing in children can affect sleep quality and is related to the child's overall quality of life. Various somatic, psychiatric, and neurological disorders often accompany this. Poor sleep can hurt children's behaviour and, in some cases, may manifest as psychiatric symptoms.²⁸ Parents in this study were mostly unaware of the consequences of mouth-breathing habits in children and their effects on SDB. All parents of the children examined completed the PSQ. The PSQ is a questionnaire comprising 22 questions designed for pediatric patients between the ages of 2 and 18, addressing snoring, sleepiness, and behaviour. This questionnaire has been proven valid and reliable, with a sensitivity of at least 85% and a specificity of at least 81%. When more than eight positive answers are given, the results are considered abnormal, and the risk of SDB on polysomnography images can be three times greater compared to results with fewer than eight positive answers.²⁷ The study results showed that question number 18 had the highest positive incidence (65.3%), while questions 5, 6, 14, and 15 had the lowest positive incidence (0%).

The results of the 18th statement (children often have difficulty organizing tasks and activities) revealed that 62 parents of children reported that their children have difficulty organizing tasks and activities, with a percentage of 65.3%. Insufficient sleep quantity can cause impaired concentration, memory, decision-making, and general ability to learn. More effort is needed to complete tasks, particularly those requiring abstract thinking, creativity, and motor skills. Studies in the United States show that 80% of teenagers lack sleep (less than 9 hours), 25% sleep less than 6 hours, and more than 25% fall asleep in class. Children who lack sleep generally have lower school grades.²⁸

Some PSQ items had low positive response rates, which may be attributed to limitations in parental observation or interpretation. However, these variations do not affect the overall scoring outcome. The primary focus of this study remains the association between mouth breathing and increased risk of sleep-disordered breathing. After undergoing the forward-backward translation process, this choice of words greatly affected the respondents' understanding. The ability of the subject's parents/guardians to understand the intent of the questions was an obstacle in data collection. Additionally, parents who work outside the medical field (eg, private employees, prosecutors, engineers, etc.) may have limited knowledge or time to recognize how children breathe or identify the symptoms of respiratory arrest during sleep.²⁹

SDB is commonly found in growth and developmental age subjects. In the pediatric population, it is important to diagnose SDB early to reduce the impact of associated comorbidities, such as obesity, hypertension, cardiovascular disease, and metabolic disorders. A study by Ikavalko et al 2017 revealed that at 6–8 years old, morphological and functional features predicted SDB two years later when the child was 9–11 years old. This included a high incidence of mouth breathing and molar tooth occlusion relations, predisposing factors for developing SDB in children.²⁶

Questionnaires are one of the instruments used to detect SDB early. Various questionnaire instruments are discussed in the literature, including SCR, OSA-18, BS, "I'm Sleep", SSSDR, and PSQ. PSQ is the best questionnaire instrument with the highest sensitivity and specificity, with polysomnography (PSG) results that are equally effective or even better. PSQ is also the questionnaire with the best diagnostic accuracy and can be validated in various cultures and languages, making it an easily accessible additional diagnostic tool after psychometric evaluation for the pediatric population.²⁹ This can be seen in the results of the study in [Table 3](#), which presents the difference in PSQ scores (%) between MB (+) and MB (-) using the Mann–Whitney test because the data is not normally distributed. A p-value of <0.01 was obtained, which means it is statistically significant. In the case of MB (+), the median PSQ score is higher (19.05) compared to the case of MB (-) (4.54), which indicates that children with

mouth-breathing habits are more likely to experience SDB. The study's results support the statement that mouth breathing is one of the most common characteristics found in children's SDB, although the symptoms are still often unknown. In this study, 96 out of 343 children were found to snore, and 52 (54.17%) had mouth-breathing habits. Based on this study, the results of clinical examinations on 343 elementary school children and the PSQ questionnaire completed by the parents of elementary school children demonstrated a relationship between mouth breathing and SDB in children. Table 4 shows that 39 children (41.1%) with mouth-breathing habits were classified as having sleep-disordered breathing, proving that children with mouth-breathing habits are at risk of experiencing SDB. This risk may be partially explained by oropharyngeal hypotonia and altered tongue posture commonly found in children with mouth breathing. Oropharyngeal muscle hypotonia and altered tongue posture are recognized contributors to upper airway collapsibility during sleep. In children with mouth-breathing habits, low resting tongue posture reduces stimulation of orofacial muscles and pharyngeal dilation, increasing susceptibility to airway obstruction. Additionally, chronic mouth opening disrupts intraoral pressure balance, further weakening muscle tone and contributing to the cascade of events that lead to SDB and related airway collapse.^{14,30-33} This is further supported by Table 4 in the RR column, which shows the relative risk of SDB is 4.24 with a 95% confidence interval. Thus, there is a relationship between mouth breathing and SDB in children, and children with mouth breathing have a 4.24 times higher risk of experiencing SDB.

Children with mouth breathing are reported to have nasal problems accompanied by the habit of snoring at night. In this study, 52 out of 96 children with mouth breathing were found to have the habit of snoring at night. The incidence of snoring at night varies greatly, depending on the age group studied or used. Petry et al found a prevalence of 27.6% of snoring habits in mouth-breathing children, which is lower than the results of this study.³⁴ Popoaski et al reported that there were 37.7% sleep problems in their research subjects who had mouth breathing habits, as assessed through their answers regarding often waking up at night, waking up with a dry mouth, and feeling sleepy during the day. The impacts arising from the mouth-breathing habit highlight the importance of early detection of mouth-breathing habits to improve the quality of children's sleep during their growth and development.³⁵

The weakness of this study is that it relies on reports and questionnaire answers from parents, fathers, and mothers, who spend more time and sleep with their children. Parents may not understand how to assess their child's sleep quality, so when given the PSQ, parents may still feel confused. In addition, clinical observation may not detect mouth breathing that occurs exclusively during sleep, which could lead to an underestimation of its association with SDB.

Conclusion

Mouth breathing habits has an impact for developing sleep-disorderd breathing. Indonesian children with mouth breathing habits have a higher likelihood of experiencing symptoms of sleep-disordered breathing.

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Disclosure

The authors report no conflicts of interest in this work.

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