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Seasonal Variations in Cerebral Palsy Births

Dorota Sienkiewicz, Grażyna Paszko-Patej, Bożena Okurowska-Zawada, and Wojciech Kułak

Department of Pediatric Rehabilitation, Medical University of Bialystok, Bialystok, Poland

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Introduction. Previous studies of cerebral palsy (CP) suggest that it seasonal variations in the incidence of CP. The purpose of this paper was to compare seasonal variations in the incidence of cerebral palsy (CP) in Podlaskie Province, Poland, between 1990−1999 (study 2005) and 2000−2014 (study 2017) in a retrospective case-controlled study.

Materials and Methods. Data were obtained from the hospital database. We compared CP births between January 1, 1990, and December 31, 1999, $n = 212$ (116 boys, 96 girls) and January 1, 2000, and December 31, 2014, $n = 205$ (114 boys, 91 girls). We used Cosinor analysis to examine the seasonality of CP births.

Results. The highest number of CP births occurred in spring and the lowest in winter, with intermediate values in summer and autumn. This seasonal pattern was significant for spring vs. winter. The peaks in the numbers of CP births occurred in May and August; the lowest numbers of CP births occurred in February, December, and November. In the 2017 study, we observed a slight increase in spastic tetraplegia and a decrease in mixed CP. No significant corrections between mean temperature and Apgar score, low birth weight, and asphyxia were found.

Conclusions. Our study confirmed the existence of seasonal patterns for CP births. © 2018 IMSS. Published by Elsevier Inc.

Key Words: Births, Cerebral palsy, Seasonal variations.

Introduction

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, behaviour, by epilepsy and by secondary musculoskeletal problems (1).

Several factors are responsible for CP, for example, an ischemic insult in utero, cerebral hemorrhage, periventricular leukomalacia, ischemia, prematurity, neonatal seizures, prolonged ventilation, ventilation, sepsis, and meningitis (2−7). Furthermore, seasonal variations may influence the occurrence of CP (8). Seasonal births have been confirmed in relation to attention-deficit hyperactivity disorder (9), Down syndrome (10), epilepsy (11), mental retardation (12), schizophrenia (13), autism (14), and amyotrophic lateral sclerosis (ALS) (15).

In addition, factors that vary by season, including the occurrence of viral infections, nutrient intake, rainfall amounts, and pesticides (16), may increase the risk of neurodevelopmental disorders. According to the Centers for Disease Control and Prevention (17), February is the month with the highest percentage of influenza cases, followed by January, March, and December. In Poland, an increase in viral infections occurs more often in autumn and winter. Studies of CP suggest that it may have an excess correlation to summer births (18). In our previous study (19) in 2005, we found that the highest number of CP births occurred in spring and the lowest in winter.

We used data from the Department of Pediatric Neurology and Rehabilitation and Department of Pediatric Rehabilitation of hospital in Białystok to assess seasonal variations in CP births in Podlaskie Province.

Address reprint requests to: Wojciech Kułak, Prof. Ph.D., Department of Pediatric Rehabilitation, Medical University of Bialystok, ul. Waszyngtona 17, 15-274 Bialystok, Poland; Phone and FAX: (+48) 857450601; E-mail: kneur2@wp.pl

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Materials and Methods

Regional Data

Podlaskie province is located at latitude 53−54° north, occupies 20,000 km^2 and is not highly urbanized, with a population of more than 1.2 million. Details are described in our study from 2005 (20).

Patients

We reviewed the medical records of children with CP referred to the Department of Pediatric Neurology and Rehabilitation and Department of Pediatric Rehabilitation of hospital in Białystok. In the previous study, babies were born between January 1, 1990, and December 31, 1999. In the present study, babies were born between January 1, 2000, and December 31, 2014. The current report included 205 children with CP (114 boys, 91 girls). Details are provided in Table 1.

A group of 205 healthy age- and gender-matched children were recruited as a comparison group. Data were drawn from the hospital's database. None of the children had motor impairments, mental retardation, or neurological disorders. CP was classified into five clinical subtypes: spastic hemiplegia (n = 50, study 2005; n = 53, study 2017); spastic diplegia (n = 64, study 2005; n = 56, study 2017); spastic tetraplegia (n = 66, study 2005; n = 74, study 2017); extrapyramidal (n = 19, study 2005, n = 16, study 2017); and mixed (n = 13, study 2005, n = 9, study 2017), according to Mutch L, et al. (3). Exclusion criteria for CP included progressive damage to the developing brain; metabolic, degenerative, and infectious disorders; and/or children <3 years of age.

In both studies spastic tetraplegia and spastic diplegia occurred more often than other types of CP in both studies. We observed a slight increase in spastic tetraplegia and a decrease in mixed CP in the 2017 study. No significant differences were found in the distribution of CP between the 2005 study and the 2017 study.

Statistical Analysis

Data from the 24 year period were pooled for the analyses, and each year was divided into four seasons. Winter included December, January, and February; spring included March, April, and May; summer included June, July, and August; and autumn included September, October, and November. The proportions of CP births and controls in the following months were compared using the χ^2 test. Cosinor analysis as used to assess seasonality (20). All statistical analyses were performed with Statistica 13. PL. Details are described in the study from 2005.

Results

We found a significantly (p = 0.003) lower gestational age in children with CP (35.60 ± 4.40) in the years 2000−2014 compared to children with (36.80 ± 4.09) in the years 1990−1999. We also observed a significantly (p = 0.03) lower weight at birth (2571 g) in children with CP in the 2017 study compared to the 2005 (2765 g) report. Details are shown in Table 1.

Figure 1 shows the distribution of the months of births for children with CP in the studies from 2005 and 2017.

The peaks in the numbers of CP births occurred in May and August; the lowest numbers of CP births occurred in February, December, and November in the studies from 2005 and 2017. Between November and December, a

Table 1. Characteristics of subjects with CP and controls

	Years 1990−1999			Years 2000−2014			Total	
	CP subjects	Controls		CP subjects	Controls		CP subjects	Controls
Variable	**(n = 212)**	**(n = 212)**	**p**	**(n = 205)**	**(n = 205)**	**p**	**(n = 417)**	**(n = 417)**
Gestational age (week)	24−43	26−43		24−42	27−43		24−43	26−43
	36.80 ± 4.09	39.03 ± 1.95	<0.001	35.60 ± 4.40**	38.80 ± 1.82	<0.001	36.20 ± 4.24	38.91 ± 1.88
Girl/boy	96/116	98/114	*NS*	91/114	91/114	*NS*	91/114	95/110
Number of pregnancies	1−7	1−7		1−7	1−7		1−7	1−7
	2.46 ± 1.57	2.09 ± 1.32	*NS*	2.34 ± 1.43	2.02 ± 1.35	*NS*	2.40 ± 1.50	2.05 ± 1.33
Number of deliveries	1−7	1−7		1−7	1−7		1−7	1−7
	2.23 ± 0.94	1.96 ±1.17	*NS*	2.11 ± 0.99	1.98 ± 1.27	*NS*	2,17 ± 0.96	1.97 ± 1.22
Apgar score at 1 min	0−10	1−10		0−10	1−10		0−10	1−10
	5.29 ± 3.61	8.97 ± 1.89	<0.001	5.17 ± 3.58	8.80 ± 1.65	<0.001	5.23 ± 3.59	8.97 ± 1.89
Weight at birth	980−4600	1012−4450		490−4600	980−4600		490−4600	1012−4600
	2765 ± 831	3342 ± 527	<0.001	2571 ± 913*	3450 ± 720	<0.001	2668 ± 872	3396 ± 623

p value from; t-test and χ^2; test between groups.
NS, not significant.
**p = 0.003 gestational age of CP in 1990−1999 vs. gestational age of CP in 2000−2014; *p = 0.03 weight at birth of CP in 1990−1999 vs. weight at birth of CP in 2000−2014.

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