

How Age Matters in the Assessment of Vertigo in the Pediatric Emergency Department

A 10-Year Age-Stratified Etiology Survey

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Abstract: Vertigo is a relatively frequent cause for referral to the pediatric emergency department, and it is usually caused by benign or self-limiting etiology. However, it could be difficult to evaluate especially in the younger child and could also conceal serious illness as encephalitis or cerebellitis. Our survey collected in a 10-year period 757 children assessed in pediatric emergency department for vertigo and stratified this population for etiology and for group of age: younger than 6 years (113, 14.9%), between 7 and 12 years (251, 33.2%), and older than 12 years (393, 51.9%). In addition, associated signs and symptoms, evaluation by a neurologist or an otorhinolaryngologist, and instrumental investigations were recorded.

We found that age is the most important variable to assess the possibility of a central nervous system disease as etiology cause of vertigo with a significant difference of incidence between the younger group (younger than 6 years, 23%) and older groups (3% and 1%; $P < 0.001$).

This finding should reinforce the index of suspicion for a central nervous system illness as cause of vertigo in the preschool children with an accurate workup including evaluation by a neurologist or an otorhinolaryngologist and instrumental investigations as needed.

Key Words: vertigo, dizziness, age, central nervous system

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KEY NOTES

- We reviewed 757 children aged 1 to 18 in a 10-year period who were admitted to the emergency department of a pediatric hospital with vertigo or disequilibrium.
- Vertigo is a not rare symptom in pediatric emergency department; unlike in adults, it is usually benign with migraine, vasovagal syncope, infections, and psychogenic causes as most common etiology
- Age younger than 6 years and presence of neurologic signs are associated with central nervous system disorders, whereas vertigo in the older child without neurological symptoms is related to a very low prevalence of central nervous system involvement.

Vertigo and dizziness are not rare symptoms in pediatric population. Approximately 5% of children report 1 episode during a year with a prevalence of 0.45% of children that have recurrent episodes.¹ Vertigo is usually defined as the illusionary perception of motion of the individual or his surroundings, whereas dizziness

is a more nonspecific sensation of instability or light headedness.² Most studies about vertigo in childhood analyze children evaluated by neurologic or otorhinolaryngologic department with a possible selection bias about the most common etiology of the symptoms,^{3,4} whereas only few studies deal with vertigo as a symptom of presentation in pediatric emergency department (PED), where the patient is evaluated for the first time.⁵

In adults, the description of the characteristics of vertigo and of the associated symptoms guides the differential diagnosis and steers the diagnostic workup.⁶ A subjective vertigo is often associated with central nervous system disease and could be the onset of various serious illness such as hemorrhagic stroke, ischemic stroke, cerebral tumors, and multiple sclerosis.^{7,8} For this reason, an accurate assessment of the characteristic of the vertigo in adults is mandatory to decide whom has to be referred for imaging and for specialist evaluation, which are both time and resources consuming. On the contrary, children not only have diverse peculiar differential diagnosis of vertigo but often cannot describe the symptom or cooperate properly to allow a detailed neurologic evaluation.^{9,10}

For this reason, although most cases in pediatric population have benign etiology¹¹ or are secondary to psychogenic disorder in the adolescent population,¹² lack of data in PED could lead to a diagnostic conundrum with a wide differential diagnosis and an escalation of unnecessary investigations.⁵

In a population of patients not stratified for age evaluated by a PED, 20% underwent an imaging investigation, although 56% of the investigated patient had no neurologic signs or symptoms. Furthermore, patients who had serious central nervous system diseases (CNS tumor, demyelinating disorder, vascular disorder) accounted for the 2% of the population and remarkably all presented associated neurologic symptoms or signs further than vertigo.¹³

The aim of this study was to analyze the prevalence of vertigo in pediatric population in PED, with a particular focus on how age and associated symptoms and signs could influence the diagnostic workup, aiming at identifying possible predictive factors that could help select further investigations.

METHODS

We enrolled retrospectively all the patients evaluated for vertigo/disequilibrium at the PED of the Institute for Maternal and Child Health “Burlo Garofolo” from January 2007 to December 2017. Patients were included if “vertigo” or “disequilibrium” was registered as first or second symptoms at triage admission or at discharge. All triage and emergency department discharge report were revised to confirm the correct assessment of the symptoms based on the story.

The emergency department is the only pediatric facility in an area of 260,000 inhabitants, with approximately 25,000 admissions per year of patients aged 0 to 18 years, in the contest of a

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TABLE 1. Distribution for Age and Sex of the Observed Population

	Male	Female	Total, %	Age, Median	SD
0–18 y	337	420	757 (100)	11.8	3.4
≤6 y	61	52	113 (14.9)	3.6	1.5
7–12 y	131	120	251 (33.2)	10.5	1.2
>12 y	145	248	393 (51.9)	15	1.2

Distribution of the observed population is shown.

third-level pediatric teaching hospital with 24/24-hour availability of pediatric radiology, neurology, and otorhinolaryngology specialist.

The study was approved by the institute internal review board, and parents of children admitted to the ED are routinely required at admission to give their consensus for anonymous use of data for research.

We arbitrarily stratified the patients for age, from the birth to 6 years, from 7 to 12 years, and older than 12 years. The rationale for this division was based on school attendance (preschool, scholar, adolescent). For each patient, we collected the following variables: age, sex, associated symptoms (headache, nausea, vomit, lethargy), associated signs (Romberg test, nystagmus, ataxia, or dysmetria), evaluation by a neurologist or an otorhinolaryngologist, associated imaging, and management at the end of the evaluation (observation, admission, discharge). Imaging was considered pathological only if consistent with the symptoms of presentation.

Discharge diagnoses were grouped in different classes: migraine crisis (including benign paroxysmal vertigo of childhood [BPVC]), vasovagal crisis, central nervous system disorder (cerebellitis, encephalitis, chorea, stroke), peripheral nervous system (vestibular neuritis, labyrinthitis, vestibular disorders), posttraumatic causes, infective causes (upper viral infection, sinusitis, otitis), psychogenic causes, and pharmacologic causes (benzodiazepines, cannabinoid, alcohol). Cases that could not fit in one of the classes are defined as not classifiable.

Statistical Analysis

We reported as numbers and percentage continuous (age), discrete (diagnosis, signs, and symptoms associated), and dichotomic (sex) variables.

We used the 2-tail Fisher exact test to compare the 3 age groups in terms of incidence of each type of vertigo, and we considered a confidence interval of 95%.

RESULTS

From January 2007 to December 2017, 288,835 patients were evaluated by the PED of the Institute for Maternal and Child Health “Burlo Garofolo.” Seven hundred fifty-seven children (0.3%) complained of vertigo/dizziness/disequilibrium at the admission as main symptoms at the triage.

A prevalence of female sex was present in the adolescent cohort (145 males, 37%, and 248 females, 63%; Table 1).

Indeed, considering the youngest cohort younger than 6 years, the most common etiology was CNS illness (23%, 26), more than half of children had a cerebellitis (14 patients), 4 had final diagnosis of epilepsy, 4 encephalitis, 1 case of stroke, 1 thrombosis of sinus transversus, 1 chorea, and 1 acute disseminated encephalomyelitis. Vertigo associated with upper viral infection and otitis seems to be the second cause (21.2%, 24). Migraine was diagnosed in 14.2% (16 children), mainly as BPVC (12 patients). Only few patients had syncope, vestibular neuritis, psychogenic disease, and posttraumatic vertigo as cause of the symptom.

In the 7- to 12-year-old cohort, the leading causes of vertigo were vasovagal syncope in the 19.7% of cases (50 patients) and migraine in 18.5% of children (49 patients), of whom 2 had BPVC. Rare were the CNS disorders (3.1%, 8 children): 4 cases of epilepsy, 2 chorea, 1 encephalitis, and 1 pseudotumor cerebri (Table 2). Vertigo due to viral infection was recognized in 16.2% of the cohort (42 patients). Psychogenic disease was diagnosed in 12.7% of the group.

In the oldest age group, migraine and vasovagal syncope were the first diagnoses, respectively, in 21.6% of the cohort and 19.3%. Psychogenic disorder was the third common cause of vertigo, affecting 16% of the sample. The CNS disorders in this age group were rare (1.5%), 2 encephalitis, and 2 epileptic disease.

In each group, a final diagnosis of vertigo was not achieved: respectively in the youngest was 18.5% of the cohort, 21.1% in children among ages 7 to 12 years and 15.5% in the oldest one.

Considering the symptoms associated at the onset, none seems to be strongly predictive of a final diagnosis. Headache was correlated to a migraine crisis in 78% of cases, but not rarely, it was complained by children with other diseases. Vomit and nausea were frequently reported in almost one third of all cases, regardless of the final diagnosis with the exception of CNS diseases where nausea rarely complained (2%).

TABLE 2. Causes of Vertigo Stratified for Age in Observed Population

	n (%)	≤6 y, n (%)	7–12 y, n (%)	>12 y, n (%)	<i>P</i> ≤ 6 vs >12 y	<i>P</i> ≤ 6 vs > 6 y
Acute migraine or BPPV	153 (20.2)	16 (14.2)	49 (18.5)	87 (22.2)	0.065	0.098
Vasovagal vertigo	141 (18.6)	8 (7.2)	53 (19.7)	79 (20.2)	0.001	0.001
Infectious disease	130 (17.2)	27 (23.8)	42 (16.2)	57 (14.5)	0.022	0.029
Psychogenic	102 (14.2)	7 (6.2)	32 (12.7)	63 (16)	0.008	<0.001
CNS	43 (5.6)	26 (23)	8 (3.1)	4 (1)	<0.001	<0.001
Peripheral nervous system	31 (4)	4 (3.6)	6 (2.4)	22 (5.6)	0.475	0.933
Posttraumatic	25 (3.3)	3 (2.7)	6 (2.4)	16 (4.1)	0.587	0.946
Not classifiable vertigo	126 (16.6)	21 (18.5)	53 (21.1)	61 (15.5)	0.469	0.791
Pharmacologic causes	6 (0.8)	0 (0)	2 (0.8)	4 (1)	0.580	0.599
Total	757	113	251	393		

The leading cause of vertigo in the examined population and summaries etiology classification stratified for age are shown.

BPPV indicates benign paroxysmal positional vertigo; CNS, central nervous system.

Vertigo was autonomously managed by the attending pediatrician in approximately half of patients (51.5%, 390) without the necessity of specialist consulting or diagnostic investigation.

Considering each age group, a neurologist referral was executed in 43% of cases in the youngest cohort, whereas in the others, the percentages were lower and similar, 22.7% in the middle age, and 25.2% in the oldest cohort. ENT consultation was performed, respectively, in 21%, 19.5%, and 22.4% of patients.

Focusing on instrumental investigation, computed tomography scan was performed in 5.3% of preschool children, whereas in the children up 12 years old and older than 12 years, it was done in 0.7% and 0.5% of the sample. None was pathological. Magnetic resonance imaging was performed in 11.5% of the children belonging to the youngest cohort and showed alterations in 38.4% of cases. In the middle age groups, magnetic resonance imaging was executed in 2.4% and was pathological in 16.6%, whereas in the oldest sample, it was done in 1.3% and was significant in 40% of cases.

Admission was considered worthwhile in 24% of cases involving preschool children, whereas it was necessary in 10.8% of 7- to 12-year-old sample and in the 7.9% of oldest cohort.

DISCUSSION

This survey shows that vertigo is a rare symptom complained in the emergency department, with an overall prevalence of 0.3% among all children assessed. This result is comparable with the only other study considering children with vertigo in a PED setting⁵ and differs significantly from the prevalence commonly described in the general pediatric population obtained from studies using a patient questionnaire as the primary method of data collection.¹⁴

Acute migraine and BPPV were, as expected, the most frequent diagnosis, accounting in almost one fifth of the overall population as already reported in previous studies where the prevalence ranges from 12% to 34%.⁴⁻⁶ The connection between BPPV and vestibular migraine is still a matter of debate but should not be labeled anymore as a mere precursor of migraine but as a part of a migraine syndrome, being classified as migraine equivalents in the latest International Classification of Headache Disorders.¹⁵

Otherwise, there were differences in disease distribution among each age groups considered.

In the preschool children, vertigo subtends a CNS disorder (cerebellitis, epilepsy, encephalitis) in almost one fourth of the cases in our sample, and this is the first diagnosis to rule out in those younger than 6 years.

Remarkably, as suggested by previous studies,¹⁶ this group of patients had almost always neurologic symptoms or signs associated with vertigo, which help in a correct assessment and diagnostic workup. Indeed, neurologist referral and neuroimaging techniques were performed more commonly in this age group than in the others, and the admission rate was higher.

To our knowledge, no previous studies have shown so high a rate of CNS disease, but we think that it could be explained by the way we have grouped the population attending PED. Indeed, considering the totality of the sample, the prevalence of central neurologic disorder was 5%, similar to what is reported in previous studies, whereas the difference comes out when the cohort is split in age groups.

Conversely, vasovagal crisis and psychogenic disorder were rare in those younger 6 years but became prevalent in the older groups, being second only to migraine. Vasovagal crisis causes transient vertigo or dizziness and seldom could conceal cardiogenic cause like arrhythmia or hypertension: for this reason, if never done before, an electrocardiogram is recommended in the

first episode of vasovagal syncope.¹⁷ A recent study has shown as vasovagal dizziness is commonly complained in a German grammar school (52%) but has limited impact on social activities.¹⁸

Patients with psychogenic disorder often complain of symptoms as vertigo or dizziness with a recurrence of the symptom and association with anxiety or agitation crisis, autonomic arousal, and depressive behavior. The terms phobic postural vertigo or psychogenic dizziness or chronic subjective dizziness are often used as synonymous and in literature are commonly described in adolescence and adulthood. Lahmann et al¹⁹ have shown as almost half of adults with vertigo/dizziness attending to a tertiary hospital have had a psychiatric comorbidity. This group of patients complaints of a bigger limitation in the daily activities compared with patient with organic vertigo and social isolation and withdrawal from work or study.¹⁹

Only a diagnostic subgroup has seemed to have a stable prevalence among each age cohort, and this was unclassified vertigo. It accounted in almost one fifth of the population, and these data are coherent with previous literature where idiopathic and unidentified vary from 10% to 20%.⁵⁻¹⁴ These results reinforce the idea that vertigo in children is difficult to evaluate, and not rarely, a final diagnosis is not achieved once a clearly defined central or peripheral vestibular pathology is ruled out or psychogenic elements do not emerge.

Finally, we notice a prevalence of female sex in the oldest group, probably because of the major prevalence of orthostatic dizziness and vertigo due to vasovagal reaction in adolescent girls, as previously known in literature.²⁰

Limits and Strengths of the Study

Limit of this study is the retrospective collection of the data of only 1 PED. Because of the retrospective analysis, eligible patients may have been missed because symptoms could be present but not registered in triage admission or discharge. Strengths are the numerosity of the survey (757 patients), the largest in literature in a wide period (10 years) and with the first ED centered age-stratified analysis of the etiologies of vertigo.

CONCLUSIONS

Age is an important variable in evaluating a child with vertigo, with an incidence younger than 6 years of 1 in 4 children who has an underlying CNS disorder. In older child, isolated vertigo without other neurologic signs or symptoms very seldom hides a CNS disorder, whereas migraine, psychogenic disorder, and vasovagal syncope cover the main part of the causes.

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