



# Epidemiology of Dizziness and Balance Problems in Children in the United States: A Population-Based Study

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**Objective** To study national prevalence of dizziness and balance problems in US children and explore associated risk factors and patterns of healthcare utilization.

**Study design** A multistage, nationally representative, probability sample of children (n = 10 954; aged 3-17 years) was examined based on the 2012 National Health Interview Survey Child Balance Supplement. Parents were asked if during the past year their child was bothered by symptoms of dizziness and balance problems: vertigo (motion sensation), light-headedness/fainting, clumsiness/poor coordination, poor balance/unsteadiness when standing-up or walking, frequent falls, or other dizziness and balance problems. Logistic regression was used to examine associations with sociodemographic information, birth weight, developmental delays, and significant health conditions.

**Results** Prevalence of dizziness and balance problems was 5.3% (3.3 million US children); females, 5.7%, males, 5.0%. Non-Hispanic white (6.1%) had increased prevalence compared with Hispanic (4.6%) and non-Hispanic black (4.3%) children,  $P = .01$ . Prevalence increased with age, from 4.1% for children aged 3-5 years to 7.5% for children aged 15-17 years,  $P < .001$ . Even though the majority had symptoms rated as “no problem” or “a small problem,” 18.6% (600 000 US children) had symptoms rated as “moderate,” “big,” or “very big” problems. Overall, 36.0% of children with dizziness and balance problems were seen by healthcare professionals during the past year and 29.9% received treatment. Among children with dizziness and balance problems rated as moderate/big/very big problems, 71.6% had seen healthcare professionals and 62.4% received treatment for dizziness and balance problems.

**Conclusions** The risk factors identified provide useful epidemiologic information about dizziness and balance problems in children and will be used in tracking the Healthy People 2020 goal to increase utilization of healthcare services for these children. (*J Pediatr* 2016;171:240-7).

“Dizziness” and “imbalance” can describe many symptoms, such as a motion sensation (vertigo), light-headedness, disequilibrium, and unsteadiness. Vertigo and dizziness rank among the most common reasons for referral to neurologists and otolaryngologists in emergency rooms and office-based settings.<sup>1,2</sup> These symptoms may cause life-altering disability and healthcare burden.<sup>3</sup>

Prevalence estimates of dizziness and balance problems in children have ranged from 5%-18%, based on limited foreign population-based studies.<sup>4-8</sup> In clinical studies, vertigo occurs in 0.3%-0.7% of children's visits to otolaryngology clinics.<sup>9-12</sup> Despite the significance of dizziness and balance problems, the prevalence in US children has not been studied previously. Consequently, the National Institute on Deafness and Other Communication Disorders funded the Child Balance Supplement (CBS) to the 2012 National Health Interview Survey (NHIS) in order to provide prevalence estimates and to begin tracking the new Healthy People 2020 objective to increase the proportion of children who receive healthcare and treatment for dizziness and balance problems.

This study was designed to identify the symptoms and overall prevalence of dizziness and balance problems in US children, assess the strength of associations between symptoms and risk factors, and determine the proportion of children seen by healthcare professionals who received treatment for dizziness and balance problems in the past 12 months.

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The National Health Interview Survey (NHIS) Child Balance Supplement was co-funded by the NIDCD/NIH and National Center for Health Statistics (NCHS)/Centers for Disease Control and Prevention (CDC) via Interagency Agreement Y1-DC-7001. NCHS staff contributed to the overall design and conduct of the NHIS, but they were not involved in the analysis or interpretation of results in this manuscript. The findings and conclusions in this report are solely those of the authors and do not necessarily represent official views of the authors' respective Federal agency or university affiliations.

Portions of the study were presented at the meeting of the Association for Research in Otolaryngology, February 23, 2014, San Diego, CA.

0022-3476/\$ - see front matter. Published by Elsevier Inc.  
<http://dx.doi.org/10.1016/j.jpeds.2015.12.002>

CBS	Child Balance Supplement
HH	Head of household
IPR	Income-to-poverty ratio
NCHS	National Center for Health Statistics
NH	Non-Hispanic
NHIS	National Health Interview Survey

## Methods

The NHIS is an annual, nationally representative, cross-sectional survey that monitors the health of the civilian, noninstitutionalized US population through collection of information on a broad range of health topics. Although some of the content changes annually, the National Center for Health Statistics (NCHS) has conducted this survey continuously since 1957. A multistage area probability design is used to sample children and adults within households. In 2012, information on 13 275 children aged <18 years was provided by proxy from a parent or knowledgeable adult family member. The response rate was 90.7% of the identified sample ( $n = 14\,637$ ), but after accounting for prior household and family nonresponse, the overall final response rate was 69.7%.<sup>13</sup> The 2012 NHIS protocol was approved by the NCHS human subjects review board. Informed consent was obtained for all participants.

The 2012 NHIS CBS component collected data only on children 3-17 years old, which reduced the sample to 10 954. Adult family members answered questions about the child's developmental history, health and symptoms of dizziness and balance problems: age at first steps; general problems with standing, walking, or using limbs; occurrence of vertigo, light-headedness, or fainting; poor balance or unsteadiness; problems with body or motor coordination or clumsiness; frequent falls; other symptoms of dizziness and balance problems; diagnosis by health professionals and receipt of treatment during the past year; limitations of participation in home, school, work, or recreational activities; and caregiver's perception of severity of the dizziness and balance problems.

### Outcome Measures

Dizziness and balance problems were determined by positive answers to the following question: "During the past 12 months, has your child been bothered by episodes of any of the following dizziness or balance problems: (1) vertigo, a spinning sensation like a carousel ("vertigo"); (2) poor balance, an unsteady or woozy feeling that makes it difficult to stand up or walk ("poor balance"); (3) problems with body or motor coordination or clumsiness ("poor coordination"); (4) frequent falls ("frequent falls"); (5) light-headedness, fainting, or feeling he/she is about to pass out ("light-headedness"); and (6) any other type of balance or dizziness problems ("other dizziness and balance problems"). These and related questions from the 2012 NHIS CBS are shown in the [Appendix](#) (available at [www.jpeds.com](http://www.jpeds.com)) and are available also from the NCHS website.<sup>14</sup>

### Covariates

To identify related characteristics, we examined parent's report of each child's medical conditions and health status, birth weight and developmental history, and sociodemographic status. The analyses included age (3-5, 6-8, 9-11, 12-14, 15-17 years), race/ethnicity (Hispanic, non-Hispanic

[NH] black, NH white, other [Asian, American Indian/Alaska Native, Pacific Islander, or multiple]), head of household (HH) education (<high school, high school, >high school/some college, college graduate or higher level), medical conditions (yes/no), hearing difficulty (yes/no), trouble seeing even with glasses/contact lenses (yes/no), age of child's first step without support (6-8, 9-11, 12-14, 15+ months), birth weight (<1500 g, 1500-2499 g, 2500-3999 g, 4000+ g, unknown), attention deficit hyperactivity disorder or attention deficit disorder (yes/no), intellectual disability, also known as mental retardation (yes/no), impairment that limited ability to crawl, walk, run, or play (yes/no), and a problem for which a child has regularly taken prescription medication for 3 months or longer (yes/no).

Hearing difficulty was defined by responses of "a little trouble hearing" or greater (yes/no) to the question: "Which statement best describes [child's name] hearing without a hearing aid: Excellent, good, a little trouble hearing, moderate trouble, a lot of trouble, or is [child's name] deaf?" Medical conditions in the past 12 months included hay fever (yes/no), respiratory allergy (yes/no), anemia (yes/no), frequent or severe headaches including migraines (yes/no), 3 or more ear infections (yes/no), seizures (yes/no), and stuttering or stammering (yes/no). Income-to-poverty ratio (IPR), the ratio of annual income to the poverty threshold based on family size, was divided into approximate quartiles as <1,  $1 \leq \text{IPR} < 2$ ,  $2 \leq \text{IPR} < 4$ , and  $\geq 4$ , where 1 = the poverty threshold.

### Statistical Analyses

National estimates and SDs were calculated taking into account the survey's complex sampling design. Two-sided tests and a significance level of  $P < .05$  were used. Participant characteristics were described using means for continuous variables and percentages for categorical variables. Multivariable logistic regression analysis, with the calculation of ORs and 95% CIs, was used to identify risk factors associated with dizziness and balance problems after adjusting for selected covariates. Analyses in model 1 ([Table 1](#); available at [www.jpeds.com](http://www.jpeds.com)) were adjusted for sex, child's age, race/ethnicity, HH educational level, and IPR. In model 2 ([Table 1](#)), all variables shown were included simultaneously in the multivariable model. SAS v 9.3 (SAS Institute, Cary, North Carolina) and SUDAAN version 10.1 software (Research Triangle Institute, Research Triangle Park, North Carolina) were used for the analyses.

## Results

Mean age of the CBS children was 10.2 years (SD, 4.4; range 3-17); 48.9% were female; race/ethnicity distribution: 20.3% Hispanic, 13.5% NH black, 53.3% NH white, and 9.5% other.

### Prevalence of Dizziness and Balance Problems

The US nationally weighted prevalence of dizziness and balance problems in the past year was 5.3% (3.3 million US children), 5.0% for boys and 5.7% for girls, and increased with

age (eg, 4.1% for 3-5 years, 5.3% for 9-11 years, and 7.5% for 15-17 years) (Table II). The prevalence in NH whites (6.1%) was higher than for other race/ethnic groups (range 4.3%-4.6%). The most prevalent dizziness and balance problem was "poor coordination" (2.4%; 1.5 million children), followed by "light-headedness" (1.9%), "poor balance" (1.6%), "vertigo" (1.5%), "frequent falls" (1.3%), and other problems (0.5%) (Table II).

### Characteristics of Dizziness and Balance Problems

Among children with dizziness and balance problems, 46.0% had "poor coordination," 35.1% "light-headedness," 30.9% "poor balance," 29.0% "vertigo," 25.0% "frequent falls," and 8.5% "other dizziness and balance problems" (Table III). A single dizziness and balance problem symptom was reported for 54.4%, 2 symptoms for 25.5%, 3 symptoms for 13.8%, and 4 or more symptoms were reported for 6.3%. Children were more likely to have 2 or more symptoms rather than any single symptom. Among children with dizziness and balance problems, vertigo alone was reported for 7.2%, and vertigo and poor balance combined was reported for 14.1% (Table III). Poor balance alone was reported for 4.4%; however, poor balance was reported in combination with poor coordination (16.0%), light-headedness (12.4%), and vertigo (14.1%).

### Severity of Dizziness and Balance Problems

Among children with dizziness and balance problems, 41.5% were reported as having "no problem," 39.8% "a small problem," and 18.6% either a "moderate," "big," or "very big" problem. For children with "a small problem," 20.6% of reporting adults said that dizziness and balance problems "interfered with home, school or recreational activities in the past 12 months" (Figure, A). For children with "moderate," "big," or "very big" problems, these percentages ranged from 59.8%-93.3%.

### Diagnoses of Dizziness and Balance Problems

Among the 586 children with dizziness and balance problems, only 32.8% were reported to have had a diagnosis. For children with moderate/big/very big problems, this percentage increased to 59.6%. Identified diagnoses included neurologic disorders, ear infections, head or neck injury or concussion, developmental motor coordination disorder ("clumsy" child), other genetic cause (eg, Usher syndrome), metabolic problem, such as low blood sugar (hypoglycemia), prescription medication or drugs, severe headaches or migraine, malformation of the ear, and vision problems/blurred vision. Among the 192 children with diagnoses, 51% had one or more of the diagnoses listed, and the remaining 49% were recorded as having "some other cause (not listed)."

### Healthcare Utilization

Among children with dizziness and balance problems, 36.0% were seen by a healthcare professional during the past

12 months; this percentage increased to 71.6% among those who had moderate/big/very big problems and to 91.7% for those who had a "very big" problem (Figure, B). Among children with dizziness and balance problems, 29.9% received treatment in the past 12 months; this percentage increased to 75.0% for children with a "very big" problem (Figure, C).

### Risk Factors Associated with Dizziness and Balance Problems

After adjusting for age, sex, race/ethnicity, education, and family income levels using logistic regression in model 1 (Table I), many factors were associated with statistically increased ORs for dizziness and balance problems: ages 12-14 and 15-17 years, HH education less than high school, family income below the poverty level, low and very low birth weight, first steps without support at age 15 months or later, and all the developmental or illness conditions or impairments listed in Table I.

With regard to other sensory problems, the prevalence of dizziness and balance problems among children with difficulty hearing was 20.9%, and those without hearing difficulty had a prevalence of dizziness and balance problems of 4.9%,  $P < .001$  (Table II). Hearing difficulty increased the risk of dizziness and balance problems, model 1 OR = 4.8, 95% CI 3.0-7.7 (Table I). For children with trouble seeing even with corrective lenses, dizziness and balance problems prevalence was 14.4%, significantly higher than 5.0% in children with no trouble seeing,  $P < .001$  (Table II). After adjusting for sociodemographic factors using logistic regression in model 1, trouble seeing increased the risk of dizziness and balance problems, OR = 3.0, 95% CI 2.1-4.5.

Further sex-specific analyses revealed that males and females shared many risk factors, including increased risk among teenagers (12-17 years), "other" (not intellectual) developmental delay, frequent headaches/migraines, seizures, and impairments limiting the child's ability to crawl, walk, run, or play. Male-specific risk factors were NH white race, attention deficit hyperactivity disorder or attention deficit disorder, told had intellectual disability, and stuttered/stammered in the past year. Female-specific risk factors were respiratory allergy in the past year, anemia, hearing difficulty; females also had higher prevalence of frequent headaches/migraines (females, 30.4% with dizziness and balance problems vs 5.4% for those without dizziness and balance problems; males, 18.5% with dizziness and balance problems vs 4.5% for those without dizziness and balance problems) with increased multivariable aORs as well (females, OR = 4.4, 95% CI 3.0-6.6; males, OR = 2.8, 95% CI 1.7-4.5). The sex-specific analysis results are not shown in the tables.

In the full multivariable logistic regression analysis, model 2 (Table I), in which all the variables listed were adjusted for simultaneously, most of the relative risk estimates (ORs) were reduced compared with the model 1 results; an exception occurred for female sex, which emerged as a significant variable. The model 2 analysis indicates which of the factors were most strongly associated with dizziness and

**Table II.** Prevalence (%) of dizziness and balance problems by sex, age, and race/ethnicity, parents' education, income status, birth weight, and children's hearing and vision problems, US children, aged 3-17 years, 2012 NHIS CBS

	Sample size, N = 10 954	Any dizziness and balance problem symptoms, %	Specific symptoms of dizziness or balance problems					Other dizziness and balance problem symptoms, %
			Vertigo, %	Light- headedness, %	Poor coordination, %	Poor balance, %	Frequent falls, %	
<b>Sex</b>								
Male	5572	5.0	1.6	1.5	2.5	1.7	1.3	0.5
Female	5382	5.7	1.5	2.2	2.4	1.6	1.3	0.4
P value		.24	.90	.03	.93	.91	.92	.72
<b>Age (y)</b>								
3-5	2217	4.1	0.3	0.1	2.9	1.3	2.5	0.2
6-8	1985	3.6	0.5	0.8	2.2	0.7	1.5	0.2
9-11	2099	5.3	1.3	1.2	3.0	1.2	1.3	0.5
12-14	2175	6.0	2.5	2.7	2.0	2.3	0.4	0.7
15-17	2478	7.5	3.0	4.5	2.0	2.7	0.9	0.6
P value		<.001	<.001	<.001	.32	<.001	<.001	.06
<b>Race/ethnicity</b>								
NH white	4853	6.1	1.7	2.3	2.9	2.0	1.2	0.6
NH black	1689	4.3	0.9	1.5	2.1	1.6	1.7	0.1
Hispanic	3174	4.6	1.9	1.3	1.7	1.2	1.5	0.5
Other	1238	4.3	1.0	1.6	2.4	1.0	1.3	0.1
P value		.01	.05	.03	.04	.10	.61	.003
<b>HH education (y)</b>								
<High school	1244	6.7	1.5	1.6	2.7	1.8	3.3	0.3
High school	2237	5.4	2.6	1.8	2.3	1.8	1.2	0.7
Some college	3843	5.8	1.3	2.0	2.9	1.8	1.6	0.5
College + more	3617	4.4	1.3	1.8	2.1	1.4	0.6	0.3
P value		.04	.17	.83	.36	.72	<.001	.24
<b>Family IPR</b>								
<1.00	2230	6.2	1.9	1.6	2.9	1.7	2.4	0.8
1.00-1.99	2404	5.7	1.8	1.9	2.8	1.5	1.7	0.3
2.00-3.99	2840	5.4	1.3	2.2	2.5	1.7	1.1	0.4
≥4.00	2492	4.5	1.3	1.7	1.9	1.8	0.5	0.3
Unknown	988	4.5	1.6	1.8	2.0	1.3	1.1	0.7
P value		.14	.52	.86	.32	.94	.001	.36
<b>Birth weight (g)</b>								
<1500	157	16.0	6.0	6.1	9.5	8.5	5.2	2.0
1500-2499	768	7.3	1.6	1.2	4.6	2.9	2.4	0.4
2500-3999	7909	5.3	1.5	1.9	2.3	1.5	1.2	0.4
≥4000	1002	3.7	1.6	1.7	1.4	1.3	0.7	0.3
Unknown	1118	4.2	1.0	2.0	2.1	1.3	1.8	0.7
P value		.002	.22	.28	.009	.05	.04	.74
<b>Any hearing difficulty, past 12 mo</b>								
Yes	254	20.9	7.1	3.5	12.1	10.0	7.2	20.9
No	10 700	4.9	1.4	1.8	2.2	1.4	1.2	4.9
P value		<.001	.007	.19	<.001	.004	.002	<.001
<b>Trouble seeing, even when wearing glasses</b>								
Yes	370	14.4	4.5	4.7	7.9	7.1	4.7	14.4
No	10 584	5.0	1.5	1.8	2.3	1.5	1.2	5.0
P value		<.001	.020	.012	<.001	.001	.005	<.001
<b>Total*</b>								
US prevalence (%)		5.3	1.5	1.9	2.4	1.6	1.3	0.5
Number in US population		3 278 000	951 000	1 150 000	1 506 000	1 013 000	818 000	278 000

\*Nationally weighted, population-based percentages and numbers for the 2012 US child population, aged 3-17 years.

balance problems after adjusting for each of the other factors. The most strongly associated factors were problems that limited ability to crawl/walk/run/play (OR = 4.3), frequent headaches/migraines (OR = 3.7), ever told child has “other” developmental delay (OR = 3.6), seizures during the past 12 months (OR = 3.1), stuttering/stammering (OR = 2.9), hearing difficulty (OR = 2.4), and anemia during the past 12 months (OR = 2.4).

## Discussion

Dizziness and balance problems had an overall prevalence of 5.3% in 3- to 17-year-old children (95% CI 4.8%, 5.9%) and increasing prevalence with age. Comparing these US findings with the reported prevalence of childhood dizziness and balance problems from other countries is difficult because the

**Table III.** Percentage of children with only one problem\*, or of children with 2 or more problems†, from among all children with any dizziness or balance problems (n = 586), US children, aged 3-17 years, 2012 NHIS CBS

	Vertigo, %	Light-headedness, %	Poor coordination, %	Poor balance, %	Frequent falls, %	Other dizziness and balance problems, %
Vertigo	7.2*	12.6	8.4	14.1	3.1	2.1
Light-headedness		14.8*	7.2	12.4	3.7	3.3
Poor coordination			17.8*	16.0	15.9	3.3
Poor balance				4.4*	7.4	3.8
Frequent falls					7.2*	1.1
Other dizziness and balance problems						3.0*
Total‡	29.0	35.1	46.0	30.9	25.0	8.5

\*Among children having at least 1 dizziness and balance problem, the percentage of children with a single symptom (shown in diagonal entries); for example, the 7.2% of children with dizziness and balance problems had only vertigo and no other symptom, while 14.8% of children with dizziness and balance problems had only light-headedness and no other symptom, etc.

†Among children having at least 1 dizziness and balance problem, the percentage of children with at least 2 (pairs of) symptoms reported (shown in off-diagonal entries); for example, 12.6% had both vertigo and light-headedness (and possibly other problems), etc.

‡Among children having at least 1 dizziness and balance problem (eg, the total percentage with vertigo is 29.0%, light-headedness is 35.1%, etc).

questions and definitions used vary considerably. Nevertheless, our results approximate the prevalence of 5.7% in 10-year-old United Kingdom children<sup>5</sup> and 5.6% in Chinese middle school students (12-17 years).<sup>6</sup> Other studies have reported higher prevalence (eg, 2 studies<sup>8,15</sup> reported 18% of children aged 5-15 years in Aberdeen, Scotland had at least 1 episode of paroxysmal vertigo during the previous year, based on asking, "Has your child suffered from attacks of dizziness in the past year?" In Finland, a study of children aged 1-15 years,<sup>7</sup> based on a sample of the general population from 3 schools and a child welfare clinic, reported 8% with vertigo and 1% with frequent falls).

The risk factors for dizziness and balance problems in children have not been well studied. We found children aged 12-17 years have a higher prevalence of dizziness and balance problems compared with younger children. Females have a higher prevalence of dizziness and balance problems and were at increased risk for some risk factors, especially for frequent headaches/migraine. NH white children have a higher prevalence of dizziness and balance problems (6.1%) than the other racial/ethnic groups combined (4.4%), which was significant (OR = 1.4; 95% CI 1.1-1.8) in the full multivariable model after adjusting for potential confounders.

Birth weight, namely, low birth weight and, especially, very low birth weight (<1500 g), was significantly associated with some dizziness and balance problems (poor coordination, poor balance, and frequent falls), but not with vertigo or light-headedness. This suggests that birth weight is more strongly associated with motor problems. Yet, there were large relative increases in the prevalence (6%) for vertigo and light-headedness associated with very low birth weight (<1500 g), however, there were too few of these births to achieve overall significance. Although the 2012 CBS sample is large, N = 10 954, there was no oversampling for low or very low birth weight infants. The association between birth weight and dizziness and balance problems was not significant after adjustment for neurodevelopmental (motor and intellectual) and sensory (hearing and vision) problems among other factors in the full multivariable model 2.

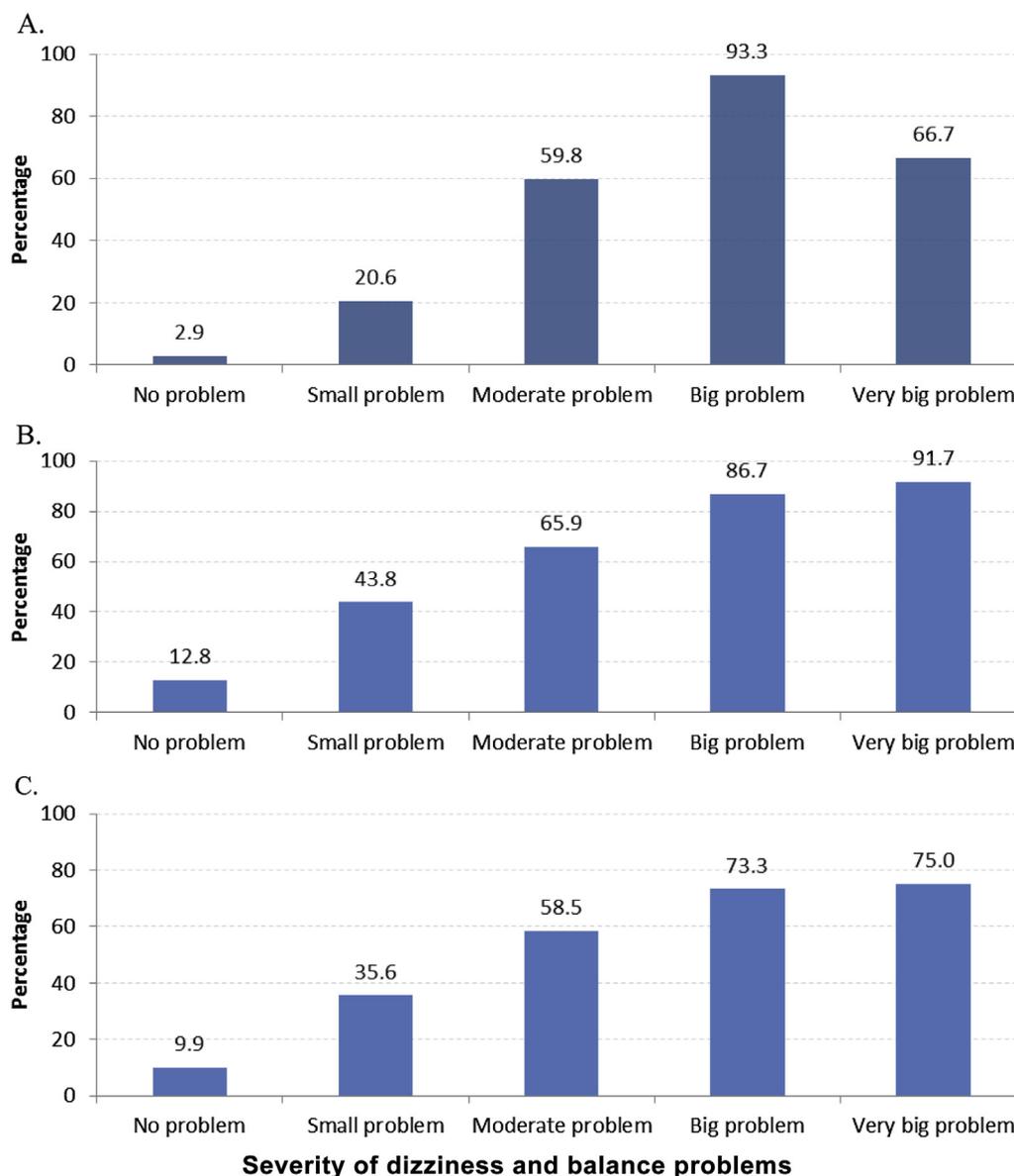
Headache/migraine was significantly associated with dizziness and balance problems in boys and girls in this study,

consistent with other studies.<sup>11,15,16</sup> One of the most common diagnoses in children with vertigo and dizziness is vestibular migraine, occurring in over one-half of children with dizziness headaches.<sup>17</sup> The manifestations of migraine in childhood, however, are varied and the prevalence of vestibular migraine is difficult to determine. Nevertheless, the prevalence and characteristics of symptoms of dizziness and balance problems in this study resemble that of prior studies of migraine in children.

Eustachian tube dysfunction with or without middle-ear effusion is a common cause of vestibular problems in children.<sup>18,19</sup> Healthcare providers often attribute dizziness and balance problems in childhood to otitis media and middle ear effusion, as symptoms and vestibular testing may improve after tympanostomy tube insertions.<sup>20-22</sup> Gioacchini et al<sup>17</sup> suggested recently that the rate of middle ear effusion and otitis media causing vertigo is underestimated. In this population-based survey, however, we did not find a significant association between dizziness and balance problems and frequent episodes of otitis media (recurrent acute ear infections), after adjusting for other variables. However, in this parental interview survey, we did not attempt to assess presence or absence of middle ear effusion for the children when their dizziness and balance problems occurred.

Children with seizure disorders often have dizziness and balance problems. Not surprisingly, a history of seizures was significantly associated with dizziness and balance problems in both boys and girls. This finding confirms previous work showing that electroencephalographic abnormalities were more common in patients with dizziness and balance problems and that dizziness was more common in epileptic patients than in controls.<sup>23</sup>

Hearing difficulty is associated with dizziness and balance problems in both sexes, consistent with several reports of significant associations between hearing loss and balance disorders.<sup>5,11,24,25</sup> A somewhat weaker association was found between dizziness and balance problems and vision (seeing trouble even with corrective lenses).<sup>26</sup> Patients diagnosed with peripheral vestibular disorder are more likely to carry an associated diagnosis of sensorineural hearing loss than the general pediatric population. Similarly, children



**Figure.** Prevalence of children’s dizziness or balance problems by severity for **A**, Interfered with home, school, or recreational activities in the past 12 months; **B**, received professional healthcare services in the past 12 months; and **C**, received recommended treatments in the past 12 months.

with sensorineural hearing loss demonstrate vestibular impairment.<sup>24,27</sup>

With increasing severity of dizziness and balance problems, parents reported progressively increasing percentages of children who experienced interference with home, school, or recreational activities (Figure, A). However, the exception to this pattern occurred for children described as having “very big” problems. These children were less frequently reported to have experienced interference with home, school, or recreational activities compared with children described as having “big” problems. We suggest the reason could be that these parents already have reduced expectations for participation in home or outside activities because of their children’s more severe limitations. In other

words, the parents’ perception of home or outside activities for these children may have already taken into account the need for special accommodations that have become the norm for these families.

Patients with dizziness and balance problems present most often to primary care offices, emergency departments, and specialized dizziness clinics.<sup>28</sup> Although most causes of vertigo are benign, rare cases of central vertigo can be life-threatening, requiring immediate medical attention. In this study, only 72% of children who had moderate/big/very big problems had received professional healthcare services during the past 12 months.

Establishing a diagnosis for the nonspecific complaint of dizziness is challenging, especially in children. In this study,

the highest prevalence of specific dizziness and balance problems was for poor coordination, light-headedness, poor balance, and vertigo. Dizziness and balance problems may be the nonspecific sequelae of numerous impairments, including deficits in vision, proprioception, and musculoskeletal, autonomic, and vestibular function. Often an adequate history is difficult to obtain because of the children's age and limited ability to express their symptoms precisely. Among the one-third of children in this study whose parents/caregivers reported they had been given a diagnosis, 49% replied that the dizziness and balance problems were due to "other" unspecified causes. This finding is not surprising. Almost 90% of children with balance disorders are categorized as "unspecified dizziness," indicating that the diagnostic accuracy and methods of physicians treating children with balance problems should be improved.<sup>11</sup>

Dizziness and balance problems in childhood can be a symptom of a neurologic abnormality. Therefore, children with dizziness and balance problems should undergo a thorough neurologic physical examination. Children or proxy responders should be encouraged to describe dizziness and balance problem symptoms using words other than "dizzy," because of variable interpretations of this nonspecific term. The most common words used by healthcare providers to describe a variety of subjective symptoms of dizziness and balance problems include vertigo, unsteadiness, light-headedness, generalized weakness, presyncope, syncope (fainting), or falling.

Strengths and limitations of this study include a nationally representative child sample and a multistage area probability design that permits the representative sampling of households. The NHIS child and adult sampling procedure uses methods of clustering, stratification, and oversampling of specific US population groups, such as black, Hispanic, or Asian persons, in order to obtain sufficient numbers on which to base estimates. In the analysis, the sample is reweighted to reflect the racial/ethnicity distribution in the 2012 US population of children; hence, the NH white percentage is 53.3%, Hispanic, 20.3%, and NH black, 13.5%. The final response rate for the 2012 NHIS CBS was 69.7%, which in the survey field is judged to be "very good," although of course a higher response rate would have been still better. One limitation is that sample children did not self-report; instead, a knowledgeable adult (usually parent) answered questions about their child's health. The proxy responses may not accurately reflect children's symptoms. A few questions asked parents to recall information about the child (eg, "age at first steps"), which could have occurred more than 10 years in the past; this may have introduced recall bias in the responses as a function of the child's age and dizziness and balance problem status. Another limitation was that the NHIS does not review medical records, and the questionnaire did not ask specifically if children had ever suffered head or neck trauma. Information about head or neck trauma was obtained if parents/caregivers mentioned it as a "diagnosis" of the child's dizziness and balance problems by a healthcare professional. Finally, the find-

ings presented are based on the 2012 CBS, which is a cross-sectional study that cannot be used to differentiate cause and effect from associations.

In conclusion, although dizziness and balance problems are common, with a prevalence of 5.3% among US children, the epidemiology of dizziness and balance problems in children is poorly understood. This survey will be used to establish the baseline prevalence for dizziness and balance problems in relation to other child and family sociodemographic characteristics for the new Healthy People 2020 objective, which is intended to promote increased utilization of healthcare for diagnosis and treatment of children with dizziness and balance problems. ■

*We thank the NHIS participants, NCHS professional staff, and US Census Bureau employees who conducted the household interviews. We also thank May Chiu and Katalin Losonczy (Epidemiology and Statistics Program, NIDCD) for their skillful technical support.*

Submitted for publication Mar 3, 2015; last revision received Nov 23, 2015; accepted Dec 4, 2015.

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**APPENDIX**

This Appendix reproduces the questions asked in the 2014 NHIS Child Balance Supplement [14].

These next questions are about balance problems or disorders that children may experience such as feeling unsteady, dizzy, light headed, or woozy or having body or motor coordination problems.

1. DURING THE PAST 12 MONTHS, has {fill: CHILD'S. name} been bothered by episodes of any of the following dizziness or balance problems?
  - a. Vertigo, a spinning sensation like a Merry-Go-Round? (*Ans: Yes/No*)
  - b. Poor balance, an unsteady or woozy feeling that makes it difficult to stand up or walk?  
(*Ans: Yes/No*)
  - c. Problems with body or motor coordination or clumsiness? (*Ans: Yes/No*)
  - d. Frequent falls? (*Ans: Yes/No*)
  - e. Light-headedness, fainting, or feeling {fill: he/she} is about to pass out? (*Ans: Yes/No*)
  - f. Any other type of balance or dizziness problems? (*Ans: Yes/No*)
2. Did a doctor or other health professional EVER tell you a diagnosis for {fill: CHILD's name}'s dizziness or balance problems? (*Ans: Yes/No*)

*Instruction:* If "Yes" to #2, go to next question; if "No", skip next question.

3. What diagnoses or reasons were you told caused {fill: CHILD'S name}'s balance or dizziness problems?

\*Enter all that apply.

[Interviewer coded the parent's verbal response to appropriate categories, as listed below.]

- a. Ear infections (inner ear infection, otitis media, fluid in ears)
- b. Vision problems/Blurred vision

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**Appendix.** 2014 NHIS Child Balance Supplement Questions. *BPPV*, benign paroxysmal positional vertigo. (*Continues*)

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- c. Positional dizziness or vertigo (BPPV)
  - d. Severe headaches or migraine
  - e. Head or neck injury or concussion
  - f. Neurological disorders including seizures, stroke, or brain tumors
  - g. Developmental motor coordination disorder (“clumsy” child)
  - h. Malformations of the ear
  - i. Other genetic cause (Asperger Syndrome, Usher’s Syndrome, etc.)
  - j. Metabolic problem, such as “low blood sugar” (hypoglycemia)
  - k. Prescription medications or drugs
  - l. Other
4. Did any of these episodes of dizziness or balance problems keep {fill: CHILD’S name} from participating in home, school, work or recreational activities? (*Ans:* Yes/No)
5. DURING THE PAST 12 MONTHS, how much of a problem were these episodes of dizziness or imbalance for {fill: CHILD’S name}? Would you say it was...

\*Read categories below.

- a. No problem
  - b. A small problem
  - c. A moderate problem
  - d. A big problem
  - e. A very big problem
6. DURING THE PAST 12 MONTHS, has {fill: CHILD’S name} seen a doctor, physical or occupational therapist, or other health care professional about these episodes of dizziness or balance problems? Include visits to the Emergency Room, hospital, or health clinics. (*Ans:* Yes/No)
7. DURING THE PAST 12 MONTHS, has {fill: CHILD’S name} tried methods recommended by a doctor, physical or occupational therapist, or other health care professional for treating {fill: his/her} episodes of dizziness or balance problems? (*Ans:* Yes/No)

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**Appendix.** Continued.

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**Table I.** Prevalence and multivariable logistic models of relative risks (ORs and 95% CIs) of factors associated with dizziness or balance problems in US children, 2012 NHIS CBS

	US 2010 population*, %	Dizziness and balance problems prevalence, %	Model 1, OR (95% CI)	Model 2, OR (95% CI)
Female	48.9	5.7	1.1 (0.9-1.4)	1.4 (1.1-1.9) <sup>†</sup>
Age (y)				
3-5	20.0	4.1	1.0	1
6-8	19.0	3.6	0.9 (0.6-1.3)	0.8 (0.5-1.3)
9-11	20.7	5.3	1.3 (0.9-1.9)	1.1 (0.7-1.6)
12-14	20.1	6.0	1.5 (1.0-2.1) <sup>‡</sup>	1.3 (0.9-1.9)
15-17	20.2	7.5	1.9 (1.4-2.7) <sup>†</sup>	1.6 (1.1-2.3) <sup>‡</sup>
Race/ethnicity				
Hispanic	23.7	4.6	0.6 (0.4-0.8) <sup>†</sup>	0.7 (0.5-1.0)
NH black	13.5	4.3	0.6 (0.4-0.8) <sup>†</sup>	0.6 (0.4-0.9) <sup>‡</sup>
NH white	53.3	6.1	1	1
Other	9.5	4.3	0.7 (0.5-1.0)	0.8 (0.6-1.2)
HH education				
<High school	10.5	6.7	1.7 (1.1-2.7) <sup>‡</sup>	1.4 (0.9-2.4)
High school	18.7	5.4	1.2 (0.8-1.7)	1.1 (0.8-1.6)
Some college	34.4	5.8	1.3 (1.0-1.7) <sup>‡</sup>	1.1 (0.9-1.5)
College degree or more	36.4	4.4	1	1
Family IPR				
<1.00	19.4	6.2	1.5 (1.0-2.1) <sup>‡</sup>	1.2 (0.8-1.8)
1.00-1.99	21.3	5.7	1.3 (0.9-1.9)	1.2 (0.8-1.7)
2.00-3.99	26.3	5.4	1.4 (0.9-1.6)	1.3 (0.8-1.7)
≥4.00	23.9	4.5	1	1
Unknown	9.1	4.5	1.0 (0.6-1.6)	1.2 (0.7-1.9)
Birth weight (g)				
<1500	1.4	16.0	5.1 (2.7-9.7) <sup>†</sup>	1.4 (0.6-3.2)
1500-2499	6.9	7.3	2.1 (1.1-3.9) <sup>‡</sup>	1.5 (0.7-2.6)
2500-3999	72.1	5.3	1.6 (1.0-2.2) <sup>‡</sup>	1.3 (0.8-2.1)
≥4000	9.6	3.7	1	1
Unknown	10.0	4.2	1.1 (0.6-2.0)	0.9 (0.4-1.7)
Age at first steps without support (mo)				
6-8	6.3	5.1	1	1
9-11	41.0	4.5	0.9 (0.6-1.4)	1.2 (0.7-2.0)
12-14	38.1	5.0	1.0 (0.6-1.5)	1.3 (0.9-2.2)
15+	8.7	10.4	2.2 (1.4-3.6) <sup>†</sup>	1.7 (1.1-3.1) <sup>‡</sup>
Ever told child had ADD/ADHD	9.5	11.8	2.6 (1.9-3.4) <sup>†</sup>	1.4 (1.0-2.2) <sup>‡</sup>
Ever told child had intellectual disability	1.2	31.3	8.4 (5.2-3.5) <sup>†</sup>	1.8 (1.0-3.6)
Ever told child had other developmental delay	4.9	25.0	7.8 (5.9-10.4) <sup>†</sup>	3.6 (2.5-5.1) <sup>†</sup>
Hay fever during past 12 mo	10.2	11.3	2.6 (2.0-3.4) <sup>†</sup>	1.7 (1.2-2.3) <sup>†</sup>
Respiratory allergy during past 12 mo	11.7	10.8	2.6 (1.9-3.5) <sup>†</sup>	1.5 (1.1-2.2) <sup>‡</sup>
Anemia during past 12 mo	1.1	19.3	4.3 (2.6-7.2) <sup>†</sup>	2.4 (1.2-4.6) <sup>‡</sup>
Had frequent headaches or migraines during past 12 mo	6.0	22.0	5.5 (4.2-7.3) <sup>†</sup>	3.7 (2.7-5.0) <sup>†</sup>
3+ ear infections during past 12 mo	4.4	11.4	2.7 (1.9-4.0) <sup>†</sup>	1.3 (0.9-1.9)
Seizures during past 12 mo	0.8	34.3	9.6 (4.5-20.4) <sup>†</sup>	3.1 (1.4-7.0) <sup>†</sup>
Stuttered or stammered during past 12 mo	1.9	21.2	6.0 (3.8-9.4) <sup>†</sup>	2.9 (1.7-4.9) <sup>†</sup>
Any hearing difficulty during past 12 mo	2.5	20.9	4.8 (3.0-7.7) <sup>†</sup>	2.4 (1.3-4.4) <sup>†</sup>
Trouble seeing during past 12 mo	3.1	14.4	3.0 (2.1-4.5) <sup>†</sup>	1.6 (1.0-2.7)
Impairment or health problem that limits ability to crawl/walk/run/play	1.9	40.5	13.2 (9.1-19.2) <sup>†</sup>	4.3 (2.5-7.2) <sup>†</sup>
Has taken prescription medication(s) for 3 mo or longer	14.6	11.9	2.9 (2.2-3.7) <sup>†</sup>	1.1 (0.8-1.5)

ADD, attention deficit disorder; ADHD, attention deficit hyperactivity disorder.

Model 1 was adjusted for age, sex, race/ethnicity, household education, and family IPR.

Model 2 was adjusted for all listed variables.

\*Number of children aged 3-17 years in the US 2010 population was 61 696 000.

<sup>†</sup> $P < .01$ .

<sup>‡</sup> $P < .05$ .