# Prevalence of Sleep Disordered Breathing Symptoms among Malay School Children in a Primary School in Malaysia

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**SUMMARY**

**Sleep disordered breathing (SDB) is increasingly being diagnosed in children. However, there is no prevalence study done in Malaysia. The study objective was to evaluate the prevalence of SDB symptoms based on parental reports and associated risk factors among Malay school children aged 6 to 10 years old in a primary school using a translated University Michigan Paediatric Sleep Questionnaire (Malay UM-PSQ). The children whose parents responded to the questionnaire and consented were examined, documenting height, weight, skin fold thickness, neck and abdominal circumference, tonsillar size, nostril examination and presence of micrognathia or retrognathia. There were 550 respondents. The prevalence of parental report of SDB symptoms was 14.9 % (95 % CI 11.9, 17.9). Two hundred and eighty-five (51.8%) school children were males with mean age of 8.5 years (SD 1.1). The associated risk factors for SDB symptoms are male, obesity, large neck and waist circumference, positive history of asthma, history of recurrent tonsillitis, enlarged tonsil (>4+) and enlarged nasal turbinate. Multivariate analysis showed that male gender is the only significant independent risk factor of SDB symptoms (OR 2.1, 95% CI 1.2, 3.5).**

**KEY WORDS:**
*Children, sleep disordered breathing, Malay, risk factors*

## INTRODUCTION

Sleep disordered breathing (SDB) is increasingly being diagnosed in children. SDB spectrum ranging from primary snoring to upper airway resistance syndrome, obstructive hypoventilation and obstructive sleep apnoea syndrome (OSAS)[1,2]. The prevalence was found to be between 1.0- 6.0% among school-aged children [3, 4].

Polysomnography (PSG) is the gold standard diagnostic tool for SDB [2]. However, this procedure is expensive, time consuming and labour intensive. A validated Paediatric Sleep Questionnaire (PSQ) can be used as a screening tool to identify SDB when PSG is not feasible.

At present, there is limited data on prevalence study on SDB in Malaysian children.The aim of this study was to describe the prevalence of SDB symptoms based on parental report and associated risk factors among Malay children aged 6 to 10 years old in a rural primary school. We used the PSQ developed by University of Michigan U.S.A (English UM PSQ) [5] that was translated to Malay language (Malay UM PSQ) [6].

## MATERIALS AND METHODS

This is a cross-sectional study involving Malay school children aged 6-10 years old in a rural primary school in Selangor. The approval of the study was obtained from Ministry of Education and the school principal.

*Survey Booklet*

The survey booklet was distributed to all the students. The booklet contained the written consent form, parents/guardian information sheet, Malay UM PSQ and list of researchers. The completed written consent and survey booklet were collected two weeks later. The children enrolled in the study were examined by the research team.

The socio-demographic data collected included date of birth, race, gender, education level, total household income and number of household. Sleeping environment such as number of bedrooms, bedroom sharing, co-sleeping or bed sharing was captured. Risk factors for SDB included physician-diagnose allergic rhinitis, asthma and recurrent tonsillitis (> 4 infections a year) was identified.

*Malay UM PSQ*

The Malay UM PSQ has Cronbach's α of 0.760 with good test-retest reliability[6]. PSQ consisted of 22 items which were divided into three domains. The domains were sleeping (7 items), snoring (9 items) and behavioural (6 items). Responses are `Yes =1', 'No = 0' and `Don`t know= Missing'. The cumulative score is calculated from responses of 'Yes' and 'No' only. The optimal SDB-scale cut-off to indicate presence of SDB is a score of at least 0.33 (i.e. 33% of the all question-items answered positively).

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**Physical Examination session**
Children's weight and height, the skin fold thickness, neck and abdominal circumference were measured. The weight and height were measured using the SECA weighing/height machine scale that was calibrated to the nearest 0.1 kg and 1.0 cm respectively with the children in school uniform, without shoes and empty pockets. BMI-for-age was calculated using WHO Child Growths Standards syntax for SPSS incorporating latest data from WHO Multicentre Growth Reference Study. It was divided into normal, overweight and obese.

The mean skin fold thickness was measured at the bicep of the right arm midway between the anterior fold of the shoulder joint and the ante-cubital fossa using Harpenden Skin Fold Calliper to the nearest 0.1 mm[7]. Neck circumference was measured to the nearest 0.1 cm using a double face measuring tape at the cricoid cartilage as the base. Abdominal circumference was measured to the nearest 0.1 cm using a double face measuring tape at the umbilicus while standing at the end of exhalation during tidal breathing. The paediatricians examined the children's nostrils and throat for tonsil and nasal turbinate size. The size of each tonsil was graded from 1 to 4 as described in previous study[8]. In the presence of bilateral enlargement; the largest size was taken as the grade for the analysis. The finding of nasal turbinate was classified as bilateral hypertrophy, unilateral hypertrophy or normal. The presence of facial abnormalities such as micrognathia and retrognathia were documented.

**Statistical analysis**
The data were analysed using PASW Statistics for Windows 18 (SPSS Inc., Chicago, IL). Numerical data were described using mean and standard deviation (SD) or median and inter-quartile range (IQR) based on their distribution. Categorical data were described using count and percentage. Chi-square test was used to test difference between proportions and Fisher's Exact test employed when applicable. Mann-Whitney U was used to test difference in numerical data because of their not normal distribution. Important variables were then included in a logistic regression. Highly correlated independent variables are studied and only those considered relevant retained in the model. The results for multivariate analysis were presented in odds ratio with its 95% confidence interval. Model's fitness was measured using Hosmer and Lemeshow's test. Significance was taken at $P < 0.05$.

*Ethics*
The study was approved by Medical Research Ethics Committee, Ministry Health of Malaysia (NMRR code: 08-860-2015), Ethics Committee UKM (code: FF-043-2009) and Ministry Of Education for the participating schools. Copyright permission for the use of UMPSQ was obtained from the original author.

## RESULTS
A total of 956 set of questionnaires were distributed. Six hundred and sixty eight parents/guardians consented and returned the survey booklet. Only 554 (57.9%) children with completed questionnaires were present for physical examination. Final sample of 550 Malay students were included in the analysis. (Figure 1)

The mean age of the school children was 8.5 years old (SD 1.1) with almost equal distribution between 7 to10 year old. Most of the parents or caretaker had secondary (n=350, 63.6%) and tertiary (n=185, 33.6%) formal education level (Table I).

The mean SDB score was 0.16 ranging from 0 to 0.75. Eighty two children scored > 0.33, giving a prevalence of parental report of SDB symptoms of 14.9% (CI 95% 11.9%, 17.9%). There was no significant difference between the age of children with parental report of SDB symptoms or without SDB symptoms (P=0.501). SDB symptoms were more prevalent in boys (56/285 vs. 26/265, P=0.001). There was no difference in the other baseline characteristics of the school children between the two groups (Table II).

Children with reported SDB symptoms were found to have higher BMI (P=0.001). When grouped into BMI-for-age status, more children with reported SDB symptoms were significantly more obese (n=33, 40.7%, P=0.002). Most of them had larger neck (P=0.001) and waist circumference (P=0.001). Children with reported SDB symptoms had higher history of asthma (17.1% vs. 7.3%, P=0.004), recurrent tonsillitis (8.5% vs. 2.8%, P=0.019); and larger tonsillar size (Grade 4+ 6.1% vs. 1.7%, P=0.044). Surprisingly, those with reported SDB was found to have less bilateral enlarged nasal turbinate (35.9% vs. 57.1%, P=0.014). Only one student with no reported SDB symptoms had micrognathia and none had retrognathia. (Table III).

Logistic regression was used to measure risk to reported SDB symptoms using significant factors observed univariately. High correlation (r=0.874) was observed between waist circumference and BMI, therefore we decided to remove BMI from the model. When gender, neck circumference, waist circumference, history of asthma and recurrent tonsillitis were put in the model (Hosmer-Lemeshow's Test $\chi^2$=3.642, df=8, P=0.888, prediction of 84.5%), the only significant independent factor was gender. Male children had about twice the risk to have reported SDB symptoms (OR 2.07, 95% CI 1.24, 3.47). (Table IV)

## DISCUSSION
This was the first community based study conducted to measure the prevalence of SBD symptoms in Malay school children using a reliable Malay PSQ. Our reported SDB symptoms prevalence of 14.9% was comparable to Chervin's study which was 11.1% [9]. Our prevalence rate was higher compared to studies from Belgium (4.1%) [10] and United States (6.0%)[11]. The difference in age group range could be the contributing factor in the difference of prevalence. In our population, the children were between 6-10 years old where adenotonsillar tissue growth is at its peak[12] while other studies involved younger children and adolescents[10,11]. The adenotonsillar tissue at this age group has most significance growth relative to their pharyngeal cavity.

Multivariate statistical analysis showed that male was the only independent risk factor for SDB. There were studies showed male was a risk factor for SDB [13,14,15] and others did not [16, 17,18]. Studies that showed male as a risk factor for SDB have bigger sample size involving older children 13 years and

**Table I: Socio-demographic characteristics of respondents**

| | | N | % |
|---|---|---|---|
| Age (years) | 6 | 7 | 1.3 |
| | 7 | 116 | 21.1 |
| | 8 | 148 | 26.9 |
| | 9 | 144 | 26.2 |
| | 10 | 135 | 24.5 |
| Gender | Male | 285 | 51.8 |
| | Female | 265 | 48.2 |
| Highest education | No formal education | 3 | 0.5 |
| | Primary | 12 | 2.2 |
| | Secondary | 350 | 63.6 |
| | Tertiary | 185 | 33.6 |

**Table II: Characteristics of the schoolchildren with parental report of SDB and without SDB symptoms**

| | | SDB | | No SDB | | P |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Child's age | 6 | 1 | 1.2 | 6 | 1.3 | *0.501 |
| | 7 | 12 | 14.6 | 104 | 22.2 | |
| | 8 | 23 | 28.0 | 125 | 26.7 | |
| | 9 | 21 | 25.6 | 123 | 26.3 | |
| | 10 | 25 | 30.5 | 110 | 23.5 | |
| Child's gender | Male | 56 | 68.3 | 229 | 48.9 | *0.001 |
| | Female | 26 | 31.7 | 239 | 51.1 | |
| Highest education | No formal education | 0 | 0.0 | 3 | 0.6 | *0.812 |
| | Primary | 1 | 1.2 | 11 | 2.4 | |
| | Secondary | 53 | 64.6 | 297 | 63.5 | |
| | Tertiary | 28 | 34.1 | 157 | 33.5 | |
| Sharing room | Yes | 57 | 69.5 | 294 | 62.8 | *0.245 |
| | No | 25 | 30.5 | 174 | 37.2 | |
| Co-sleeping (sharing bed) | Yes | 46 | 56.1 | 226 | 48.3 | *0.192 |
| | No | 36 | 43.9 | 242 | 51.7 | |

*Chi-square test

**Table III: Comparisons of risk factors between parental reported SDB and non-SDB symptoms group**

| | | SDB | | No SDB | | P |
|---|---|---|---|---|---|---|
| | | Median | IQR | Median | IQR | |
| BMI | | 16.6 | 7.6 | 15.4 | 3.4 | *0.002 |
| Neck Circumference (cm) | | 26.0 | 5.0 | 25.7 | 3.0 | *0.002 |
| Waist Circumference (cm) | | 55.3 | 18.5 | 53.0 | 9.8 | *0.001 |
| Skinfold Thickness (mm) | | 5.8 | 4.6 | 5.1 | 2.7 | *0.060 |
| | | SDB | | No SDB | | P |
| | | N | % | N | % | |
| BMI-for-age | Thin | 6 | 7.4 | 43 | 9.3 | *0.002 |
| | Normal | 42 | 51.9 | 317 | 68.3 | |
| | Overweight & Obese | 33 | 40.7 | 104 | 22.4 | |
| History of asthma | Yes | 14 | 17.1 | 34 | 7.3 | *0.004 |
| | No | 68 | 82.9 | 434 | 92.7 | |
| History of allergic rhinitis | Yes | 6 | 7.3 | 16 | 3.4 | **0.120 |
| | No | 76 | 92.7 | 452 | 96.6 | |
| History of recurrent tonsillitis | Yes | 7 | 8.5 | 13 | 2.8 | **0.019 |
| | No | 75 | 91.5 | 455 | 97.2 | |
| Largest tonsil size | 1 | 39 | 47.6 | 210 | 44.9 | *0.044 |
| | 2 | 21 | 25.6 | 166 | 35.5 | |
| | 3 | 17 | 20.7 | 84 | 17.9 | |
| | 4 | 5 | 6.1 | 8 | 1.7 | |
| Swollen inferior nasal turbinates | Yes | 41 | 50.0 | 225 | 48.1 | *0.748 |
| | No | 41 | 50.0 | 243 | 51.9 | |
| Swollen inferior nasal turbinates site*** | Bilateral | 14 | 35.9 | 128 | 57.1 | *0.014 |
| | Unilateral | 25 | 64.1 | 96 | 42.9 | |
| Nasal polyps | Yes | 1 | 1.2 | 0 | .0 | **0.149 |
| | No | 81 | 98.8 | 468 | 100.0 | |
| Micrognathia | Yes | 0 | .0 | 1 | .2 | **0.999 |
| | No | 82 | 100.0 | 467 | 99.8 | |
| Retrognathia | No | 82 | 100 | 468 | 100 | - |

*Chi-square test ** Fisher's Exact test, *** Only for those with swollen inferior turbinate. 3 missing values

**Table IV: Risk of having parental reported SDB by gender, neck circumference, and waist circumference, history of asthma and history of recurrent tonsillitis**

| | B | S.E. | Wald | df | P | OR | 95% CI | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Male | 0.729 | 0.263 | 7.687 | 1 | 0.006 | 2.074 | 1.238 | 3.472 |
| Neck circumference (cm) | 0.111 | 0.061 | 3.346 | 1 | 0.067 | 1.117 | 0.992 | 1.258 |
| Waist circumference (cm) | 0.015 | 0.017 | 0.803 | 1 | 0.370 | 1.015 | 0.982 | 1.049 |
| History of asthma | 0.782 | 0.367 | 4.542 | 1 | 0.033 | 2.187 | 1.065 | 4.490 |
| History of recurrent tonsillitis | 0.891 | 0.524 | 2.897 | 1 | 0.089 | 2.438 | 0.874 | 6.806 |

Logistic Regression Hosmer-Lemeshow's Test $\chi^2$=3.642, df=8,P=0.888,

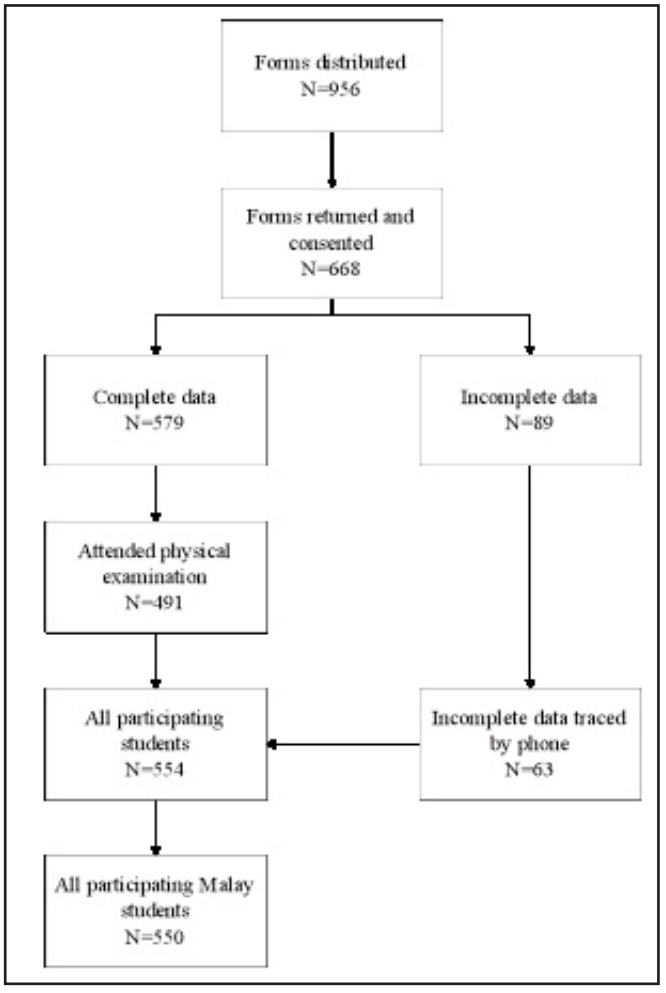


**Fig. 1:** illustrated the flow of the study and the response.

above[19]. Unlike adult, there was no obvious explanation why male children have higher risk for SDB. In adult, the difference in upper airway anatomy and the effect of the androgen hormone were postulated to be the cause of higher risk of OSAS in male[20].

The study showed obesity and its related parameters were shown to be significant risk factor for SDB in univariate analysis only. Many studies showed obesity is a significant risk factor for SDB[11,21,22]. Obesity may cause alterations in the upper airway, reduced chest wall compliance and in the respiratory drive resulting in upper airway obstruction[20].

Nineteen percent of children in this study had enlarged tonsils more than 2+ tonsillar size. This was expected for the age range selected. Those patients with enlarged tonsil (4+) had 3.3 times risk of developing SDB symptoms (95% CI 1.05, 10.83). Several other studies had shown similar findings[14,22]. In our study, asthma was found to be an additional risk factor of SDB symptoms. However, allergic rhinitis was not shown to be a risk factor of SDB. These findings were different compared to other study which showed otherwise[14].

UM PSQ questionnaire contain the combination of persistent snoring with a constellation of sleep related clinical symptoms which could have increased the sensitivity and specificity of the instrument[5]. The questionnaire was selected because it encompassed all related and important symptoms of SDB (face validity) and was tested with the PSG (construct validity). The sensitivity and specificity of the original questionnaire ranged between 81% - 85% and specificity of 87%[5]. There were many other questionnaires that look into the prevalence of habitual snoring without focusing on other SDB symptoms. The reported prevalence of habitual snoring in children in a recent reviewed paper ranged between 3.2 – 14.8%[20].

There were few limitations of the study such as possibility of underreporting or over reporting of the snoring symptoms by parents. However, there was no significant difference in the prevalence of parental reporting of SDB symptoms among children who sleep alone or co-sleep suggestive that this factor was not significance. Furthermore, the parents were given two weeks to go through the questionnaire and this period should be adequate for them to recall and reconfirmed the snoring and SDB symptoms.

## CONCLUSION

This study was conducted to determine the prevalence of SDB symptoms in Malay primary school children. It showed that the prevalence of parental reported SDB symptoms among this group of school children age between 6 – 10 years old was 15% (95 % CI 11.9, 17.9). The risk factors for SDB symptoms identified were male gender, obesity, tonsil size 4 +, recurrent tonsillitis, swollen nasal turbinate and asthma. After adjusted for all identified risk factors, male gender was the only significant risk factor. Polysomnography would be important to determine the true prevalence of SDB.

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