

## Research Article



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## EVALUATION OF HIGH-FREQUENCY HEARING, RELATED TINNITUS, AND VERTIGO IN CHILDREN WITH GROWTH HORMONE INSUFFICIENCY, EARLY PUBERTY, TYPE 1 DIABETES MELLITUS, OBESITY, AND IDIOPATHIC SHORT STATURE

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### ABSTRACT

**Background:** Globally, a sizable fraction of infant mortality and morbidity are associated with metabolic and endocrine diseases. Diabetes mellitus, growth hormone deficiency, childhood obesity, precocious puberty, and other conditions are among the comorbidities and disorders that influence many body organs, including inner ear functions.

**Objectives:** This clinical experiment evaluated high-frequency hearing, related tinnitus, and vertigo in children with growth hormone insufficiency, early puberty, type 1 diabetes mellitus, obesity, and idiopathic short stature, among other endocrine problems.

**Methods:** 32 healthy children and 120 subjects with idiopathic short stature, precocious puberty, type 1 diabetes mellitus, obesity, and/or growth hormone deficiency underwent evaluations that included a full otolaryngologic examination, otoscopic ear examination, tympanometry, vertigo, and tinnitus. After statistical analysis of the gathered data, conclusions were drawn.

**Methods:** 2.5% (n=3) of the patients saw PTA>20dB, 5% (n=6) saw HF $\tilde{A}$ 20dB, and 5% (n=6) saw both PTA and HF $\tilde{A}$ 20dB (p= 1.000, 0.465, and 1.000). 8.82% (n=9) experienced dizziness, while 18.6% (n=19) reported tinnitus. In study participants with ISS, vertigo and tinnitus were present in 22.7% (p=0.04) of cases. Vertigo with PTA and HFA value >20dB was observed in 3.06% (n=3) people in the entire study group, 5.88% (n=2) respondents with Type 1 DM, 4% (n=1) subjects with obesity, and 3.84% (n=1) subjects with GHD.

**Conclusion:** Within the constraints of the study, the findings indicate that pediatric endocrine disorders may cause changes in the inner ear that have an unclear cause. To identify and address any related abnormalities at an early stage, the study recommends that all children entering endocrinology clinics undergo a comprehensive hearing test as well as a balancing assessment.

**Keywords:** vertigo, tinnitus, pediatrics, endocrine problems, and hearing pattern

### INTRODUCTION

Endocrine and metabolic disorders are linked to a significant portion of child mortality and morbidity globally. These conditions can have comorbidities with metabolic and endocrine issues in addition to their specific consequences, which raise the risk of both the diseases themselves and death and morbidity. These diseases and their accompanying problems affect many body systems and organs, including the inner ear. Among these problems include growth hormone deficiency, diabetes mellitus, childhood obesity, and early puberty.

1. Persistent hyperglycemia is a genetically-based metabolic condition known as diabetes mellitus, which is linked to a number of vascular and neuropathic consequences. About 90% of children are diagnosed with insulin-dependent

diabetes mellitus (type-I DM), which is typically discovered in adolescence. The impact and harm that Type 1 Diabetes Mellitus causes on the cochlear and retrocochlear pathways connected to the auditory system are well-described in a number of published studies.<sup>2</sup>

Growth hormone deficiency (GHD), which affects roughly 1 in 4–10 thousand live births, is another illness that can show, be treated, and be diagnosed in childhood. It manifests as low stature. The most frequent cause of pediatric visits in children is idiopathic short stature (ISS). Researchers from different backgrounds have proven the impact of growth hormone shortage on hearing. It was demonstrated that growth hormone insufficiency in humans affects the development and functions of the auditory system.<sup>3</sup> Globally, the prevalence of childhood and teenage obesity is rising, and one-third of these youngsters suffer from one or more metabolic abnormalities. It has been demonstrated that obesity and related comorbidities raise the risk of hearing loss.<sup>4</sup>

Another illness known as precocious puberty affects both sexes equally, however it affects girls more. In males younger than nine years old, it manifests as testicular enlargement, while in females younger than eight years old, it manifests as breast budding. The majority of pediatric patients examined in endocrinology departments have idiopathic low stature and early puberty. In children, these metabolic diseases and their comorbidities have an impact on normal inner ear and hearing capabilities.<sup>5</sup> Therefore, the current clinical trial was conducted to evaluate children with endocrine disorders, such as growth hormone deficiency, precocious puberty, type 1 diabetes mellitus, obesity, and idiopathic short stature (ISS), for hearing, including high-frequency hearing, and associated tinnitus and vertigo.

## **MATERIALS AND METHODS**

After receiving approval from the relevant ethical committee, the current study was conducted. There were 120 individuals in all, with a mean age of 9.3 years and a range of ages from 6 to 17 for both males and females. Children receiving treatment for growth hormone deficiency, precocious puberty, type 1 diabetes mellitus, obesity, and/or idiopathic short stature at Gauri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal were the children from which the subjects were selected. 32 healthy youngsters, with a mean age of 9.28 years and an age range of 6-16 years, were included in the study as controls. There were 17 males and 15 girls, and they were free of chronic diseases.

Children between the ages of 6 and 16 who had one of the following conditions were eligible for inclusion in the study: growth hormone deficiency, precocious puberty, type 1 diabetes mellitus, obesity, or idiopathic short stature. Exclusion criteria for the study included the following conditions: active ear effusion/inflammation, history of Adenotonsillectomy/ear surgery, thyroid disease, ear wax, current respiratory tract infection, mentally retarded subjects, and/or vestibule-cochlear system syndrome. The subjects received an explanation of the study design following their final inclusion. The parents of the children that were included were then asked for their informed consent.

After enrollment, each subject underwent a thorough otolaryngologic examination, which was followed by an otoscopic examination of both ears. An experienced audiologist performed tympanometry using the tympanic device. This was followed by a hearing examination in an anechoic space using the following frequencies: air conduction hearing test in the 250–20,000 Hz range; HFA (High-frequency average) in the 8, 10, 12, 16, and 20 thousand Hz range; PTA (Pure tone average) in the 500–1000, 2000, and 4000 Hz range; bone conduction hearing test in the 500–4000 Hz range; and acoustic reflex recording. The study did not include subjects who tested positive for Type B and C tympanograms or who showed signs of hearing loss on audiometry tests. The results were presented as single-ear because of the tiny difference (<10dB) in frequencies over a two-year period. The normal hearing range was measured at 0–20 dB, while hearing loss was defined as being at or above 20 dB.

The Pediatric Vestibular Symptom Questionnaire<sup>6</sup> was utilized to assess vertigo, and it consisted of 10 questions with scores of 3, 2, 1, and 0 for mostly, sometimes, seldom, and never. I don't know was added as an extra choice, but it was removed and received no points. Vertigo symptoms were diagnosed with ratings between 15 and 30, with values between 0 and 15 being considered normal. If individuals reported hearing a ringing or buzzing sound, it was scored using the same criteria as vertigo. Individuals who had a score of two or three were diagnosed with tinnitus.

The statistical analysis of the gathered data was conducted using the ANOVA and t-test functions of SPSS software, version 21.0, 2012, Armonk, NY. The formulation of the results was done with a  $p \sim 0.05$  level of significance.

## **RESULTS**

There were 120 individuals in all, with a mean age of 9.29 years and a range of ages from 6 to 17 for both males and females. 32 healthy youngsters, with a mean age of 9.28 years and an age range of 6-16 years, were included in the study as controls. There were 17 males and 15 girls, and they were free of chronic diseases. Table 1 provides an

overview of the study individuals' demographic and illness characteristics. The children under examination consisted of 64 females and 56 males, whereas the controls included 17 females and 15 men.

In the children under examination, Type-1 diabetes mellitus affected 28.33% (n=34) of the participants, GHD affected 21.66% (n=26), obesity affected 20.83% (n=25), idiopathic short stature affected 18.33% (n=220), and premature puberty affected 10.83% (n=13). In the control group, HFA and PTA were  $4.37\pm 6.46$  Hz and  $3.13\pm 4.56$  Hz, respectively. HFA was  $5.59\pm 7.53$ ,  $4.57\pm 7.62$ ,  $7.31\pm 9.33$ ,  $6.74\pm 10.24$ , and  $4.05\pm 2.99$  in children with GHD, precocious puberty, Type-1 DM, obesity, and ISS, and PTA values were  $4.06\pm 5.11$ ,  $3.71\pm 3.11$ ,  $5.35\pm 5.99$ ,  $5.07\pm 5.99$ , and  $3.60\pm 3.67$  in the same children. While hearing loss was taken into consideration at HFA and PTA of  $>20$ dB, the normal hearing range was measured between 0 and 20dB.

Out of all the study participants, 2.5% (n=3) had a PTA value more than 20 dB, 5% (n=6) had an HFA value of  $>20$  dB, and 5% (n=6) had both PTA and HFA values of  $>20$  dB. These differences, with corresponding p-values of 1.000, 0.465, and 1.000, were statistically not significant. When evaluating the control group against GHD, premature puberty, Type 1 diabetes, obesity, and idiopathic short stature for  $>20$ dB, statistical analysis revealed that the difference was not statistically significant ( $p>0.05$ ). Table 2 describes each of these parameters' individual values. Among the 102 kids that were examined, 8.82% (n=9) experienced vertigo and 18.6% (n=19) suffered tinnitus.

For GHD, precocious puberty, Type 1 DM, obesity, and idiopathic short stature, as well as the entire study population, there was no statistically significant difference observed in the individual parameter assessment for the presence of vertigo and tinnitus in study subjects. However, in children with ISS, 22.7% (n=5) of the subjects reported having tinnitus symptoms ( $p=0.04$ ). No participant with PTA and HFA value  $\sim 20$ dB had tinnitus or vertigo among those with precocious puberty and ISS. Among the entire experimental group, 3.84% (n=1) of the subjects had GHD, 5.88% (n=2) had Type 1 DM, 4% (n=1) had obesity, and 3.06% (n=3) had vertigo with PTA and HFA value  $>20$ dB. Similar to this, participants with GHD, Type 1 DM, obesity, and the entire experimental group had PTA and HFA values of  $>20$ dB with tinnitus and vertigo in 3.84% (n=1), 2.94% (n=1), 4% (n=1), and 2.04% (n=2) of the subjects, respectively (Table 3).

## DISCUSSION

In the current study, 17 females and 15 males served as controls, and 64 females and 56 males made up the youngsters under examination. In the children under examination, Type-1 diabetes mellitus affected 28.33% (n=34) of the participants, GHD affected 21.66% (n=26), obesity affected 20.83% (n=25), idiopathic short stature affected 18.33% (n=220), and premature puberty affected 10.83% (n=13). In the control group, HFA and PTA were  $4.37\pm 6.46$  Hz and  $3.13\pm 4.56$  Hz, respectively. HFA was  $5.59\pm 7.53$ ,  $4.57\pm 7.62$ ,  $7.31\pm 9.33$ ,  $6.74\pm 10.24$ , and  $4.05\pm 2.99$  in children with GHD, precocious puberty, Type-1 DM, obesity, and ISS, and PTA values were  $4.06\pm 5.11$ ,  $3.71\pm 3.11$ ,  $5.35\pm 5.99$ ,  $5.07\pm 5.99$ , and  $3.60\pm 3.67$  in the same children.

These results were in line with research conducted in 2018 by Kılıç K et al<sup>7</sup> and in 2001 by McGaughan JM et al<sup>8</sup>, whose values were similar to those seen in the current investigation. In this study, the normal hearing range was defined as 0–20 dB, whereas hearing loss was defined as an HFA and PTA of  $\sim 20$  dB. Out of all the study participants, 2.5% (n=3) had a PTA value more than 20 dB, 5% (n=6) had an HFA value of  $>20$  dB, and 5% (n=6) had both PTA and HFA values of  $>20$  dB. These differences, with corresponding p-values of 1.000, 0.465, and 1.000, were statistically not significant.

When evaluating the control group against GHD, premature puberty, Type 1 diabetes, obesity, and idiopathic short stature for  $>20$ dB, statistical analysis revealed that the difference was not statistically significant ( $p>0.05$ ). These results corroborated those of Hwang JH et al. (2009) and Allen DB et al. (2013), who noted comparable hearing patterns in the subjects they studied.

Among the 102 kids that were examined, 8.82% (n=9) experienced vertigo and 18.6% (n=19) suffered tinnitus. For GHD, precocious puberty, Type 1 DM, obesity, and idiopathic short stature, as well as the entire study population, there was no statistically significant difference observed in the individual parameter assessment for the presence of vertigo and tinnitus in study subjects. However, in children with ISS, 22.7% (n=5) of the subjects reported having tinnitus symptoms ( $p=0.04$ ).

No participant with PTA and HFA value  $\sim 20$ dB had tinnitus or vertigo among those with precocious puberty and ISS. Vertigo with PTA and HFA value  $>20$ dB was observed in 3.06% (n=3) people in the entire study group, 5.88% (n=2) respondents with Type 1 DM, 4% (n=1) subjects with obesity, and 3.84% (n=1) subjects with GHD. In a similar vein, 3.84% (n=1), 2.94% (n=1), 4% (n=1), and 2.04% (n=2) of the participants with GHD, Type 1 DM,

obesity, and the entire experimental group, respectively, had PTA and HFA values of >20dB with tinnitus and vertigo. There is little information and few authors that have examined the connection between tinnitus and vertigo in patients with endocrine problems and hearing loss.

However, these findings were comparable to the study of Kocyigit M et al<sup>11</sup> in 2020 where authors reported similar findings concerning vertigo and tinnitus in subjects with endocrine and metabolic diseases.

**CONCLUSION**

Within its limitations, the present study concludes that endocrine diseases manifested in childhood can lead to alterations in the inner ear with poorly understood etiology. However, the study suggests a balance examination and thorough hearing examination be done in all children visiting endocrinology clinics to detect and treat any associated abnormality at an early stage. However, the present study had few limitations including a smaller small size, shorter monitoring period, geographical area biases, and single-institutional nature. Hence, further longitudinal studies with a larger sample size and longer monitoring period are required to reach a definitive conclusion.

**REFERENCES**

1. Ergun-Longmire B, Wajnrajch MP. Growth and growth disorders. In: De Groot LJ, Chrousos G, Dungan K, Feingold KR, Grossman A, Hershman JM, et al., editors. Endotext. South Dartmouth (MA): MDText.com, Inc.; 2000.
2. Maia CAS, Campos CAH. Diabetes mellitus as etiological factor of hearing loss. Rev Bras Otorrinolaringol (Engl Ed) 2005;71:208–14.
3. Muus, J. S., Weir, F. W., Kreicher, K. L., Bowlby, D. A., Discolo, C. M., and Meyer, T. A. Hearing loss in children with growth hormone deficiency. Int. J. Pediatr. Otorhinolaryngol. 2017;100:107–13.
4. Cherian KE, Kapoor N, Mathews SS, Paul TV. Endocrine Glands and Hearing: Auditory Manifestations of Various Endocrine and Metabolic Conditions. Indian J Endocrinol Metab. 2017;21:464–9.
5. McGaughran JM, Price DA, Kerr BA. Precocious puberty, endometriosis, skeletal anomalies, and mild hearing loss: a new autosomal dominant syndrome? Clin Dysmorphol 2001;10:235–9.
6. Pavlou M, Whitney S, Alkathiry AA, et al. The Pediatric Vestibular Symptom Questionnaire: A Validation Study. J Pediatr 2016; 168:171–7.
7. Kılıç K, Sakat MS, Çayır A. Evaluation of Hearing in Children with Metabolic Syndrome. Turk Arch Otorhinolaryngol 2018;56:160–5.
8. McGaughran JM, Price DA, Kerr BA. Precocious puberty, endometriosis, skeletal anomalies, and mild hearing loss: a new autosomal dominant syndrome? Clin Dysmorphol 2001;10:235–9.
9. Hwang JH, Hsu CJ, Liu TC, Yang WS. Association of plasma adiponectin levels with hearing thresholds in adults. Clin Endocrinol (Oxf) 2011;75:614–20.
10. Allen DB, Cuttler L. Clinical practice. Short stature in childhood– challenges and choices. N Engl J Med 2013;368:1220–8.
11. Kocyigit M, Bezgin SU, Cakabay T, Ortekin SG, Yildiz M, Ozkaya G, et al. An Investigation of Hearing (250–20,000 Hz) in Children with Endocrine Diseases and Evaluation of Tinnitus and Vertigo Symptoms. Int Arch Otorhinolaryngol 2020;24:204–11.

**TABLES**

Characteristics	Controls		Growth Hormone Deficiency		Precocious Puberty		Type 1 DM		Obesity		Idiopathic Short Stature	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Number (n)	32	100	26	21.66	13	10.83	34	28.33	25	20.83	22	18.33
Mean age (years)	9.28		9.27		8.44		9.24		9.86		9.65	
Gender												
Females (64)	17	53.12	13	50	10	76.92	18	52.94	12	48	11	50
Males (56)	15	46.87	13	50	3	23.07	16	47.05	13	52	11	50
High-Frequency Average (Mean±S.D)	4.37±6.46		5.59±7.53		4.57±7.62		7.31±9.33		6.74±10.24		4.05±2.99	
Pure Tone Average (Mean ± S.D)	3.13±4.56		4.06±5.11		3.71±3.11		5.35±5.99		5.07±6.04		3.60±3.67	

**Table 1: Demographic and disease characteristics of the study subjects**

Characteristics	Controls (32)		Growth Hormone Deficiency (26)		Precocious Puberty (13)		Type 1 DM (34)		Obesity (25)		Idiopathic Short Stature (22)	
	n%	p	n%	p	n%	p	n%	P	n%	P	n%	p
HFA <20dB	1(3.125)	-	2(7.69)	0.326	0	1.0	3(8.82)	0.363	2(8)	0.314	0	1.0
PTA <20dB	1(3.125)	-	1(3.84)	1.0	0	1.0	1(2.94)	1.0	1(4)	0.578	0	1.0
HFA and PT< 20dB	1(3.125)	-	1(3.84)	1.0	0	1.0	1(2.94)	1.0	1(4)	1.000	0	1.0

**Table 2: HFA, PTA, and HFA and PTA values of more than 20dB in the study subjects**

Parameter with scores	Controls (32)		Growth Hormone Deficiency (26)		Precocious Puberty (13)		Total (102)	
	n%	p	n%	p	n%	p	n%	P
Tinnitus symptom 0/1	29(90.6)		22(84.6)		11(84.6)		83(81.3)	
Tinnitus symptom 2/3	3(9.37)	0.341	4(15.3)	0.341	2(15.3)	0.265	19(18.6)	0.074
Pediatric vestibular symptom questionnaire 0/1	31 96.8%		24(92.3)		12(92.3)		93(91.1)	
Pediatric vestibular symptom questionnaire 2/3	1(4)	0.655	2(7.69)	0.655	1(7.69)	0.572	9(8.82)	0.263
HFA and PTA >20dB with Vertigo	0	0.203	1(3.84)	0.203	0	-	3(3.06)	0.347
HFA and PTA >20dB with Tinnitus and vertigo	0	0.453	1(3.84)	0.453	0	-	2(2.04)	0.580

**Table 3: Tinnitus and Vertigo in the study subjects**

Parameter with scores	Type 1 DM (34)		Obesity (25)		Idiopathic Short Stature (22)		Total (102)	
	n%	p	n%	p	n%	P	n%	P
Tinnitus symptom 0/1	27(82.35)		20(80)		17(77.2)		83(81.3)	
Tinnitus symptom 2/3	7(20.5)	0.14	5(20)	0.094	5(22.7)	0.044	19(18.6)	0.074
Pediatric vestibular symptom questionnaire 0/1	30(88.2)		21(84)		21(95.4)		93(91.1)	
Pediatric vestibular symptom questionnaire 2/3	4(11.7)	0.272	4(16)	0.131	1(4.54)	1.0	9(8.82)	0.263
HFA and PTA >20dB with Vertigo	2(5.88)	0.242	1(4)	0.437	0	-	3(3.06)	0.347
HFA and PTA >20dB with Tinnitus and vertigo	1(2.94)	0.494	1(4)	0.437	0	-	2(2.04)	0.580