Obstructive Sleep Apnea (OSA): Prevalence among 4-8 Years Old Children in the General Population and Connection with Overweight/Obesity

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Background

Sleep plays a fundamental role in mental and physical health with recent research indicating that untreated obstructive sleep apnea (OSA) has negative effects on cardiovascular-, cardiometabolic- and neurocognitive health and may have non-reversible effects on young children if untreated. Most of the literature looking at prevalence of OSA in young children is based on subjective questionnaires known to be inaccurate. The prevalence of childhood overweight and obesity is a public health concern globally. Obesity is the most common cause of OSA among adults but there is a lack of research into the causes of OSA among children. Early weight gain in strongly related to OSA, possibly as a negative spiral where weight gain is causing OSA and OSA contributing to weight gain.

The study aimed to evaluate: 1) prevalence of obstructive sleep apnea among 4-8 years old children, 2) the association between overweight or obesity and obstructive sleep apnea.

Table 1. Characteristics at baseline in relation to the apnea-hypopnea index (AHI)

	All[a] (n=373)	AHI < 5[b] (n= 287, 77%)	AHI ≥ 5[c] (n=86, 23%)	p value
Age (y)	6.0 ± 1.5	6.0 ± 1.4	5.9 ± 1.6	0.59[d]
Male (%)	51	49	51	0.70[e]
Caucasian (%)	97	97	99	0.26[e]
History of asthma (%)	6	6	6	0.93[e]
History of allergy (%)	10	10	9	0.90[e]
Current BMI z-score	0.65 ± 1.29	0.48 ± 1.24	1.24 ± 1.40	<0.0001[d]
z-score < 1.5 (%)	79	84	59	<0.001[e]
1.5 ≥ z-score < 2.5 (%)	12	9	23	
z-score ≥ 2.5 (%)	9	7	17	
BMI z-score at 18 months of age	-0.72 ± 1.12	-0.82 ± 1.07	-0.39 ± 1.25	0.01[d]

[a]Values are mean ± standard deviation and percentages for categorical variables

[b] no or mild obstructive sleep apnoe

[c] modeare or severe obstructive sleep apnoe

[d]F-test (Type III) of differences among groups

[e]Chi-square test of differences among groups.

Table 2. The association between BMI z-score and obstructive sleep apnoea (OSA)

		Unadjusted		Adjusted[2]		Adjusted[3]	
	n,%	OR[1]	95%CI	OR[1]	95%CI	OR[1]	95%CI
BMI z-score[4]	373, 100%	**1.56**	1.29, 1.89	**1.58**	1.30, 1.91	**1.58**	1.30, 1.91
BMI z-score < 1.5	293.79%	ref	ref	ref	ref	ref	ref
1.5 ≥ BMI z-score < 2.5	45.12%	**3.80**	1.96, 7.35	**4.04**	2.06, 7.92	**4.09**	2.07, 8.06
BMI z-score ≥ 2.5	35, 9%	**3.56**	1.71, 7.42	**3.82**	1.81, 8.04	**3.80**	1.80, 8.02
Δ BMI z-score[5]	316, 85%	**1.30**	1.05, 1,60	**1.35**	1.09, 1.68	**1.35**	1.09, 1.68

[1] Logistic regression model, reflecting the odds of **modeare** or severe OSA (apnea-hypopnea index ≥ 5)

[2] Adjusted for age and sex

[3] Adjusted for age, sex and history of allergy or asthma

[4] Showing increase in the outcome variable per 1 z-score increasein weight gain

[5] The difference between current BMI z-score (age 4-8 years old) and BMI z-score at 18 months of age

Materials and Methods

A cross-sectional study. After ethics approval (VSN-22-096) and study registration (NCT05479201) healthy population-based children aged 4-8 years residing in Akureyri, Iceland were invited to participate. Parents assisted their child to record their sleep for a minimum of 2 nights for OSA diagnosis with FDA-cleared/EU Medical Device Directive (CE mark 0413) HST, SleepImage®, and respond to sleep- and health-questionnaires (pediatric sleep questionnaire-sleep related breathing disorders (PSQ-SRBD)). OSA diagnosis was defined based on apnea-hypopnea-index-3% ($AHI_{3\%}$)/hour of sleep; no-OSA (AHI<2), mild-OSA (AHI 2-5), moderate-OSA (AHI 5-10), severe-OSA (AHI ≥ 10). The night with highest AHI was used to determine the severity of OSA. Data was collected July 2022 – June 15th, 2023; participation was not compensated for. The children's height and weight were measured to calculate BMI z-score. In the study, overweight was defined when a child was more than 1.5 standard deviations above the average body weight curve, and obesity if a child was more than 2.5 standard deviations above the average body weight curve. Binary logistic regression was used to analyze the association between weight and OSA. Main analyses were adjusted for age and sex.

Results

Of 373 children, 51% were male and 97% were caucasian. The average age of participants was 6 years. Prevalence of OSA was high, with 23% (n=86) diagnosed with moderate (16%) or severe (7%) OSA. In total 12% were overweight and 9% had obesity. After adjustment, each 1 BMI z-score increase was associated with 1.58 (95% CI: 1.30, 1.91) higher odds of having moderate/severe OSA. Childhood overweight (OR= 4.04; 95% CI 2.06, 7.92) or obesity (OR=3.82; 95% CI 1.81, 8.04) was associated with ~4 times higher odds of having OSA. Further adjustment for history of allergy or asthma did not change the results. When analyzing the development of BMI z-score from 18 months of age to the current age (ΔBMI z-score), each 1 BMI z-score increase was associated with 1.35 (95% CI: 1.09, 1.68) higher odds of having moderate/severe OSA at 4-8 year of age.

Conclusions

Prevalence of OSA in young children is higher than previously estimated with 23% diagnosed with moderate or severe OSA. The results show that overweight and obesity is strongly associated with childhood OSA. Moreover, early weight gain (from 18 months of age) may be an important risk factor for childhood OSA. Further, studies including more diverse race-groups, more economically diversified population and conducted in other geographical locations are needed to better understand the prevalence of OSA in young children and how OSA may affect health and quality of life if it is not addressed. Additionally, utilizing AHI as the sole parameter to diagnose sleep disorder breathing disorders and what the appropriate cut-off values should be, needs to be further considered.