Short Communication

Increased Prevalence of Tic Disorders in Premature Children: A Prospective Study from Northern Italy

Cristiano Termine[1,2], Chiara Luoni[2], Marta Quadrelli[3], Eva Kraus[4], Massimo Agosti[3,5], Andrea E. Cavanna[6,7,8,9,10]

[1]Department of Medicine and Technological Innovation, University of Insubria, Varese, Italy, [2]Child Neuropsychiatry Unit, ASST Sette Laghi, Varese, Italy, [3]Department of Maternal and Child Health, ASST Sette Laghi, Varese, Italy, [4]Department of Clinical and Experimental Sciences, University of Brescia, Italy, [5]Department of Medicine and Surgery, University of Insubria, Varese, Italy, [6]Department of Neuropsychiatry, Birmingham and Solihull Mental Health NHS Foundation Trust, Birmingham, United Kingdom, [7]Birmingham Medical School, School of Medical Sciences, College of Medicine and Health, University of Birmingham, Birmingham, United Kingdom, [8]College of Health and Life Sciences, Institute of Health and Neurodevelopment, Aston University, Birmingham, United Kingdom, [9]Department of Child Neuropsychiatry, Fondazione IRCCS San Gerardo dei Tintori, Monza, Italy, [10]School of Medicine and Surgery, University of Milano-Bicocca, Milan, Italy

Abstract

Environmental risk factors for tic disorders are not yet fully understood. Both prenatal and perinatal factors, especially prematurity and maternal smoking in pregnancy, have been suggested as predictors for the development of tic disorders in the offspring. We assessed possible associations with prenatal and perinatal factors using comprehensive clinical data of 406 premature and very/extremely low weight newborns admitted to a single Neonatal Intensive Care Unit between 2008 and 2012. Of these, 264 were followed up after 8–11 years to evaluate the possible development of a tic disorder via a two-stage process involving a telephone interview with their parents and a face-to-face assessment. We found that 6.8% of children born premature with birth weight lower than 1500 g developed a tic disorder during childhood (before the age of 8–11 years). The prevalence of tic disorders in the offspring of mothers who smoked more than five cigarettes per day during pregnancy was 20.0%, compared to 7.6% in nonsmoking mothers. Our findings support the hypothesis that premature children have an increased risk of developing a tic disorder and prompt further research into the possible contributing role of modifiable risk factors such as maternal smoking during pregnancy.

Keywords: Birth weight, maternal smoking, premature children, preterm birth, tic disorders, Tourette syndrome

Introduction

Both genetic and environmental factors are thought to contribute to the development of tic disorders, including Tourette syndrome (TS).[1] Research focusing on specific environmental factors occurring during the prenatal and perinatal periods identified possible risk factors. Advanced parental age, prematurity, low birth weight, perinatal complications, maternal stress, and smoking during pregnancy have been suggested to increase the risk for the development of tics, increased tic severity, and presence of TS-related comorbidities such as obsessive-compulsive disorder and attention-deficit/hyperactivity disorder.[2-8]

While the exact mechanisms remain unclear, these factors collectively suggest a strong environmental influence on the development and severity of tics, as well as associated neurodevelopmental conditions. Our study examined possible associations between tic disorders and several prenatal/perinatal risk factors, including premature birth, low birth weight, and maternal smoking during pregnancy.

Access this article online

Quick Response Code:

Website: https://journals.lww.com/armh

DOI: 10.4103/amhs.amhs_248_25

Materials and Methods

Comprehensive demographic and clinical data were collected from all premature newborns weighing <1500 g who were admitted to the Neonatal Intensive Care Unit of the Filippo

Address for correspondence: Prof. Andrea E. Cavanna, Department of Neuropsychiatry, National Centre for Mental Health, 25 Vincent Drive, Birmingham B15 2FG, United Kingdom. E-mail: a.e.cavanna@bham.ac.uk

Submitted: 26-Aug-2025 **Revised:** 20-Sep-2025
Accepted: 22-Sep-2025 **Published:** 27-Mar-2026

How to cite this article: Termine C, Luoni C, Quadrelli M, Kraus E, Agosti M, Cavanna AE. Increased prevalence of tic disorders in premature children: A prospective study from northern Italy. Arch Med Health Sci 2026;14:164-6.

del Ponte Hospital in Varese, Italy, between 2008 and 2012. The following data were systematically retrieved from neonatology records: sex, gestational age, birth weight, length, head circumference, venous pH, APGAR scores at 1 min and 5 min, maternal age, maternal smoking during pregnancy, hypertension, and infection (s) during pregnancy. A follow-up assessment was conducted 8–11 years after initial data collection via telephone interview with the parents of the participants. As part of a routine health status update, we ascertained the possible development of tics through a two-stage approach. In stage 1, parents were asked the following two questions: (1) "Is your child currently under the care of a child neuropsychiatry rehabilitation service? If so, for which condition (s)?" (2) "Have you noticed that your child has developed repetitive, sudden, nonrhythmic movements (such as blinking, eye rolling, mouth opening/pulling, tongue protrusion, grimacing, nose wrinkling, and neck jerking/stretching) and/or vocalizations (such as grunting, sniffing, coughing, and throat clearing)?." In Stage 2, all parents who answered affirmatively to at least one question were invited to accompany their child to a face-to-face neuropsychiatric assessment with an experienced child and adolescent psychiatrist to validate their tic disorder diagnosis. The study was performed in accordance with internal institutional ethical guidelines from the Filippo del Ponte Hospital in Varese, Italy, which granted ethics approval to the study protocol (Reg. no. 51/2008). As per the Research Ethics Committee's advice, research limited to secondary use of anonymized information previously collected in the course of an approved study is exempt from further informed consent requirements.

Final data analysis was conducted in 2019. The Statistical Package for the Social Sciences for Windows (SPSS Inc., Chicago, IL, USA, version 25) was used to perform all statistical analyses. We used the Chi-square test for categorical variables and Student's *t*-test (independent-samples, unpaired two-tailed comparison) for continuous variables to assess possible differences in the demographic and clinical characteristics.

Results

We identified a total of 406 premature newborns with a birth weight below 1500 g. Of these, 42 (10.3%) died and 142 (35.0%) were lost at follow-up. Of the remaining 264 children, 19 were invited to a face-to-face neuropsychiatric assessment for possible tic disorder, as their parents had answered affirmatively to at least one screening question. A diagnosis of neurodevelopmental tic disorder was confirmed in all children but one, yielding a prevalence figure of 18/264 (6.8%; age range 8–11 years; male: female ratio 11:7). There were no significant differences in any demographic or clinical characteristics between those who developed a tic disorder and those who did not [Table 1].

Albeit not statistically significant, the risk of the offspring having a tic disorder was found to increase linearly with maternal smoking habits. Data about maternal smoking during pregnancy were available from 207 mothers. A total of 22 mothers (10.6%) reported smoking during pregnancy. Of them, 12 (5.8%) smoked between 1 and 4 cigarettes per day and 10 (4.8%) smoked between 5 and 10 cigarettes per day. The prevalence of children with a tic disorder among those with smoking mothers (3/22, 13.6%) was higher than among those with nonsmoking mothers (15/185, 8.1%), and the prevalence of children with a tic disorder among mothers smoking 5–10 cigarettes per day (2/10, 20.0%) was higher than among mothers smoking 1–4 cigarettes per day (1/12, 8.3%).

Discussion

In our study, 6.8% of 264 children who were born premature developed a tic disorder during childhood (before the age of 8–11 years). This figure is over twice the prevalence reported by a large epidemiological study of 2347 school-aged children of similar age (6–11 years) from a nearby geographical area (2.9%).[9] Thus, our data provide support to the hypothesis that prematurity may represent a risk factor for the development of tic disorders. Prematurity might be associated with a particular neurodevelopmental phenotype, as females were overrepresented in our sample compared to the general population of patients with tic disorders (male: female ratio of 11:7 vs. 4:1).[1]

We did not find significant differences in any demographic or clinical characteristics between children born premature who developed a tic disorder and those who did not. However, mothers who smoked five or more cigarettes per day during pregnancy were two-to-three times more likely to have children with a tic disorder than nonsmoking mothers (20.0% vs. 7.6%). These findings are in line with the results of a recent meta-analysis showing a significant association between maternal smoking during pregnancy and tic disorders in the offspring.[10] Specifically, prenatal exposure to maternal smoking was found to increase the risk of developing TS by 35%.

Our data did not suggest that lower birth weight should be included among the risk factors for the development of tic disorders. However, this finding could be explained by our recruitment strategy, as our cohort of premature newborns was characterized by very low and extremely low birth weight, whereas less severe phenotypes of premature newborns with low birth weight (1500–2500 g) were not included. Other limitations of our study included the screening questions at follow-up, which relied on proxy reports. Finally, although most children with tic disorders develop tics before 12 years, the age at tic onset is between 12 and 18 years in a subgroup of patients. It is therefore possible that our prevalence figure is an underestimate of the real prevalence of tic disorders in premature children.

Table 1: Demographic and clinical characteristics of children born premature who developed tics versus those without tics

Characteristics	Total sample (*n*=264)	Children with tics (*n*=18)	Children without tics (*n*=246)	*P*
Age at follow-up – years, mean (SD)	8.1 (1.4)	8.3 (1.3)	8.0 (1.4)	0.35
Female sex (*n*, %)	127 (48.8)	7 (38.9)	118 (48.0)	0.92
Gestational age – week, mean (SD)	29.6 (2.8)	30.7 (2.8)	29.4 (2.8)	0.05
Birth weight (g), mean (SD)	1120.9 (290.6)	1242.4 (240.4)	1100.9 (303.8)	0.06
Length at birth (cm), mean (SD)	37.6 (3.7)	37.9 (3.1)	37.5 (3.8)	0.59
Head circumference at birth (cm), mean (SD)	27.1 (2.4)	27.7 (2.0)	27.1 (2.4)	0.34
Venous pH at birth, mean (SD)	7.4 (0.1)	7.4 (0.1)	7.4 (0.1)	0.51
Apgar score at 1 min, mean (SD)	5.8 (2.3)	5.9 (2.4)	5.8 (2.3)	0.73
Apgar score at 5 min, mean (SD)	7.9 (1.4)	8.2 (0.9)	8.0 (1.3)	0.44
Maternal age (years), mean (SD)	32.1 (5.3)	31.1 (6.4)	32.8 (4.6)	0.47
Maternal smoking during pregnancy, *n* (%)	22 (10.6)	3 (16.7)	19 (7.7)	0.40
Hypertension during pregnancy, *n* (%)	39 (17.8)	3 (16.7)	36 (14.6)	0.90
Infection (s) during pregnancy, *n* (%)	30 (11.4)	4 (22.2)	26 (10.6)	0.29

SD: Standard deviation

Conclusion

The findings of the present study support the hypothesis that premature children have an increased risk of developing tic disorders, and prompt further research into the possible contributing role of maternal smoking during pregnancy as a modifiable risk factor. Future studies are needed to shed further light into the intricate relationship between preterm birth and the development of tics. Observing larger premature populations, incorporating a more comprehensive range of factors, and implementing prospective data collection methods would be beneficial to validate the results of the present study and to explore alternative hypotheses for the higher prevalence of neurodevelopmental tic disorders in premature children.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Cavanna AE. Gilles de la Tourette syndrome as a paradigmatic neuropsychiatric disorder. CNS Spectr 2018;23:213-8.
2. Mathews CA, Bimson B, Lowe TL, Herrera LD, Budman CL, Erenberg G, *et al*. Association between maternal smoking and increased symptom severity in Tourette's syndrome. Am J Psychiatry 2006;163:1066-73.
3. Pringsheim T, Sandor P, Lang A, Shah P, O'Connor P. Prenatal and perinatal morbidity in children with Tourette syndrome and attention-deficit hyperactivity disorder. J Dev Behav Pediatr 2009;30:115-21.
4. Hoekstra PJ, Dietrich A, Edwards MJ, Elamin I, Martino D. Environmental factors in Tourette syndrome. Neurosci Biobehav Rev 2013;37:1040-9.
5. Chao TK, Hu J, Pringsheim T. Prenatal risk factors for Tourette syndrome: A systematic review. BMC Pregnancy Childbirth 2014;14:53.
6. Browne HA, Modabbernia A, Buxbaum JD, Hansen SN, Schendel DE, Parner ET, *et al*. Prenatal maternal smoking and increased risk for Tourette syndrome and chronic tic disorders. J Am Acad Child Adolesc Psychiatry 2016;55:784-91.
7. Chudal R, Leivonen S, Rintala H, Hinkka-Yli-Salomäki S, Sourander A. Parental age and the risk of obsessive compulsive disorder and Tourette syndrome/chronic tic disorder in a nationwide population-based sample. J Affect Disord 2017;223:101-5.
8. Brander G, Rydell M, Kuja-Halkola R, Fernández de la Cruz L, Lichtenstein P, Serlachius E, *et al*. Perinatal risk factors in Tourette's and chronic tic disorders: A total population sibling comparison study. Mol Psychiatry 2018;23:1189-97.
9. Lanzi G, Zambrino CA, Termine C, Palestra M, Ferrari Ginevra O, Orcesi S, *et al.* Prevalence of tic disorders among primary school students in the city of Pavia, Italy. Arch Dis Child 2004;89:45-7.
10. Ayubi E, Mansori K, Doosti-Irani A. Effect of maternal smoking during pregnancy on Tourette syndrome and chronic tic disorders among offspring: A systematic review and meta-analysis. Obstet Gynecol Sci 2021;64:1-12.