

Tics and Problem Behaviors in Schoolchildren: Prevalence, Characterization, and Associations

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ABSTRACT. *Objective.* Tic disorders are the most common movement disorder diagnosed in children and have symptoms that fluctuate in frequency and intensity over time. We conducted an 8-month longitudinal observational study to determine the variations in frequency of motor tics and associated problem behaviors.

Methods. A total of 553 children, kindergarten through sixth grade, were observed monthly from November 1999 to June 2000 by 3 raters. Motor tics were recorded by location and rated for severity as none (0), mild (1), moderate (2), or severe (3). Problem behaviors were rated as absent (0), subclinical (1), or clinical (2) in each of 6 categories: disruptive, hyperactive, impulsive, aggressive, anxious, and distracted.

Results. The monthly point prevalence of motor tics ranged from 3.2% to 9.6%, with an overall frequency of 24.4%. The monthly point prevalence of problem behaviors ranged from 2.6% to 11.0%, with an overall frequency of 25.7%. The incidence of motor tics and problem behaviors was significantly higher during the winter months of November through February, compared with the spring months of March through June (motor tics: $z = 4.97$; problem behaviors: $z = 3.79$). Motor tics were observed in 2 distinct patterns (isolated and persistent), which varied by the number of months present, gender ratio of affected children, severity of tic symptoms, and association with problem behaviors.

Conclusions. Motor tics and problem behaviors are frequent occurrences among schoolchildren and seem to occur more frequently during the winter months. For most children, the tics were mild, observed on only 1 occasion, and were not accompanied by problem behaviors. *Pediatrics* 2002;110:331–336; *observational study, longitudinal study, tic disorder, childhood onset.*

Tic disorders are the most common movement disorder diagnosed in children,¹ with 5% to 20% of schoolchildren experiencing a simple or complex motor or vocal tic during their lifetime.² This great variation in estimated prevalence could be partially explained by differences in the methods used by individual investigators (parental report vs observation) and the different populations studied

(clinic-based vs community sample). A reporting bias could explain why lower rates of tic frequency are found in studies based on parental report when compared with those using direct observation. Because clinic-based studies include mainly children with severe tic symptoms, ascertainment bias could explain why these studies tend to underestimate the prevalence of tics when compared with community-based studies. Although there is a limited amount of research on the incidence of transient tic behaviors, community-based reports suggest that children are 5 to 12 times more likely to be identified as having a tic disorder than adults, and that boys are more commonly affected than girls.^{3,4} The ratio of boys to girls affected with a tic disorder is <2 to 1 in the majority of community samples⁵ but has been reported as high as 9 to 1 in clinic-based samples.^{3,6}

The transient nature of tic symptoms may also contribute to the large variability in the cross-sectional estimate of tic prevalence. There is a fluctuation in tic frequency and intensity over time.⁷ A child may have 3 weeks of debilitating motor tics and then 3 months of relative quiescence. The severity of a tic is determined by its frequency, intensity, and complexity. However, the diagnosis of a tic disorder is dependent not on the severity but on the duration of the symptoms.⁸ As such, a child with a mild eye tic occurring a few times a month over a 1-year period would be classified as having a chronic motor tic disorder, while a child with a continuous debilitating tic present for less than a year would be diagnosed with a transient tic disorder. The breadth of the tic spectrum not only makes accurate diagnosis and characterization challenging, but also causes difficulty in determining the best treatment course for a child who presents with recent onset tic symptoms.⁹

Children diagnosed with a tic disorder are often found to have accompanying behavioral difficulties, including disinhibited speech or conduct, impulsivity, distractibility, motoric hyperactivity, and obsessive-compulsive symptoms.⁵ These behavior symptoms are often more impairing than the tics and frequently are the reason that treatment is sought for the child. To date, however, there have been no longitudinal investigations of the association between tic symptoms and problem behaviors among schoolchildren.

The purpose of this study was to determine the prevalence of tics and problem behaviors by monthly systematic observations in a large community sam-

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ple of kindergarten through sixth-grade children. We hypothesized that the longitudinal collection of observational data would provide a better estimate of frequency in symptoms that vary over time, as well as allow an examination of the seasonal variation in incidence.

METHODS

Participants

The participants of this investigation were 553 kindergarten through sixth-grade children enrolled at a large elementary school in an upper-middle class suburb of Washington, DC. The school is notable for its racial and ethnic diversity. These 553 children came from 28 classrooms chosen on the basis of the teacher's willingness to have his or her class participate. Of the 553 participating children, 50.4% (279/553) were boys and 49.5% (274/553) were girls.

The study was discussed at 2 parent-teacher meetings and in the school's newsletter before a letter of invitation and consent forms being sent to the children's homes for consideration. Written consent from a parent/guardian and written assent from the child were requested. If either the child or parent declined participation in the study, no data were collected on that child. Furthermore, if either the parent or child objected to the observations being done on other children in the classroom while the child was present, the observations were scheduled at a time when the child was not present in his or her classroom ($n = 3$) or the classroom was not entered into the study (1 sixth-grade and 1 second-grade classroom). The study was performed with the approval of the Institutional Review Board of the National Institute of Mental Health, Bethesda, Maryland.

Direct Observation

The direct observation of tics and classroom behaviors were done by 1 of 3 raters each month who was trained to reliability by a pediatric neurologist (M.A.G.) and a psychologist (L.D.S.) experienced in rating classroom behaviors. Measures of interrater and inter-interval reliability were obtained by having observers rate classrooms in concert with 1 of the primary raters (M.A.G. and L.D.S.) during selected months of the study period and a post-study analysis of the individual raters observations. The observations occurred monthly over 8 months from November 1999 to June 2000. The raters were located at the front of the classroom and were able to move about as needed to directly observe each participant. Teachers provided classroom-seating charts to allow the observations to be performed in a systematic manner. The classroom as a whole was observed for 5 minutes and then each study participant was observed for 3 minutes noting the child's demeanor and the presence of tics. Motor tics were defined as 3 or more repetitions of the same movement or motion and were rated as none (0), mild (1), moderate (2), or severe (3). The location of the adventitious movements (eye, nose, mouth, head, neck, shoulders, extremity, trunk, or other) was also noted. Vocal tics were not rated because of the level of background noise during the classroom observations and the variable distances of the rater from the child being observed. Problem behaviors were rated by direct observation as absent (0), subclinical (1), or clinical (2) in each of 6 categories: disruptive, hyperactive, impulsive, aggressive, anxious, and distracted.

Teacher Reports

A 13-item teacher report form based on the Conners' Teacher Rating Scale-Revised¹⁰ was completed by participating teachers. Each teacher completed a single form for all of the students participating in the study in his or her class each month. This form rated the following behaviors in each participant over the entire month: impulsivity, inattention, irritability, emotional lability, anxiety/tension, disruptive behaviors, and decline in academic performance. When a symptom was present, the teacher gave a rating of mild (1), moderate (2), or severe (3) and noted whether the given behavior prompted intervention and what the specific intervention was.

Parental Report Form

Tics were explained to the parents at 2 parent-teacher meetings as abnormal movements (like shoulder shrugs, eye blinks, and

facial grimaces) in repetitive patterns. At the initiation of the study, parents were asked to complete a checklist of problem behaviors and tic symptoms (like shoulder shrugs, eye blinks, and facial grimaces) that were present in their child. They also provided a listing of any psychiatric diagnoses or medications prescribed for their child.

Data Analysis

Point-prevalence rates at each point of data collection, as well as an overall 8-month frequency, were determined by simple frequency counts. This was done separately for tics and behavioral symptoms. A McNemar's χ^2 analysis was used to examine the association between tics and observed behavior symptoms. A Yates χ^2 analysis was used to compare the isolated and persistent groups for observed behavior symptoms and gender ratio of affected children, as well as in the children observed to have motor tics and those that did not for behaviors observed by the teachers. A repeated measures analysis of variance was performed to compare the mean severity of the motor tics by group with mean tic severity rating as the dependent variable and pattern of tic symptoms as the between-subjects variable. An exact binomial calculation was performed to compare the incidence during the months of November through February with the incidence during the months of March through June for both motor tics and problem behaviors independently. To avoid the bias of children with multiple months of observed motor tics or problem behaviors, the seasonal incidences were calculated from the children with motor tics in the isolated group ($n = 101$) and the children who had only 1 month of problem behaviors observed ($n = 106$). The data were analyzed with the Number Cruncher Statistical Systems statistical package,¹¹ with significance set at the .05 level.

RESULTS

Motor tics were observed in 135 (24.4%) of the 553 participating children during at least 1 month of the study. The monthly prevalence of motor tics ranged from 3.2% to 9.6% (Fig 1). There was a significantly higher incidence of motor tics observed during the winter months of November through February (76/101, 75%), compared with the spring months of March through June (25/101, 25%; $z = 4.97$; $P < .01$; Fig 2). Boys were observed to have a greater frequency of motor tics than girls by a ratio of 2:1 (92:43). Motor tics observed by grade ranged from 15% (16/109) in the sixth grade to 47% (27/57) in the first grade (Table 1). Eye tics were the most common location for a motor tic to be observed, with 68% (84/135) of the children with tics observed to have an eye tic. Mouth tics were seen in 47%, nose tics in 25%, head/neck tics in 8%, shoulder tics in 3%, extremity tics in 2%, trunk tics in 1%, and other tics in 10% of the children observed to have motor tics. When looking at the entire population, the children observed to have motor tics were not significantly more likely to have an observed problem behavior than children without motor tics. Children observed to have a problem behavior were not significantly more likely to have a motor tic than children without problem behaviors ($\chi^2 = 0.31$; $P = .58$).

The children with motor tics clustered into 2 groups by duration of symptoms. Isolated motor tics, present for either 1 month or 2 consecutive months, were observed in 101 (101/553, 18%) children and persistent motor tics, present for 2 nonconsecutive months or >3 months, were observed in 34 (34/553, 6.1%) children. The persistent group had a mean severity score of 1.25, which was significantly higher than the isolated group with a score of 1.08 ($t = 2.7$; $P < .01$). The persistent group had a significantly

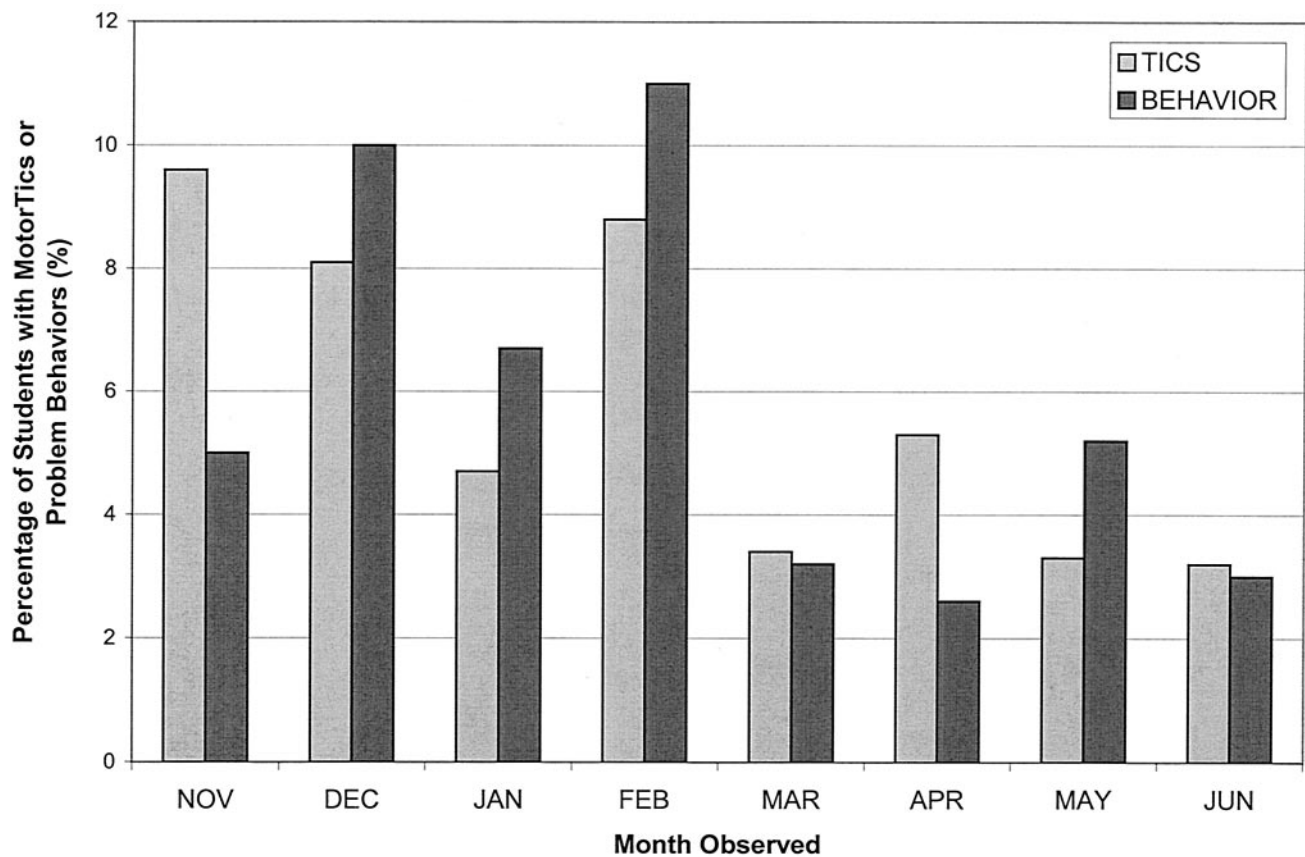


Fig 1. Percentage of children observed each month to exhibit motor tics or problem behaviors.

higher ratio of boys to girls at 7.5:1, than the isolated group with a ratio of 1.6:1 ($\chi^2 = 13.6$; $P < .01$; Table 1). The occurrence of motor tics and problem behaviors was found to be significantly associated in the persistent group but not in the isolated group. Of the 34 children with persistent tics, 14 (41%) were observed to have a problem behavior in the months they were observed to have tic symptoms, while in the isolated group only 23 (23%) of the 101 children were observed to have a concurrent problem behavior ($\chi^2 = 7.3$; $P < .01$).

There appeared to be 2 subgroups within the category of persistent tics ($n = 34$), with 7 children having motor tics for at least 4 of the months observed (chronic group) and the other 27 children having motor tics for 2 or 3 months but not consecutively (episodic group). Although there were not significant differences between the groups, certain tendencies were noted. The mean severity of the tics observed in the chronic group was higher than the episodic group (1.45 vs 1.19, respectively.) Only 1 (14%) of the 7 children in the chronic group had a concurrent observed problem behavior, whereas 13 (48%) of the 27 children in the episodic group were observed to have concurrent problem behaviors. The ratio of boys to girls in the affected children was not different between the 2 groups (6:1 in the chronic group and 8:1 in the episodic group).

Problem behaviors were observed in 142 (25.7%) of the 553 participating children in 1 or more of the 6 behavior categories during at least 1 month of the study. The monthly point prevalence of problem be-

haviors ranged from 2.6% to 11.0% (Fig 1). There was a significantly higher incidence of problem behaviors observed during the winter months of November through February (73/106, 69%) compared with the spring months of March through June (33/106, 31%; $z = 3.79$; $P < .01$; Fig. 2). Of the 142 children who were observed to have a problem behavior, 73% (103/142) were observed to have a distracted behavior at least once during the 8 months. Hyperactive behaviors were observed in 57 of the children (40%), impulsive behaviors in 22 (15%), anxious behaviors in 17 (12%), disruptive behaviors in 16 (11%), and aggressive behaviors in 7 (5%) during the study period. Problem behaviors were more common among boys by a 2:1 ratio (96:46). Frequency of problem behaviors by grade ranged from 8% (9/109) in the sixth grade to 51% (29/57) in the first grade. Of the 553 participating children, only 36 (6.5%) had a problem behavior observed for >1 month, with only 14 (2.5%) having problem behaviors present for 3 or greater months. Problem behaviors that persisted for >1 month were more common among the kindergarten, first-, and second-grade participants by a 2:1 ratio (25:11), and more common among boys at a ratio of 3.5:1 (28:8; Table 2).

Teacher-reported behaviors were collected for 361 of the children over a 5-month period (January through May). The teachers reported 67% (242/361) of the children to have a problem behavior for at least 1 month. The monthly prevalence did not vary significantly, ranging from 41% (149/361) to 51% (183/361). Of the 361 children who were rated by

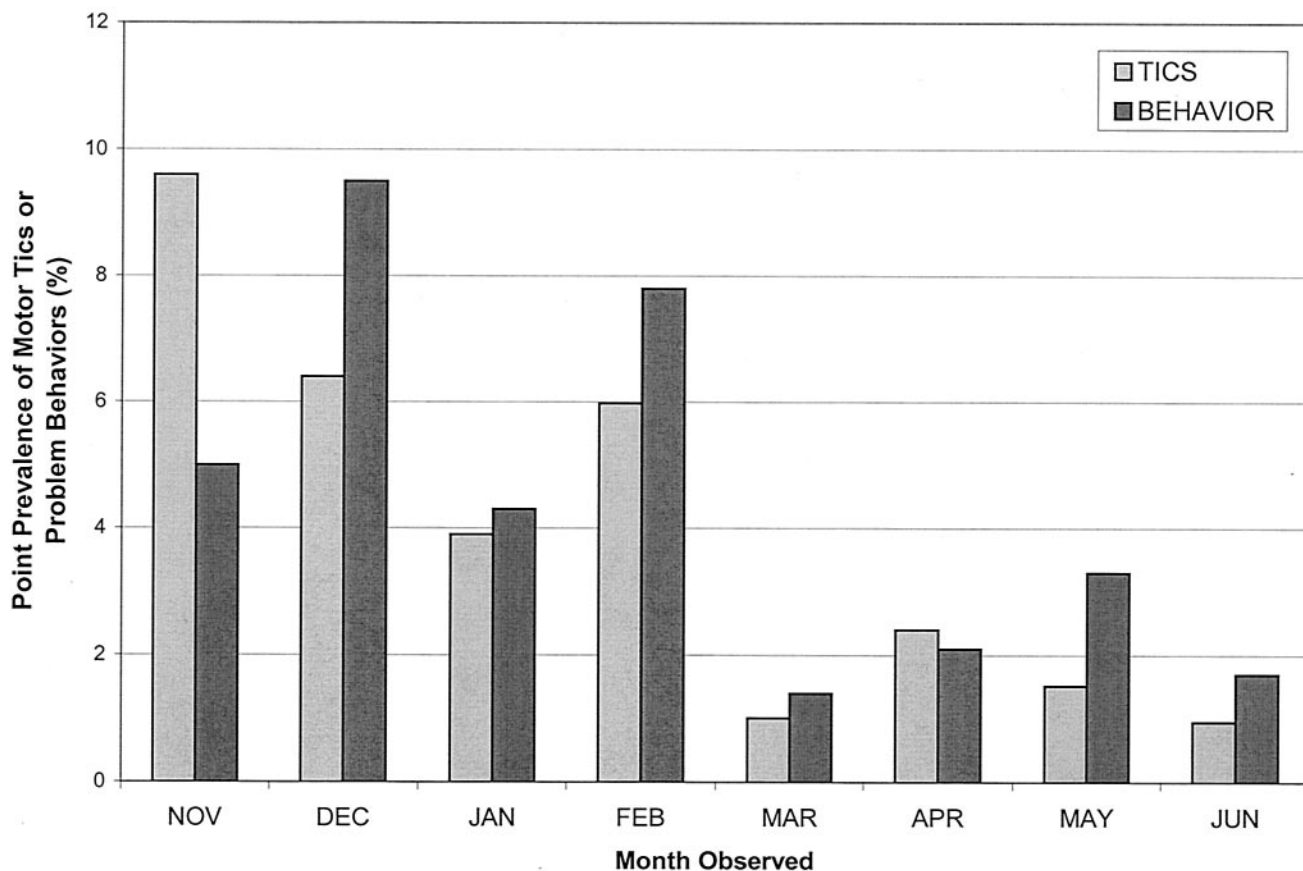


Fig 2. Point prevalence of new cases each month of motor tics or problem behaviors.

TABLE 1. Tic Characteristics Observed in Schoolchildren

	No Tics	Isolated Tics	Persistent Tics
N = 553	418 (76%)	101 (18%)	34 (6.1%)
Boys (n = 279)	187 (67%)	62 (22%)	30 (11%)
Girls (n = 274)	231 (84%)	39 (14%)	4 (1.5%)
K (n = 83)	66 (80%)	9 (11%)	8 (9.6%)
First (n = 57)	30 (53%)	22 (38%)	5 (8.8%)
Second (n = 85)	69 (81%)	13 (15%)	3 (3.5%)
Third (n = 43)	34 (79%)	5 (12%)	4 (9.3%)
Fourth (n = 98)	69 (71%)	20 (20%)	9 (9.2%)
Fifth (n = 78)	57 (73%)	18 (23%)	3 (3.8%)
Sixth (n = 109)	93 (85%)	14 (13%)	2 (1.8%)

TABLE 2. Problem Behaviors Observed in Schoolchildren

	No Problem Behaviors	Any Problem Behavior(s)	Behavior Persisting >1 Month
N = 553	411 (74%)	142 (26%)	36 (6.5%)
Boys (n = 279)	183 (66%)	96 (34%)	28 (10%)
Girls (n = 274)	228 (83%)	46 (17%)	8 (2.9%)
K (n = 83)	62 (75%)	21 (25%)	8 (10%)
First (n = 57)	28 (49%)	29 (51%)	11 (19%)
Second (n = 85)	62 (73%)	23 (27%)	6 (7.1%)
Third (n = 43)	29 (67%)	14 (33%)	2 (4.7%)
Fourth (n = 98)	69 (70%)	29 (30%)	4 (4.1%)
Fifth (n = 78)	61 (78%)	17 (22%)	4 (5.1%)
Sixth (n = 109)	100 (92%)	9 (8%)	1 (1.0%)

their teachers, 90 were observed to have motor tics. The teachers reported problem behaviors in 66 (73%) of these 90 children with motor tics. The teachers reported significantly less problem behaviors in 90 class- and sex-matched controls without motor tics, with only 41 (46%) reported to have problem behaviors ($\chi^2 = 13.3$; $P < .01$).

The parental report forms were returned for 27% (152/553) of the children. Of 152 children who had parental reports 33 (22%) were observed to have motor tics, whereas only 15 (10%) were reported by their parents to have a diagnosis of motor tics, vocal tics, or Tourette syndrome. Of the 15 children reported to have a tic disorder, only 7 (21%) were observed to have motor tics during the 8 months of the study. Of the 8 children reported to have a tic disorder by their parent but not observed to have

motor tics during the study, 3 were reported to have only vocal tics and 3 others were receiving medications for their movement disorders. There were 2 children reported on the parental form to have the diagnosis of Tourette syndrome. One child, who was reported to be on medication for his movement disorder was not observed to have motor tics; the other child was not reported to be on medication and motor tics were observed during 4 months of the study.

DISCUSSION

Our results suggest that the occurrence of motor tics and problem behaviors are common among elementary schoolchildren, with approximately one

quarter of all children exhibiting each of these symptoms. Motor tics and problem behaviors were not present simultaneously, but appeared to occur independently. For most children, the symptoms were transient and observed during only 1 month of the study. The incidence of tics and problem behaviors was found to be 3 times higher during the winter months than the spring months. However, conclusions about seasonal prevalence are limited by the fact that the children were not observed from July through October.

The rate of motor tics observed in our study is higher than previously reported. This may be the result of the methodology employed, which used longitudinal direct observations in a community sample. Observing the same population of children on multiple occasions provided an opportunity to "catch" children when tics were present. In contrast, a cross-sectional study during the month of March would have estimated tic frequency at only 3.4%. Clinic-based studies are believed to underestimate the frequency of tics, as only a small fraction of children with tics are brought to a health care provider for evaluation.¹² We also found evidence of a reporting bias in our study with <50% of the children with observed tics reported to have tics by their parents. Results of this investigation also support the previously reported findings that tics wax and wane in severity and frequency over time,⁷ as individual children had fluctuating symptoms over the observation period.

Previous studies have reported that behavior problems are often comorbid with tic disorders.¹³ It is possible that clinic-based studies overestimate the frequency of comorbid behavior problems, in part because the behavior problems can be more troublesome than the tic symptoms and become the motivating factor for seeking treatment.^{14,15} It is also possible that clinic-based studies estimate accurately the prevalence of comorbid conditions and that the discrepancy is from the inappropriate generalization of clinic based data to community populations. Our data suggest that behavior comorbidity is associated with the more persistent tic symptoms versus all tic symptoms, as children with isolated tics lasting only 1 to 2 months did not have increased rates of problem behaviors, whereas those with a more persistent course did.

The frequency of observed problem behaviors did not correlate well with that reported by the teachers. This may reflect a difference in the method of data collection between the raters and the teachers. The teachers were rating the children on their behaviors over the entire month, whereas the observers rated behaviors present during 1 brief time period each month. For the behaviors reported by the teachers, there did not seem to be any temporal variation in the frequency and the same children were repeatedly noted to have behavior problems each month.

This study supports previous findings that the prevalence of tics is more common among boys than girls. For motor tics, the ratio of boys to girls was 1.6 to 1 in the isolated group and 7.5 to 1 in the persistent group. This correlates well with the findings that in

many clinic-based studies of tic disorders the ratio of boys to girls is 6–8:1 and in community-based studies the ratio closer to 2:1. Our persistent group would be more indicative of a clinic-based sample because of the fact that children with more severe and enduring tics are more likely to be seen by a physician. Our isolated group with relatively mild symptoms has a similar ratio to the community-based studies. It has also been previously reported that boys exhibit higher rates of externalizing behaviors when compared with girls.¹⁶ These externalizing behaviors could have been picked up by the raters more than the internalizing behaviors, which would not be as easily detected in a brief observation. Our finding that a disproportionate number of boys were observed to have problem behaviors when compared with girls could be partially explained by this gender discrepancy in behavior types.

Through the longitudinal collection of data, we were able to characterize 2 distinct patterns of tic symptoms: isolated motor tics which were present for either 1 month or 2 consecutive months, and persistent motor tics which were present for 2 non-consecutive months or >3 months. The children in the isolated group (18%, 101/553) may be included in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, definition of transient tic disorder. The persistent group had a significantly higher mean severity rating for motor tics than the isolated group. The children in the persistent group were also 2 times more likely to exhibit nonfacial tics than children in the isolated group. This suggests that eye blinks and facial tics when seen alone are more likely to be transient than tics located in other areas of the body. However, additional study is required before such a conclusion can be reached as many of the children in the persistent group also had facial tics.

Seven of the 34 children in the persistent group were observed to have motor tics for at least 4 of the months in the study (a chronic group), and 27 participants were observed to have motor tics for 2 or 3 months but not consecutively (an episodic group). The children in the chronic group (1.3%, 7/553) may represent children with a chronic tic disorder or Tourette syndrome diagnosis. The children in the episodic group had more observed behaviors during the months they had tic symptoms than the participants in the chronic group or the isolated group. Although the children in the chronic group were rated by their teachers as having problem behaviors during most of the study months, they were not found to exhibit these behaviors when observed to have motor tics by our raters. It is possible that these children had more internalizing problem behaviors that were noted by teachers who observed them on a daily basis that could not be picked up by the raters' brief observation period.

The episodic group of children (4.8%, 27/553) could fit into any of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* tic disorder diagnoses, or may represent a newly defined subgroup of patients whose tics are environmentally influenced. We found that new cases of motor tics

and problem behaviors were most common during the months of November through February, which would coincide with the previously reported seasonal prevalence of streptococcal infections.^{17,18} Cardona and colleagues¹⁹ reported that exposure to streptococcal antigens was correlated with the onset of tic disorders in an Italian pediatric population. Kiessling et al²⁰ reported an association between a community outbreak of streptococcal infections in Rhode Island and a 10-fold rise in the number of children presenting to a local movement disorder clinic with new onset tics.

The results of the present investigation demonstrate that motor tics are common among elementary-schoolchildren, but for most children are mild, brief, and are not accompanied by problem behaviors.

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“It's not what you say, but how you say it, that matters.”

Ewen S. *PR! A Social History of Spin*. New York, NY: Basic Books; 1996

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