

# Obstructive Sleep Apnea in Children with Down Syndrome: Demographic and Clinical Factors

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## Background

- OSA is characterized by periodic reductions in airflow, hypercapnia, and hypoxemia that affects up to 80% of DS children compared to just 2-5% of the general pediatric population. OSA is the most common reason a child with DS seeks a consult with an otolaryngologist
- Although obesity and tonsillar hypertrophy are risk factors for developing OSA in normal children, their impact on children with DS children are non-linear and inconclusive.

## Objective

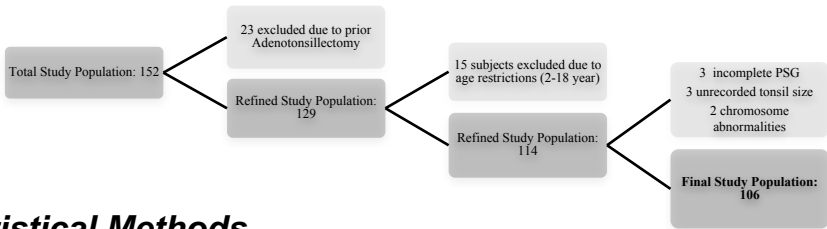
The primary aim of this study was to use a relatively large patient population to evaluate the demographic, clinical, and polysomnographic features of children with DS suspected of having OSA. The secondary objective was to identify demographic and clinical factors that predict severe OSA in these children.

## Methods

### Study Participants

- Participants (N=106) were children ages 2 to 18 years with down syndrome who had a polysomnography (PSG) in the last 5 years [Figure 1].
- Demographic and clinical data was collected through Epic electronic medical record
- Children were placed into weight categories based on age-and-sex adjusted BMI percentile categories using CDC classifications (obese ≥ 95th percentile, non-obese < 95<sup>th</sup> percentile)

Figure 1. Study population after selection criteria.



### Statistical Methods

- Continuous data is presented as means with standard deviations and categorical data as counts with percentages.
- Demographic and polysomnographic differences between obese and non-obese DS children were compared using Pearson chi-squared for categorical data and ANOVA for continuous data.
- Collection of data included performing a univariable analyses. Using this data, variables that exhibited a p value of ≤ .25 were added to a multivariable logistic regression model. After elimination of nonsignificant variables, the remaining variables were tested for any statistical interactions final regression model was tested via the Pearson chi-square test and validated with jackknife regression.

## Results

Table 1: Characteristics of Children with Down Syndrome Referred For Polysomnography.

Variable Mean (SD), No. (%)	Total (n=106)	Non-Obese (n=63)	Obese (n=43)	P value
Age, mean (SD)	7.3 (4)	6.1 (4)	9.1 (5)	<.001
< 12 years, No. (%)	89 (84)	58 (92)	31 (72)	.008
≥ 12 years, % No. (%)	17 (16)	5 (8)	12 (28)	.008
Male, No. (%)	56 (53)	31 (49)	25 (58)	.366
Ethnicity				
Caucasian, No. (%)	14 (13)	10 (16)	4 (9)	.327
African American, No. (%)	15 (14)	5 (8)	10 (23)	.044
Hispanic, No. (%)	72 (68)	47(75)	25 (58)	.092
Other, No. (%)	5 (5)	1 (1)	4 (9)	.156
Weight in kg, mean (SD)	27.4 (44)	19.5 (11)	39.5 (24)	<.001
BMI z score	1.2	0.4	2.4	<.001
Comorbidity				
Preterm, No. (%)	23 (22)	15 (24)	8 (19)	.459
Allergies, No. (%)	32 (30)	18 (29)	14 (33)	.673
Asthma, No. (%)	25 (24)	16 (25)	9 (21)	.648
GERD, No. (%)	11 (10)	8 (13)	3 (7)	.519
Hypothyroidism, No. (%)	26 (25)	17 (27)	9 (21)	.477
CHD, No. (%)	65 (61)	45 (71)	20 (47)	.014
Hearing Loss, No. (%)	29 (27)	19 (30)	10 (23)	.545
Tonsil size				
Non-hypertrophy (I/II), No. (%)	55 (52)	31 (49)	24 (56)	.504
Hypertrophy (III/IV), No. (%)	51 (48)	32 (51)	19 (44)	.549
OSA diagnosis				
No OSA, No. (%)	11 (10)	7 (11)	4 (9)	1.00
Mild/Mod OSA, No. (%)	49 (46)	34 (54)	15 (35)	.070
Severe, No. (%)	46 (44)	22 (35)	24 (56)	.044

Abbreviations: BMI z-score, standard deviation determining relative weightx adjusted for age and sex ; Preterm, born before 37 weeks gestation; GERD, gastrointestinal reflux; CHD, congenital heart disease; OSA, obstructive sleep apnea; SD = standard deviation.  
No OSA = AHI <1; Mild/Moderate OSA = 1<AHI<9.9; Severe OSA = AHI ≥10.  
P value based on ANOVA for continuous variables, and Pearson Chi Squared or Fisher Exact test for categorical variables; Significant p-values are in bold

Table 2: Polysomnographic Characteristics of Children with Down Syndrome.

Variable	Total Mean (SD)	Non-Obese Mean (SD)	Obese Mean (SD)	P value
Apnea-Hypopnea Index	16.7 (25)	14.1 (24)	20.6 (28)	.170
AHI (age < 12)	16.4 (26)	14.8 (24)	19.7 (31)	.381
AHI (Age ≥12)	18.1 (16)	5.9 (5)	23.1 (16)	.036
Apnea Index (AI)	4.4 (11)	2.8 (9)	5.8 (14)	.187
Hypopnea Index (HI)	11.5 (18)	9.8 (15)	14.0 (21)	.263
Central Apnea Index	1.4 (4)	6.1 (4)	9.1 (5)	.174
% of REM Sleep	18.6 (7)	18.9 (8)	17.0 (7)	.132
Sleep efficiency	84.4 (12)	85.7 (10)	82.5 (14)	.194
Arousal Index	18.2 (13)	18.3 (13)	18.0 (12)	.913
SaO <sub>2</sub> nadir	83.0 (10)	84.8 (7)	80.3 (14)	.016
SaO <sub>2</sub> nadir (age < 12)	83.0 (11)	84.7 (7)	79.7 (16)	.050
SaO <sub>2</sub> nadir (age > 12)	82.9 (6)	85.6 (7)	81.8 (6)	.264
Peak CO <sub>2</sub> mmHg	51.7 (8)	51.4 (9)	52.1 (6)	.679
Time(min) > 50mmHg CO <sub>2</sub>	16.0 (25)	16.1 (26)	15.7 (25)	.889

Abbreviations: AHI, apnea hypopnea index; AI, apnea index; HI, hypopnea index; CAI, central apnea index; REM, rapid eye movement; Sleep efficiency, percentage of time the patient was asleep; SaO<sub>2</sub> nadir, lowest pulse oximetry measured hemoglobin saturation; TST > 50, total sleep time spent at greater than 50 mm Hg blood CO<sub>2</sub> saturation. P value based upon ANOVA;  
Significant p-values are in bold

Table 3. Simple Logistic Regression of Demographic and Clinical Parameters For Predictors of Severe OSA.

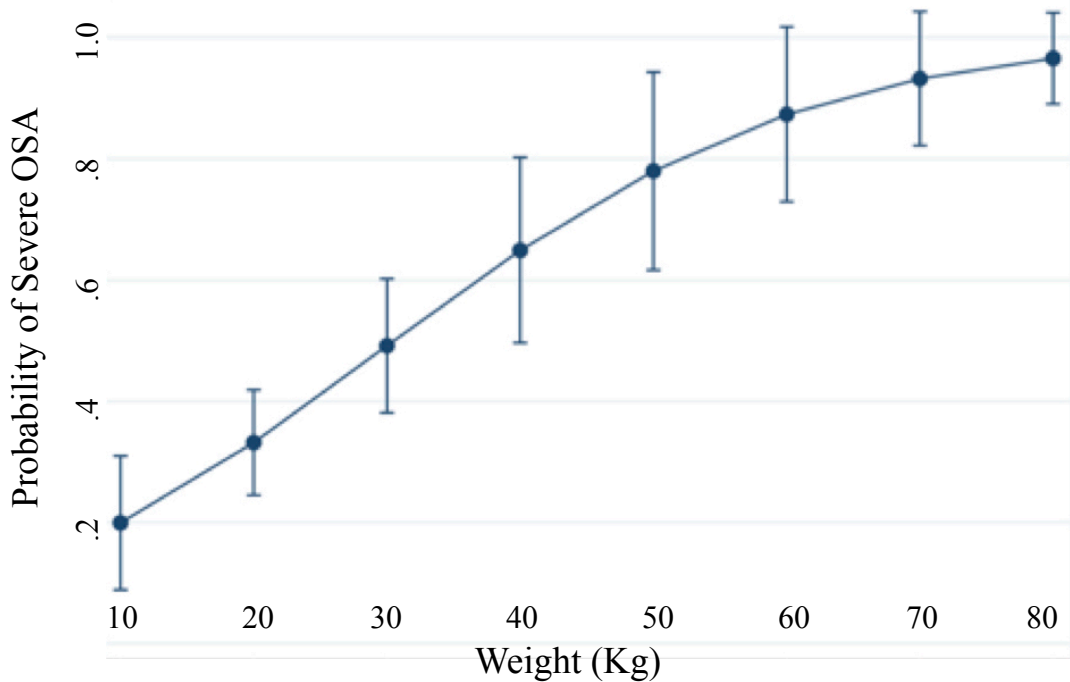
	Inter.	Coeff	Std Err	Wald X <sup>2</sup>	P value	OR	95% CI
Age	-1.2	0.1	0.05	6.42	.110	1.1	1.0 to 1.2
Age < 12	0.9	-1.3	0.58	5.56	.020	0.3	0.1 to 0.8
Age ≥ 12	-0.5	1.4	0.58	5.56	.020	1.3	0.2 to 2.5
Male	-0.3	0.1	0.39	1.11	.784	1.1	0.5 to 2.4
Female	0.2	0.1	0.39	1.11	.784	0.9	0.4 to 1.9
Hispanic	-0.2	-0.4	0.60	0.38	.535	0.7	0.2 to 2.2
African American	-0.4	1.1	0.59	3.61	.058	3.1	1.0 to 9.7
Caucasian	0.1	-0.6	0.42	1.84	.175	0.6	0.2 to 1.3
Weight (kg)	-1.2	0.03	0.01	9.90	.002	1.0	1.0 to 1.1
BMI z score	-0.4	0.1	0.14	0.89	.344	1.1	0.9 to 1.5
Obesity	-0.6	0.9	0.40	4.47	.035	2.3	1.1 to 5.2
Tonsil Size I/II	-0.1	-0.3	0.39	0.54	.464	0.8	0.3 to 1.6
Tonsil Size III/IV	-0.4	0.3	0.39	0.54	.462	1.3	0.6 to 2.9
Allergy	-0.3	0.2	0.42	0.23	.638	1.2	0.5 to 2.8
Asthma	-0.4	0.5	0.45	0.98	.322	1.6	0.6 to 3.9
GERD	-0.2	-0.3	0.66	0.25	.620	0.7	0.2 to 2.6
CHD	0.5	-0.5	0.40	1.66	.200	0.6	0.2 to 1.3
Hypothyroid	-0.3	0.1	0.45	0.11	.744	1.2	0.5 to 2.8
Hearing loss	-0.8	0.8	0.46	2.44	.119	2.1	0.8 to 5.1

Table 4. Multivariable Logistic Regression Model for Predictors of Severe OSA (AHI≥10)

Variable	Coeff	Std. Err.	Wald X <sup>2</sup>	P value	OR	95% CI
Intercept	-0.10	2.0	-	-	-	-
Age	-0.13	0.18	0.34	.560	0.87	0.6 to 1.3
Weight (kg)	0.08	0.03	5.33	.015	1.10	1.0 to 1.1

Abbreviations: Inter = regression intercept; Coeff = coefficient of regression; Std Err = standard error of the mean; Wald X<sup>2</sup> = Wald Chi Squared Test; OR= Odds Ratio; CI = confidence interval; Chi-square goodness of fit test = 103.8. Significant p-values are in bold

Figure 2: Risk of Severe OSA (AHI≥10) By Weight in Children with Down Syndrome.



## Conclusion

- Approximately, 10% had normal sleep studies, and 44% had severe OSA. Severe OSA was more likely among older, obese children.
- Tonsillar hypertrophy was present in about 50% of the study population and equally observed in obese and non-obese children.
- Gender, asthma, and allergies did not show an association with obesity or OSA severity in children with DS.
- Hypoxemia, while worse among obese children, was seen in the majority of children with DS.
- Weight, but not age, was closely associated with severe OSA.