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Prevalence of Obesity in children with unexplained dizziness: A cross-sectional study

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Abstract

Introduction: Egypt is one of the countries that face obesity and overweight health problem. Previous studies suggested that childhood obesity is a significant public health issue in Egypt. Dizziness is a prevalent complaint among the general population; moreover, it is common condition in children. Dizziness arises from different vestibular and non-vestibular diseases; however, some patients remained unexplained in terms of the etiology of dizziness.

Aim of the study: That study aimed to assess the prevalence of childhood obesity in children with explained and unexplained dizziness in order to explain the etiology of their dizziness.

Subjects and Methods: A total of 150 children complaining of dizziness were included in this cross-sectional study. All participants underwent full audiological and vestibular assessment. Their Body Mass Index (BMI) were calculated according to their anthropometric measurements.

Results: The correlation between the final diagnosis reached to explain dizziness in normal and obese children revealed that only 4.9% of those with normal body weight had unexplained dizziness, compared to 90.9 % of obese participants with unexplained dizziness.

Conclusions: Obese children showed unexplained dizziness more frequently than normal-weight children; therefore, screening for BMI was required in all children with dizziness. Dynamic post-urography should be added to the standard assessment of children with dizziness.

Keywords: Dizziness; Children Obesity; Body Mass Index; Dynamic post-urography.

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1. Introduction

Obesity is a major public health hazard impacting over 500 million people worldwide. More than 1.9 billion people were overweight, while and 600 million

were obese in 2018, worldwide [1]. Egypt is one of the countries that face obesity and overweight health problem. Egypt has the highest rate of overweight and obesity in the world, with a proportion exceeding 35% of the overall population [2]. Previous research has suggested that childhood obesity is a significant public health issue in Egypt [3]. According to Salem et al., 2002, the prevalence of obesity among Egyptian children was 14.7% for boys and 15.08% for girls [4].

The revised CDC charts classified children and adolescents as overweight, if their body mass index (BMI) falls between the 85th and 95th percentiles, and obese, if it exceeds the 95th percentile for their age and gender. A 2-year-old toddler is obese if his/her weight for recumbent length exceeds the 97 % percentile of WHO growth guidelines [5]. Extreme obesity is defined as a BMI of 120 % of the 95th percentile or 35 kilograms per square meter [6]. Numerous diseases and health difficulties was linked to childhood obesity and overweight.

Dizziness is a prevalent complaint among the general population. Dizziness can result from the labyrinth, cardiac, neurological, endocrinological, and psychological dysfunctions and has a substantial impact on one's life quality and work capacity [7].

The prevalence of vertigo, dizziness, and unsteadiness arising from a variety of vestibular and non-vestibular diseases was 48.3%, 35.6%, and 39.1%, respectively [8]. Besides, vertigo is a common condition in children, and variation in published prevalence data reaches 10% in the majority of clinical trials [9].

According to Elghaffar et al., 2022, the indicated diagnosis was that 17.6% of the patients had benign paroxysmal vertigo of childhood and 23.9% of the cases had dizziness associated with otitis media [10]. Patients with migraines made up 11.2%, while 5.5% of cases had benign paroxysmal positional vertigo, compared to 4.4%, who had labyrinthitis or vestibular neuritis. Less than 3% of cases were due to less frequent reasons like cholesteatoma, ototoxicity, perilymph fistula, increased vestibular aqueduct, Meniere's Disease, and labyrinthine hydrops. Only 6.6% of patients had neurological reasons. 13.9% of episodes were due to general factors like anemia, diabetes mellitus, and other endocrine problems. 3.1% of cases had cardiovascular diseases, compared to 1.8% with visual disorders. While the cause of dizziness in 20.5% of patients was undiagnosed, Similar findings were made by Choung et al., 2003, who found that 18.2% of their pediatric vertigo patients were "unclassified" [11]. Thus, when it comes to the etiology of their dizziness, some patients remain undiagnosed, and these people frequently need more monitoring and screening than those who have a definite diagnosis.

That cross-sectional study aimed to assess the prevalence of childhood obesity in children with explained and unexplained dizziness to comprehend the etiology of their dizziness.

2. Subjects and methods

2.1. Subjects

A total of 150 children complaining of dizziness were included in this study which spanned two years, from January 2020 to January 2022, at the Fayoum University hospital's Audio-Vestibular unit, Otolaryngology department.

Inclusion criteria

Any child who feels dizzy and may complain about any one of the following symptoms: unsteadiness, imbalance, light-headedness, or vertigo, was recruited. The ages ranged from 6 to 18 years (females or males).

Exclusion criteria

Any child who declined to finish the examination (either child or guardian) was excluded. Also, any child was known to suffer from a known neurological disease was excluded, as well

2.2. Study design

A comprehensive medical history

That included a detailed description of the dizzy complaint's frequency, duration, progression, and nature. Also included were triggering and alleviating influences. Any additional symptoms and medications administered were recorded.

Anthropometric measurements

The height was measured using a tape measure firmly attached to a wall, while the head was held in position. The weight was calculated with a digital electronic scale. Weekly, the scale was reset to zero and calibrated. BMI was calculated by the Metric System Formula: weight (kg)/ height $(m)^2$.

Calculating BMI Percentiles for Children and Adolescents (Ages 2 to 20) [12]:

1. Measuing of height and weight.
2. Calculating of BMI using the above formula at the CDC's BMI calculator [12].
3. Plot the BMI value on the appropriate CDC BMI-for-age growth chart (for females or boys, as applicable). Online growth charts from the CDC were accessed at http://www.cdc.gov/healthyweight/assessing/bmi/childrensBMI/aboutchildrenBMI.html [12]
4. Using the online Child and Teen BMI Calculator from the CDC at http://nccd.cdc.gov/dnpabmi/Calculator.aspx, which automatically presents the BMI percentile during the BMI calculation [12].
5. Determination of the Weight Status Category for the BMI-for-age percentile that was calculated.
6. Children were then divided into two categories:
   A. Normal: (less than 85th percentile).
   B. Obese or overweight (more than 85th percentile).

Pediatric Dizziness Questionnaire [13]

Basic audiological evaluation: Pure tone audiometry: air conduction thresholds & Bone conduction thresholds. Speech audiometry: Speech reception threshold (SRT) [14] and word discrimination scores (WDS) [15].

Video-nystagmography (VNG)

VNG was performed using two-channel monocular Micro-medical Mobile Eyes.

VNG subtests were oceanography tests (smooth pursuit, saccade, and optokinetic), spontaneous nystagmus, gaze, positional, positioning, and caloric tests.

2.3. Statistical analysis

Using the Statistical Package for Social Science (SPSS) software, the data was analyzed for quantitative parametric data: One-Sample Kolmogorov-Smirnov test & Independent samples t-test between two independent groups. Bivariate Pearson correlation test to determine connections between factors for qualitative data.

3. Results

A total of 150 children were included in that study. 25 guardians declined to complete the study, where only 125 children completed it. 52% of them were females, while 48% of them were males. Their median age was ten years old. The median BMI of participants is 18.13 K/gm2. According to the CDC recommendations, 82.4% had normal weight, while 17.6% were overweight or obese (their BMI percentile ≥85) (Table 1).

Parameters		Frequency (n=125)
Sex	Female	65 (52%)
	Male	60 (48%)
BMI (According to CDC)	Normal weight (≤85%)	103 (82.4%)
	Overweight or obese (≥85%)	22 (17.6%)
Age	**Median** (10), **IQR** (6.5)	
BMI	**Median** (18.13), **IQR** (6.31)	

Table 1: Demographics of the study population.

The scores for each category based on the questionnaire are provided in (Table 2**)**. The median scores for the Vestibular, Neurological, General, CVS, Ocular and Psych categories were 8, 4, 6, 4, 0, and 0, respectively. The median total score was 26.

Table 2: Summary of Pediatric Dizziness Questionnaire items (n=125).

Categories score	Median	IQR
Vestibular	8.00	4.50
Neurological	4.00	5.00
General	6.00	6.00
CVS	4.00	8.00
Ocular	0.00	4.00
Psych	0.00	8.00
Total score	26.00	19.5

Regarding basic audiological evaluation: Pure tone Audiometry results were as follows 56.8% were normal, 17.6% of participants had unilateral Conductive hearing loss, 13% of participants had bilateral Conductive hearing loss, 8% had bilateral Sensorineural hearing loss, 6.4% had unilateral Sensorineural hearing loss, and 0.8% of participants had mixed hearing loss.

While Tympanometry showed 80.8 % type A on the right side and 76.8 % on the left side, type B represented 14.4 % of the study group on the right side and 16.8 % on the left side. Type C represented 3.2 % on both sides. Tympanometry could not be performed in 1.6% and 3.2% of participants on the right and left sides, respectively.

The final diagnosis for dizziness was completed in 80% of cases (either vestibular, neurological, general, or dual causes), while 20% remained with unexplained cause dizziness as shown in (Table 3).

Table 3: Final diagnosis of participants (n=125).

Parameters	Frequency (n=125)
Unexplained dizziness	25 (20%)
Vestibular	51 (40.8%)
Neurological	7 (5.6%)
General	8 (6.4%)
CVS	2 (1.6%)
Vestibular + general	10 (8%)
Ocular + vestibular	2 (1.6%)
Vestibular + cardiac	2 (1.6%)
Neurological +vestibular	18 (14.4%)

VNG subtests' findings in all participants compared to their BMI were as follows (Table 4):

Occulography results revealed that normal-weight children had 8.8 % abnormal saccades, 8.8% with low gain smooth pursuit and asymmetry, and 8% with low gain Optokinetic tests. 3.2% of cases had

spontaneous nystagmus. On positional testing, 15.2% showed positional nystagmus, and 8% showed positioning nystagmus. On the other hand, none of the obese children showed any abnormality except in caloric testing: 77.6% of normal-weight children were within normal, contrasted with 95.5% of the obese children.

The correlation between the final diagnosis obtained to explain dizziness in children between normal weight children and obese ones revealed that only 4.9 % of those with normal body weight remained with unexplained dizziness, compared to 90.9 % of obese participants who remained with unexplained dizziness and that was a statistically significant difference (Table 4).

Table 4: Association between obesity and dizziness (n=125).

Variables		Participants		*P-value*
		Normal weight (n=103)	Obese (n=22)	
Sex	Male	46 (44.7%)	14 (63.6%)	0.106
	Female	57 (55.3%)	8 (36.4%)	
Nystagmus	Normal	99 (96.1%)	22 (100%)	>0.999
	Abnormal	4 (3.9%)	0	
Positional	Normal	84 (81.6%)	22 (100%)	0.024*
	Abnormal	19 (18.4%)	0	
Positioning	Normal	93 (90.3%)	22 (100%)	0.206
	Abnormal	10 (9.7%)	0	
Caloric test	Normal	76 (73.8%)	21 (95.5%)	0.212
	Abnormal	15 (14.6%)	1 (4.5%)	
Oculography Saccade	Normal	92 (89.3%)	22 (100%)	0.21
	Abnormal	11 (10.7%)	0	
Oculography OPK	Normal	93 (90.3%)	22 (100%)	0.207
	Abnormal	10 (9.7%)	0	
Final Diagnosis	Explained	98 (95.1%)	2 (9.1%)	<0.001*
	Unexplained	5 (4.9%)	20 (90.9%)	

* Significant *P-value*.

4. Discussion

Obesity in children has been of medical attention for over 150 years [16-17]. Obesity also fosters the development of various diseases, including insulin resistance type 2 diabetes mellitus, arterial hypertension, and hypertriglyceridemia. Moreover, obesity exacerbates many diseases once they have developed [18]. Obese children are at a greater risk for the development of vascular disease, which is exacerbated by the worsening of obesity-related risk factors [19].

In the current study, the correlation between obesity and different VNG findings revealed abnormal findings with normal children more than obese ones, which could explain the cause of their complaints. Moreover, the correlation between the final diagnoses obtained to explain dizziness in children with normal and obese revealed that 90.9 % of obese participants remained with unexplained dizziness, whereas only 4 (9 %) of those with normal body weight had unexplained dizziness.

The unexplained etiology of dizziness in obese children could be attributed to numerous factors. Inflammation contributes to insulin resistance and metabolic alterations linked with obesity [20], in addition to the aberrant inflammatory activation in obese children, which has been described. Obesity results in systemic damage to the vasculature in children and adults [21]. This process involves inflammatory activation in the vascular wall and adipose tissue [22]. More and above, childhood obesity is linked to the child's psychological profile including, anxiety and depression, low self-esteem and reported lower quality of life, and social issues such as bullying and discrimination [21].

Excessive body weight is a major risk factor for morbidity and death from cardiovascular illnesses, diabetes, cancer, and musculoskeletal and mental disorders, with a negative impact on handicaps and life quality [22]. The excessive amount of fat affects the body's shape by adding passive mass to various regions [23]. That alters the biomechanics of daily activities, generating functional restrictions, and possibly predisposing to injury [24]. There seems to be quantitative evidence that it has a devastating effect on activities such as sit-to-stand [25], walking, and equilibrium [26]. In addition, the accumulation of adipose tissue and the rise in body mass are among the factors that contribute to the occurrence of falls, and obese individuals have a higher risk of falling than normal-weight subjects when exposed to everyday postural stresses and perturbations [27]. More and above, obesity may be related to a changed body image, both in terms of conscious cognition and perception and unconscious behaviors. According to Corna *et al.,* 2017, the incidence of dizziness and falls appears to be higher in an obese inpatient population than in a matched general population [28]. Despite that, the rate of falls and dizziness do not likely to be correlated to the severity of obesity [28]. Corbeil et al., 2001, observed that a much greater ankle torque is required to support the body in obese individuals; hence, this may also impair their directional control [29]. They found that directional control scores drop when BMI rises. Emara *et al.,* 2020, concluded that increased body weight affects the balance function of the normal individual, and that might be assessed by dynamic post-urography [30].

Obese individuals experience more frequent and more severe balance issues; thus, diet and weight loss can be beneficial. The equilibrium system has a greater ability for environmental adaptation. People who are fit, active, and in good shape had fewer problems with their balance and recover from balance disorders more quickly.

Conclusions

Obese children showed unexplained dizziness more frequently than normal-weight children; therefore, screening for BMI is required in children with dizziness. Dynamic post-urography should be added to the standard assessment of children with dizziness. Larger studies are required to corroborate the prior findings, with a focus on the effect of obesity on children with dizziness and follow-up results following weight loss.

Declarations

Ethical approval and consent to participate: The study was approved by the local research ethics board of Fayoum University on May 15th, 2016, and written informed consent was obtained from all patients' guardians to participate in this work.

Consent for publication: All patients' guardians obtained written informed consent to publish this work.

Availability of data and material: all datasets used are available.

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