Trends in the Prevalence of Autism on the Basis of Special Education Data
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Trends in the Prevalence of Autism on the Basis of Special Education Data

WHAT’S KNOWN ON THIS SUBJECT: The numbers of children receiving special education and other services because of autism have increased steadily in the United States since the early 1990s. It is unclear how long this trend will continue or whether it is leveling off.

WHAT THIS STUDY ADDS: The prevalence of children being served under the special education autism category in Wisconsin increased significantly each year between 2002 and 2008 in districts with relatively low baseline prevalence but may be leveling off at >1% in other districts.

abstract

OBJECTIVE: The goal was to determine whether the increasing prevalence of autism, on the basis of educational data, in Wisconsin between 2002 and 2008 was uniform in all school districts or was greatest in districts with lower baseline (2002) prevalence.

METHODS: Special education counts were obtained for all Wisconsin elementary school districts from 2002 through 2008. The annual prevalence of children being served under the autism category was calculated for each district, districts were grouped into 8 categories (octiles) according to their baseline prevalence, and prevalence trends were plotted according to octile.

RESULTS: The overall prevalence of use of the autism category in Wisconsin elementary schools increased from 4.9 to 9.0 cases per 1000 children between 2002 and 2008. The magnitude of this increase was not uniform across districts and was inversely associated with baseline prevalence. Prevalence in the lowest octile increased from 0.5 cases per 1000 students in 2002 to 7.0 cases per 1000 students in 2008 (P < .0001), whereas no significant trend was seen for the octile with the highest baseline prevalence (range: 11.2–12.3 cases per 1000 students; P = .11). The highest-octile/lowest-octile prevalence ratio decreased from 24.6 (95% confidence interval: 16.2–37.3) in 2002 to 1.8 (95% confidence interval: 1.6–2.1) in 2008.

CONCLUSIONS: The prevalence of use of the autism special education category in Wisconsin seems to be leveling off in the school districts with the highest prevalence rates, at ~12 cases per 1000 students, whereas the gap in prevalence between districts overall has narrowed. Pediatrics 2010;126:e1018–e1025

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KEY WORDS

autism, prevalence, special education

ABBREVIATION

CI—confidence interval

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Population-based data from around the world have shown steady increases in the measured prevalence of autism (used here to refer to all autism spectrum disorders) since the early 1990s. Recent epidemiological studies have reported that the prevalence of autism exceeded 1% of children in some populations. The trends of increasing prevalence have led to widespread public concern about a possible epidemic of autism attributable to hypothesized or unknown environmental factors. They also have fueled debates about the contributions of confounding factors such as expansion of diagnostic criteria, increased awareness, access to services, and the role of diagnostic “substitution” and “accretion.” Each report showing the prevalence to be increasing or higher than previously estimated raises the question of whether to expect the trend to continue for the foreseeable future. Alternatively, is there evidence that the prevalence of autism stabilizes after reaching a certain level? In the United States, annual special education enrollment data frequently are used as proxy measures of disability prevalence and are cited as evidence of the increasing prevalence of autism. This data source indicated that the number of children who received special education services under the autism reporting category increased by 13% to 28% each year and by >1700% overall between 1992 and 2008. In reviewing these data, it is important to note that autism did not become a special education reporting category in the United States until after passage of the federal Individuals With Disabilities Education Act in 1991. Gernsbacher et al posited that annual increases in the number of children served under this category after its introduction would be a function of the pace at which school districts adopt the autism reporting category rather than indicating actual changes in the number of children with autism. It also was suggested that increasing trends in the prevalence of use of the autism special education category would taper off once the autism category was in full use in all school districts.

The purpose of this study was to examine annual special education data available for each school district in Wisconsin for the period of 2002–2008, to test 2 hypotheses. Our first hypothesis was that there would be substantial variability across school districts in the proportions of children receiving services under the autism category in 2002. If this hypothesis was supported, then our assumption would be that school districts with relatively large proportions of children served under the autism category in 2002 had implemented it earlier than other districts. Our second hypothesis was that the proportions of children served under the autism category would be more stable (ie, would have leveled off) between 2002 and 2008 among school districts with relatively high rates of use of the autism category at the beginning of the study period (2002), whereas school districts with lower rates of use of the autism category in 2002 would show increasing prevalence each year during the study period. An implication of this second hypothesis, if it was confirmed, would be that the gap between school districts with high and low rates of use would decrease during the study period, as school districts that had adopted use of the autism reporting category later caught up with districts that had adopted it earlier.

METHODS

Data Sources
School enrollment data, including the number of children in elementary school who receive services under various disability categories, are publicly available from the Wisconsin Department of Public Instruction. School-level data for every public elementary and combined elementary/secondary school in Wisconsin (representing 407,775 students on December 1, 2002) were obtained for the years 2002 through 2008. Data for previous years and age- or gender-specific data were not available to us at the school or district level.

Autism Special Education Category
Autism is 1 of 11 primary disability categories for which children receive special education services in Wisconsin. The decision to evaluate a child’s eligibility for the autism category is made within the local educational agency (school district). Although the criteria for being placed in the autism special education category are similar to the diagnostic criteria for autism spectrum disorders in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, this evaluation is not equivalent to a medical diagnosis. The Individuals With Disabilities Education Act stipulates that children with disabilities do not necessarily need to be classified according to their specific disabilities, as long as they are identified as having a disability and receive appropriate educational services. Only primary disability categories are reported; students with a nonautism primary disability and an autism secondary disability are not included.

Rationale for Analyzing Variability According to School Districts and Restricting Analyses to Elementary School-Aged Children
If the increasing prevalence of use of the autism special education category is driven by gradual change at a local level, it would be necessary to consider small areas that are not necessarily influenced by special education practices in surrounding regions. Schools within a school district are
part of the same local educational agency and share resources such as the property tax base, school staff, and educational policies. We restricted the analysis to include only elementary schools, because previous studies showed that each successive grade/age cohort generally had higher autism prevalence than older cohorts. With the inclusion of only elementary schools (typically kindergarten through fifth grade), stabilization in the prevalence of use of the autism category would be detectable in a shorter time frame, because less time would need to elapse for the older cohorts (with lower prevalence) to age out of the selected schools.

Analyses

We aggregated the school-level data to the school district level (either unified school district or elementary school district, in the absence of a unified district) and calculated the prevalence of use of the autism reporting category as the number of elementary school children served under the autism category divided by the total elementary school student population. We ranked the school districts according to the prevalence of use of the autism category in the first year of observation (2002), weighted each school district according to its number of elementary school students, and created octiles of ascending prevalence in 2002. Because of the weighting, octiles included approximately the same numbers of students, rather than equivalent numbers of school districts. The Milwaukee school district elementary school population is 5 times larger than the next-largest school district in Wisconsin and represents 1 full octile. Table 1 presents the population and autism disability category prevalence for each octile in 2002. We repeated all analyses by using quintiles rather than octiles, to evaluate the robustness of the findings, and we found similar results. All statistical tests used frequency weights for the number of children in each group. We calculated prevalence ratios and 95% confidence intervals (CIs) to measure between-octile disparities in each year. For each octile, changes across years were measured with 3 statistical tests, that is, a t test comparing 2002 vs 2008 prevalence, a Pearson χ² test including all 7 years, and the Cochran-Armitage test for trend for all 7 years. Weighted linear regression analysis of school districts was used to measure the association between baseline (2002) prevalence and the change in prevalence from 2002 to 2008. P values of <.05 were considered statistically significant. Data analysis was performed with SAS 9.1.3 (SAS Institute, Cary, NC), and plots were constructed with the ggplot2 plotting system (R Foundation for Statistical Computing, Vienna, Austria) for R (R Foundation for Statistical Computing).

We performed an additional exploratory analysis to determine whether school districts with a relatively high prevalence of use of the autism disability category in 2002 differed in terms of funding or measures of socioeconomic status, on the basis of US Census block group data aggregated to school district geographic areas. All analyses were based on de-identified, administrative data. This project was approved by the University of Wisconsin-Madison institutional review board, because no individual-level information is contained in these publicly available data sets.

RESULTS

The overall autism special education prevalence in Wisconsin elementary schools was 4.9 cases per 1000 students (2008 cases per 407 775 students) in 2002. This prevalence increased each year and reached 9.0 cases per 1000 students (3831 cases per 428 030 students) by 2008 (Fig 1). There was considerable variability in prevalence between school districts in each year, ranging from 0 cases per 1000 students to >15 cases per 1000 students. The trends between 2002 and 2008 for octiles (defined in terms of 2002 prevalence) showed some evidence of leveling off among districts with high autism primary disability category prevalence in 2002 (Fig 1). Evaluation of the trends according to octiles also demonstrated a decrease in the prevalence gap, and the highest-octile/lowest-octile prevalence ratio decreased each year, from a high of 24.8 (95% CI: 16.2–37.3) in 2002 to 1.8 (95% CI: 1.6–2.1) in 2008 (Fig 1).

Over the 7-year study period, the absolute increase in prevalence in the low-

### TABLE 1  Categorization of Wisconsin Elementary Schools Into Octiles According to 2002 Autism Special Education Category Prevalence

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Students in 2002–2003</th>
<th>Proportion of Wisconsin Elementary School Students, %</th>
<th>No. of School Districts</th>
<th>2002 Autism Category Prevalence, Mean (Range), Cases per 1000 Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest octile in 2002</td>
<td>51 190</td>
<td>12.6</td>
<td>61</td>
<td>11.2 (8.2–29.3)</td>
</tr>
<tr>
<td>2nd octile</td>
<td>51 184</td>
<td>12.6</td>
<td>42</td>
<td>7.1 (6.3–8.2)</td>
</tr>
<tr>
<td>3rd octile</td>
<td>48 928</td>
<td>12.0</td>
<td>43</td>
<td>5.6 (5.1–6.2)</td>
</tr>
<tr>
<td>4th octile</td>
<td>42 518</td>
<td>10.4</td>
<td>31</td>
<td>4.8 (4.3–6.1)</td>
</tr>
<tr>
<td>5th octile (Milwaukee metropolitan area)</td>
<td>56 524</td>
<td>13.9</td>
<td>1</td>
<td>4.2</td>
</tr>
<tr>
<td>6th octile</td>
<td>59 435</td>
<td>14.6</td>
<td>52</td>
<td>3.7 (3.1–4.2)</td>
</tr>
<tr>
<td>7th octile</td>
<td>47 592</td>
<td>11.7</td>
<td>66</td>
<td>2.4 (1.7–3.1)</td>
</tr>
<tr>
<td>Lowest octile</td>
<td>50 404</td>
<td>12.4</td>
<td>116</td>
<td>0.5 (0–1.7)</td>
</tr>
<tr>
<td>Wisconsin elementary school total</td>
<td>407 775</td>
<td>100.0</td>
<td>412</td>
<td>4.9 (0–29.3)</td>
</tr>
</tbody>
</table>
est octile (net increase of 6.5 cases per 1000 students) was nearly 6 times that of the increase in the highest octile (net increase of 1.1 case per 1000 students). Plotting of the change in prevalence against the initial 2002 prevalence revealed a relatively linear trend ($R^2 = 0.71$) in which higher initial prevalence of use of the autism category was associated with smaller overall increases in prevalence (Fig 2). This relationship was observed for both absolute and percentage increases in prevalence between 2002 and 2008 (Fig 2).

In the highest octile (representing 50,616 students in 2002), the prevalence of use of the autism disability category increased from 11.2 to 12.3 cases per 1000 students over the included years, with little or weak evidence of a trend of increasing prevalence in this group. A t test comparing prevalence rates in 2002 versus 2008 yielded nonsignificant results ($t$ test, $P = .11$) for the highest octile, and tests including all 7 school years also produced nonsignificant results ($\chi^2$ test, $P = .42$; Cochran-Armitage test for trend, $P = .07$). In contrast, these statistical tests yielded highly significant results for all 7 of the remaining octiles (all $P < .0001$).

We performed a separate regression analysis in which school districts were the unit of analysis, rather than octiles of school districts, to establish whether the patterns observed among the octiles were artifacts resulting from our choices of categorization. This analysis produced a noisier plot because of the small size of many districts but still contained a significant inverse association between 2002 prevalence and prevalence increases between 2002 and 2008 (Fig 3). The weighted linear regression line indicated that, on average, a school district’s prevalence increase between 2002 and 2008 was attenuated by 0.47 cases per 1000 students ($P < .0001$) for every 1 case per 1000 students in autism category prevalence in 2002.

School district-level 2002 prevalence rates for use of the autism disability category were weakly but not significantly associated with per-pupil

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**Figure 1**
Special education autism category prevalence rates for school district octiles (lines) and statewide averages (bars) for Wisconsin elementary schools in 2002 through 2008 (school years).
spending ($P = .06$), proportions of children eligible for subsidized lunch (negative association, $P = .07$), and proportions of children living in poverty (negative association, $P = .06$). Baseline prevalence rates were weakly associated with median household incomes ($R^2 = 0.02; P = .002$), proportions of adults with bachelor’s degrees ($R^2 = 0.01; P = .02$), and proportions of school revenue derived from local property taxes ($R^2 = 0.03; P = .001$).

**DISCUSSION**

In 2002, there was a wide range of proportions of elementary school students served under the autism disability category in Wisconsin school districts. This pattern fully supported our hypothesis that the use of the autism special education category was not the same in all districts. The results of this study also largely supported our second hypothesis, which was that school districts with relatively high autism disability category prevalence rates in 2002 would, as a whole, see little additional increase in prevalence during the subsequent 6-year period, whereas the prevalence would continue to increase during the study period in districts with relatively low prevalence rates in 2002. As a result of these trends, the disparity in prevalence between districts decreased considerably during the study period.

If we assume that these trends will continue, then we would expect the overall (statewide) proportion of children served under the autism category to continue to increase in the near future and perhaps to level off in the range of the highest prevalence districts today. This is near the prevalence observed for the highest octile during the 2002–2008 study period and similar to the upper range of autism prevalence reported from the latest US epidemiological studies using population-based surveillance. Despite the impressive reduction in the prevalence disparity between the highest and lowest octiles during the study period, we should not necessarily expect this gap to disappear altogether. It is likely that some district-level variation will remain, because of factors such as migration to districts with better access to services and geographic variability in demographic characteristics or other risk factors for autism, such as...
Special education data provide only a proxy measure of the prevalence of autism in the population; unmet needs for autism services in the population may or may not exist after leveling off of the prevalence of children served under the autism category in schools.

The trends shown in this study have important implications for planning and provision of services for children with autism and their families. Recognition that the proportions of children currently served under the autism special education category are not consistent across areas may help policymakers anticipate future resource needs. Among the Individuals With Disabilities Education Act disability categories under which children receive special education services, autism was shown nationally to have the highest per-pupil expenditures for special education. Intensive services for both children and adults with autism are among the most costly services to provide, with lifetime costs estimated in the millions of dollars. A sizeable proportion of these expenses are publicly funded and administered through school and community services.

An important advantage of this study is the simultaneous analysis of variations and changes in prevalence both over time and geographically. Several previous studies attempted to draw inferences from special education data about potential environmental or geographically distributed risk factors for autism (including environmental mercury, Superfund sites, precipitation, and high levels of parental education) but analyzed geographic variability without considering small-area variations in temporal trends. The results of our analysis demonstrate that geographic associations may be confounded by trends over time in the proportions of children served under the autism category. For example, if the highest-octile school districts in this study were associated with a point-source environmental exposure at baseline, then the strength of that association would weaken over time as the prevalence in the lower octiles approached that in the highest octiles. Administrative data sets may not be well suited for assessment of environmental exposures but accounting for both temporal and geographic variations could strengthen the evidence these studies provide. The need to consider geographic and temporal information simultaneously is especially relevant given recent calls for more re-

FIGURE 3
Changes in special education autism category prevalence rates between 2002 and 2008, compared with baseline (2002) prevalence, for Wisconsin elementary school districts (with weighted, best-fit line and 95% CI [shaded area]).
A limitation of this study is its restriction to the 7-year period of 2002–2008. Data from previous years were not available at the school district level. Availability of both geographic and time trend data for previous years would provide some insight into the patterns of adoption among the group of schools in which the prevalence of use of the autism category had largely stabilized by 2002. Another limitation is our reliance on publicly available school- or district-level education counts, which could not be stratified according to variables such as gender, race, or age. Although the findings in this analysis are consistent with the hypothesis that the adoption of the autism disability category is gradual and occurs at a local level, we cannot confirm a causal mechanism with these data.

Factors associated with local adoption of the autism category cannot be gleaned from administrative counts. These factors may include availability of resources, school and community policies, parental involvement, and school personnel. Our exploratory analyses investigating socioeconomic factors and proximity to services and diagnostic centers explained little of the variability in baseline prevalence rates between school districts. Circumstances prompting the adoption of the autism category within a school district may involve events and factors such as a new teacher interested in autism, an influential family of a child with autism, and other situations not captured by broad socioeconomic or service measures. It has been noted frequently that autism counts from schools or other administrative sources do not use consistent classification criteria and likely underestimate the actual prevalence.

These findings suggest potential avenues for additional research. First, most studies reported increases in autism prevalence, but few identified instances in which the prevalence stabilized over time. Replication of these findings could provide context to the continued increases in autism prevalence observed and might be useful for anticipating future service needs. Autism trends are averaged frequently across large regions, to produce statewide or national estimates. Our analysis of smaller-area variations in prevalence trends suggests that such averaging may mask evidence that prevalence has leveled off in selected areas and that areas identified as high risk at 1 time point may be characterized as “early adopters” in a time trend analysis. These findings are derived from autism prevalence trends based on school data; additional research is needed to determine whether similar trends are present in epidemiological studies or prevalence studies based on health service records. Also needed is a better understanding of how factors such as costs, greater awareness, and entitlement to services influence the use of the autism disability category and the autism diagnosis in general.

**CONCLUSIONS**

The prevalence of autism is expressed popularly as single point estimates for relatively large regions, such as countries or states. The findings presented here demonstrate that variability of trends within smaller areas offers additional insights into the increasing prevalence of autism in special education, and they reveal heterogeneous trends within a population. Wisconsin elementary school districts with relatively low autism disability category prevalence rates at the beginning of the study period tended to see larger increases in prevalence than did districts with initially higher prevalence rates. The 7 years included in this analysis showed a decreasing gap between districts with high versus low prevalence rates. It remains to be seen whether the low-prevalence districts will catch up to the high-prevalence group completely and what the peak prevalence of autism in special education will be. Although the autism category in special education existed for nearly a decade before the first year included in this study, these trends are consistent with the hypothesis that the autism special education category is not uniformly applied across school districts.

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