ARTICLE

# Recent Trends in Childhood Attention-Deficit/Hyperactivity Disorder

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**Objective:** To examine trends in attention-deficit/hyperactivity disorder (ADHD) by race/ethnicity, age, sex, and median household income.

**Design:** An ecologic study of trends in the diagnosis of ADHD using the Kaiser Permanente Southern California (KPSC) health plan medical records. Rates of ADHD diagnosis were derived using Poisson regression analyses after adjustments for potential confounders.

**Setting:** Kaiser Permanente Southern California, Pasadena.

**Participants:** All children who received care at the KPSC from January 1, 2001, through December 31, 2010 (n = 842 830).

**Main Exposure:** Period of ADHD diagnosis (in years).

**Main Outcome Measures:** Incidence of physician-diagnosed ADHD in children aged 5 to 11 years.

**Results:** Rates of ADHD diagnosis were 2.5% in 2001 and 3.1% in 2010, a relative increase of 24%. From 2001 to 2010, the rate increased among whites (4.7%-5.6%; relative risk [RR] = 1.3; 95% CI, 1.2-1.4), blacks (2.6%- 4.1%; RR = 1.7; 95% CI, 1.5-1.9), and Hispanics (1.7%-2.5%; RR = 1.6; 95% CI, 1.5-1.7). Rates for Asian/Pacific Islander and other racial groups remained unchanged over time. The increase in ADHD diagnosis among blacks was largely driven by an increase in females (RR = 1.9; 95% CI, 1.5-2.3). Although boys were more likely to be diagnosed as having ADHD than girls, results suggest the sex gap for blacks may be closing over time. Children living in high-income households were at increased risk of diagnosis.

**Conclusions:** The findings suggest that the rate of ADHD diagnosis among children in the health plan notably has increased over time. We observed disproportionately high ADHD diagnosis rates among white children and notable increases among black girls.

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DURING THE LAST DECADE, attention-deficit/hyperactivity disorder (ADHD) diagnosis has reached epidemic proportions in the United States.[1] It is one of the most common chronic childhood psychiatric disorders, affecting 4% to 12% of all school-aged children[1-7] and persisting into adolescence and adulthood in approximately 66% to 85% of children.[8-11] The 3 major subtypes of ADHD are predominantly inattentive, predominantly hyperactive-impulsive, and combined.[12]

Children with ADHD are more likely than unaffected children to experience learning problems, miss school, become injured, experience troublesome relationships with family members and peers,[13-16] and exhibit mental and physical conditions.[17] Between 1995 and 1999, more than 14 million children in the United States aged 5 to 18 years visited physicians for treatment of ADHD.[18] In 2006 alone, ADHD-related ambulatory care visits reached an estimated 7 million.[19] By 2005, in children younger than 18 years, the annual cost attributable to ADHD was estimated to be between $36 billion and $52.4 billion.[20] Costs are likely to continue growing proportional to increasing ADHD prevalence.

Although the origin of ADHD is not fully understood, emerging evidence suggests that both genetic and environmental factors have important roles.[21-23] Potential risk factors include family history of ADHD,[24] maternal borderline personality disorders,[25] exposure to environmental tobacco smoke,[26-28] exposure to toxins and lead,[28,29] maternal use of antidepressant medications during pregnancy,[30] male sex,[31,32] low birthweight,[33] prematurity,[34] and artificial food additives.[35]

Because of small and nonrepresentative samples, previous studies have been limited in their applicability to the gen-

eral population. Furthermore, studies[36-38] have relied on parent- and teacher-reported cases, which overestimate true prevalence. Accurate estimates of disease burden in a large study population will provide information for determining health care resource allocation for ADHD prevention programs. In addition, research on the influence of child race/ethnicity on ADHD trends is sparse, and identifying potential disparities in ADHD prevalence is an important step in eliminating health inequalities. The Kaiser Permanente Southern California (KPSC) systems have detailed medical records and treatment information for a large number of children in the health plan. Using these integrated patient medical records, we investigated recent trends in ADHD diagnosis from 2001 to 2010 by child race/ethnicity, age, sex, and median household income. Specifically, we tested the following hypotheses: (1) that the diagnosis of ADHD has increased more rapidly among children of races other than white during the study period, (2) that the diagnosis of ADHD has increased among children of families with higher socioeconomic status and children across all age groups from 5 to 11 years, and (3) that the sex gap in ADHD diagnosis has narrowed over time.

## METHODS

### DATA SOURCE AND PATIENT SELECTION

For this analysis, demographic and clinical information from 2001 to 2010 was obtained from the KPSC medical records, which include information about membership, inpatient and outpatient physician encounters, and pharmacy use. The KPSC membership records contain information about race/ethnicity, sex, and date of birth. Information on supplemental drug benefits, Medicaid status, and changes to membership and demographics are also available.

The study cohort is composed of member children aged 5 to 11 years who received care at the KPSC from January 1, 2001, through December 31, 2010, regardless of membership status at the time the care was given. Children in this age group were selected to maintain uniformity in diagnostic criteria (*Diagnostic and Statistical Manual of Mental Disorders [Fourth Edition]* [*DSM-IV*]). Children with diagnoses of autism spectrum disorder (n=15 400) were excluded from the final study cohort (n=842 830).

Potential confounders and mediators included race/ethnicity (categorized as non-Hispanic white [white], non-Hispanic black [black], Hispanic, Asian/Pacific Islander, and other/multiple [other] racial/ethnic groups), sex (male or female), age (5-7, 8-9, and 10-11 years), and area-based (US Census tract) median family household income (<$29 999, $30 000-$49 000, $50 000-$69 999, $70 000-$89 999, and ≥$90 000). Child race/ethnicity was determined on the basis of maternal and paternal race/ethnicity. The other/multiple (other) race/ethnicity category includes non-Hispanic children with multiple recorded races.

Primary diagnosis of ADHD was determined using *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis code 314.x from child hospitalization, outpatient office visit, and emergency department visit across all the KPSC facilities. The outpatient, inpatient, and emergency department systems are integrated. During the child visit in any of these facilities, the practitioner has access to the child's diagnosis, but often the diagnosis of ADHD is made in an outpatient setting. The following criteria were used to diagnose and code ADHD within the KPSC: (1) a Child Behavior Checklist must be filled out by parents and teachers to describe child behavioral and emotional problems, and (2) a clinical interview must be performed by a qualified mental health professional. In a preliminary study conducted for this project, 96% of children with ADHD were found to have had their conditions diagnosed by child and adolescent psychiatrists, developmental and behavioral pediatricians, child psychologists, and neurologists. To further increase the specificity of the case definition, we used data for receipt of drugs specific to ADHD extracted from pharmacy records. These drugs included amphetamine aspartate, amphetamine sulfate, dextroamphetamine aspartate, dextroamphetamine sulfate, and methylphenidate hydrochloride.

**Table 1. Distribution of Child Characteristics Based on ADHD Status[a]**

| Characteristic | Children, % | |
|---|---|---|
| | With No ADHD (n = 803 630) | With ADHD (n = 39 200) |
| Child age, y | | |
| 5-7 | 23.9 | 16.4 |
| 8-9 | 17.2 | 26.6 |
| 10-11 | 59.0 | 57.0 |
| Child sex | | |
| Female | 50.2 | 25.4 |
| Male | 49.9 | 74.6 |
| Child race/ethnicity | | |
| Non-Hispanic white | 18.3 | 34.3 |
| Non-Hispanic black | 8.1 | 10.2 |
| Hispanic | 40.8 | 31.8 |
| Asian/Pacific Islander | 5.6 | 2.6 |
| Other[b] | 2.1 | 2.5 |
| Unknown | 25.2 | 18.6 |
| Household income, median, $[c] | | |
| <30 000 | 5.7 | 4.0 |
| 30 000-49 999 | 27.6 | 22.3 |
| 50 000-69 999 | 29.1 | 28.1 |
| 70 000-89 999 | 19.8 | 22.8 |
| ≥90 000 | 17.5 | 22.3 |

Abbreviation: ADHD, attention-deficit/hyperactivity disorder.
[a] Differences between children with and without ADHD by child characteristics were statistically significant at $P < .001$.
[b] Other race/ethnicity includes non-Hispanic children with multiple recorded races/ethnicities.
[c] Median household income based on US Census tract information.

### STATISTICAL ANALYSIS

First, we compared the distribution of child age, sex, race/ethnicity, and median household income by ADHD status using the $\chi^2$ tests. Second, the annual rates of ADHD per 100 children were estimated using Poisson regression. For this, the yearly count of ADHD was the outcome variable and year of diagnosis was the independent variable, adjusting for potential confounding factors (**Table 1**). Dummy variables were constructed for the various categories of covariates. The mean predicted probabilities were estimated from the adjusted models. Third, increases of relative risk (RR) from 2001 to 2010 were quantified using regression analysis. The population-based nature of our study and the low rates of ADHD allow odds ratios to be reasonably good approximations of RRs.

We further stratified the analyses by child age and sex. We examined temporal trends in the diagnosis of ADHD by comparing rates in the earliest (2001) vs most recent (2010) years.

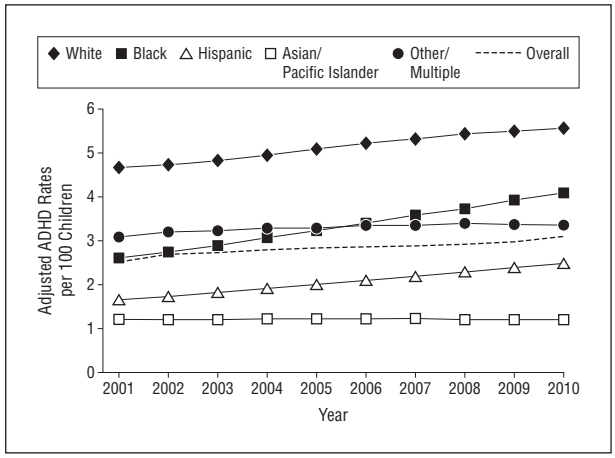


**Figure 1.** Race/ethnicity-specific adjusted rates of attention-deficit/hyperactivity disorder (ADHD) diagnosis: Kaiser Permanente Southern California (2001-2010). Adjustments were made for child age, sex, and median household income.

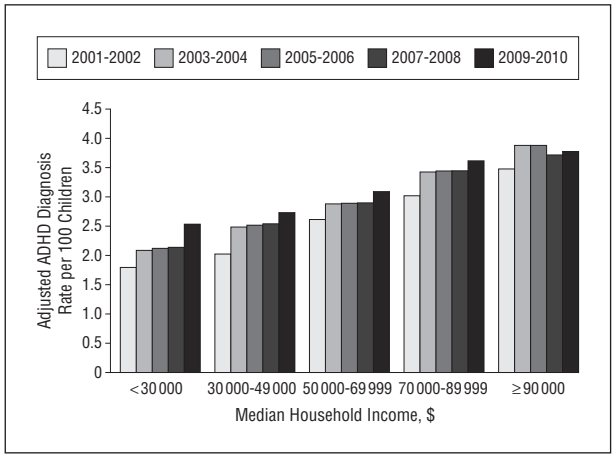


**Figure 2.** Median household income–specific adjusted rate of attention-deficit/hyperactivity disorder (ADHD) diagnosis: Kaiser Permanente Southern California (2001-2010). Adjustments were made for child age, sex, and race/ethnicity.

The significance of differences in ADHD trend rates was tested using linear regression analysis.

In a previous study that used KPSC medical records, we found that race/ethnicity data are most commonly missing in children of races/ethnicities other than white.[39] Similarly, Ray et al[40] and Aratani and Cooper[41] reported that, compared with whites, children of other races are less likely to use mental health services, particularly Asian American children. Therefore, records with missing data on race/ethnicity are more likely to have come from children of races other than white. We performed sensitivity analyses to investigate the effect of missing race data on our findings. We reran the analyses by assigning missing race/ethnicity data to every race/ethnicity group one at a time.

All statistical analyses were performed using SAS statistical software, version 9.2 (SAS Institute, Inc). The study was approved by the KPSC Institutional Review Board.

## RESULTS

Among children in the study who were cared for in the KPSC from January 1, 2001, through December 31, 2010, 39 200 of 842 830 (4.9%) had a diagnosis of ADHD. During the same period, the number of children diagnosed as having ADHD increased from 6869 (2.5%) in 2001 to 8006 (3.1%) in 2010. Both the race/ethnicity- and sex-specific mean ages at ADHD diagnosis remained relatively stable throughout the study period, ranging from 8.4 to 9.5 years.

Table 1 gives the distributions of child characteristics based on ADHD diagnosis. White and black children were more likely than Hispanics and Asian/Pacific Islanders to be diagnosed as having ADHD. Children between 8 and 9 years and those from high-income families (≥$70 000) were more likely to be diagnosed as having ADHD, as were boys in general.

**Figure 1** shows race/ethnicity-specific adjusted rates of ADHD diagnosis and their relative increases between 2001 and 2010. During the study period, we observed markedly higher rates of ADHD diagnoses among whites (4.5%) and a relatively lower rate among Asian/Pacific Islanders (1.1%). Between 2001 and 2010, blacks had the highest relative increase in ADHD diagnosis rates (69.6%), followed by Hispanics (60.4%) and whites (29.8%) (*P* for linear trend <.001). Rates for Asian/Pacific Islanders remained unchanged over time.

**Figure 2** shows biannual median household income rates of ADHD diagnosis with adjustment for age, sex, and race/ethnicity. We observed a markedly higher rate of ADHD diagnosis among children living in high-income households (*P* for linear trend <.001).

**Table 2** and **Table 3** give the adjusted ADHD rates and relative changes from the earliest to the most recent years. Also included are significance levels for temporal trends derived using Poisson regression analysis. After controlling for child age and household income (Table 2), we observed increases in ADHD diagnosis rates during the study period for white, Hispanic, and black race/ethnicity and sex categories. Attention-deficit/hyperactivity disorder increased from 4.7% in 2001 to 5.6% in 2010 among whites (RR = 1.3; 95% CI, 1.2-1.4), 2.6% in 2001 to 4.1% in 2010 among blacks (RR = 1.7; 95% CI, 1.5-1.9), and 1.7% in 2001 to 2.5% in 2010 among Hispanics (RR = 1.6; 95% CI, 1.5-1.7). Rates for Asian/Pacific Islanders remained unchanged over time. In all racial/ethnic categories, rates for males across the study period were substantially higher than those for females. However, between 2001 and 2010, we noted a marked increase in the diagnosis of ADHD among black girls (RR = 1.9; 95% CI, 1.5-2.3). The sex gap remained stable during the study period among whites, Hispanics, and Asian/Pacific Islanders.

Table 3 gives the race/ethnicity- and age-specific ADHD diagnosis rates with adjustment for sex and median family household income. During the study period, ADHD diagnosis rates increased consistently for all race/ethnicity and age categories. Although white children had substantially higher ADHD diagnosis rates than children of other races in every age group, the increase was especially pronounced among blacks in the age groups of 5 to 7 years (RR = 1.8; 95% CI, 1.4-2.2) and 8 to 9 years (RR = 1.8; 95% CI, 1.5-2.1). The same was true for Hispanics in the age groups of 8 to 9 years (RR = 1.7; 95% CI, 1.5-1.8) and 10 to 11 years (RR, 1.7; 95% CI, 1.6-1.9) years.

**Table 2. Rates and Relative Increases in ADHD Diagnosis Among the KPSC Member Children by Race/Ethnicity and Sex per 100 Children, 2001-2010[a]**

| Race/Ethnicity and Sex | Children by Year, % | | | | | | | | | | *P* Value for Linear Trend | RR (95% CI) for 2010 vs 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| White | | | | | | | | | | | | |
| Female | 2.5 | 2.6 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.2 | <.001 | 1.3 (1.2-1.5) |
| Male | 6.7 | 6.8 | 6.9 | 7.1 | 7.2 | 7.4 | 7.5 | 7.6 | 7.7 | 7.7 | <.001 | 1.2 (1.1-1.3) |
| Total | 4.7 | 4.7 | 4.8 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | <.001 | 1.3 (1.2-1.4) |
| Hispanic | | | | | | | | | | | | |
| Female | 0.7 | 0.8 | 0.8 | 0.8 | 0.9 | 0.9 | 1.0 | 1.0 | 1.0 | 1.1 | <.001 | 1.7 (1.5-1.9) |
| Male | 2.6 | 2.7 | 2.8 | 3.0 | 3.1 | 3.2 | 3.7 | 3.5 | 3.7 | 3.8 | <.001 | 1.6 (1.5-1.7) |
| Total | 1.7 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | <.001 | 1.6 (1.5-1.7) |
| Black | | | | | | | | | | | | |
| Female | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 | <.001 | 1.9 (1.5-2.3) |
| Male | 4.0 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | 5.3 | 5.5 | 5.7 | 5.9 | <.001 | 1.6 (1.5-1.8) |
| Total | 2.6 | 2.8 | 2.9 | 3.1 | 3.2 | 3.4 | 3.6 | 3.7 | 3.9 | 4.1 | <.001 | 1.7 (1.5-1.9) |
| Asian/Pacific Islander | | | | | | | | | | | | |
| Female | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | .61 | 1.1 (0.7-1.8) |
| Male | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.8 | 1.8 | 1.8 | .72 | 1.0 (0.8-1.2) |
| Total | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | .93 | 1.0 (0.8-1.2) |
| Other | | | | | | | | | | | | |
| Female | 1.6 | 1.7 | 1.7 | 1.7 | 1.6 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | .11 | 1.4 (0.9-2.2) |
| Male | 4.6 | 4.8 | 4.8 | 4.8 | 4.9 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | .03 | 1.3 (1.0-1.7) |
| Total | 3.1 | 3.2 | 3.2 | 3.3 | 3.3 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | .01 | 1.1 (1.0-1.2) |

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; KPSC, Kaiser Permanente Southern California; RR, relative risk.
[a] Adjustments were made for child age and median household income.

The degree of missing racial/ethnic data is substantial for children of races other than white (Table 1) and may have biased our findings. To investigate this potential bias, we performed a sensitivity analysis, separately assigning children with missing race/ethnicity data to every race/ethnicity group one at a time. Results were comparable to those in which children with missing race/ethnicity had been excluded from analysis (data not shown).

## COMMENT

Within the ethnically diverse patient population at the KPSC, we observed increasing trends in ADHD diagnosis across the study period. Confirming our initial hypotheses, we observed wide variation in recent ADHD diagnosis trends by child age, sex, race/ethnicity, and median household income. White, black, and Hispanic children were more likely to be diagnosed as having ADHD than Asian/Pacific Islanders and children of other race/ethnicities. Furthermore, children living in high-income household areas had a higher incidence of physician-diagnosed ADHD. Asians were less likely to use mental health services and more likely to discontinue therapy despite having equal access to care within KPSC.[40] This finding suggests that cultural factors may influence the treatment-seeking behavior of some groups.

We observed a male-to-female ratio of approximately 3:1 in ADHD rates, which confirmed findings from previous studies.[31,32] Our new findings highlight disproportionately higher relative increases in ADHD diagnosis rates among black girls in recent years, suggesting the sex gap may be narrowing in this racial/ethnic group. The sex gap remained relatively stable, however, for whites, Hispanics, and Asian/Pacific Islanders. Mean age at ADHD diagnosis for Hispanic girls increased during the study period by approximately 1 year, from 8.4 to 9.3 years ($P = .005$). This finding is partially explained by increases in ADHD diagnosis rates among Hispanics aged 8 to 11 years, suggesting delayed diagnosis. Although the reasons for increasing ADHD rates are not well understood, contributing factors may include heightened ADHD awareness among parents and physicians, increased use of screening and other preventive services, and variability in surveillance methods among institutions. These reasons may also partially account for discrepancies in rate estimates in the literature. Other reasons for variation in the reported rates may include changes in diagnostic criteria over time, differences in diagnostic criteria among institutions, and demographic variation among patient populations.

Diagnosing ADHD can be challenging because of signs and symptoms of the disorder often resembling normal behaviors.[2,42] Children with ADHD are easily distracted, impulsive, and unable to concentrate on simple tasks for even short periods and become disruptive in the classroom. In particular, heightened levels of stress or anxiety can be a prelude to much more severe symptoms. Although distinguishing between ADHD behavior and normal teen behavior can be difficult, children with ADHD show persistent patterns of extreme behavior beyond their control. Diagnosis and management of the disorder are further complicated by comorbid conditions, including learning disabilities, conduct disorders, and anxiety disorders.[2,42] As a result, the rates of ADHD reported in many epidemiological studies are often an overestimate.

Higher rates of ADHD observed in affluent, white families likely represent an effort by these highly educated

**Table 3. Rates and Relative Increases in ADHD Diagnosis Among the KPSC Member Children by Race/Ethnicity and Age per 100 Children, 2001-2010[a]**

| Race/Ethnicity and Age, y | Children by Year, % | | | | | | | | | | *P* Value for Linear Trend | RR (95% CI) for 2010 vs 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| White | | | | | | | | | | | | |
| 5-7 | 2.6 | 2.7 | 2.7 | 2.8 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 | .004 | 1.2 (1.2-1.3) |
| 8-9 | 5.7 | 5.8 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.8 | 6.9 | <.001 | 1.3 (1.2-1.5) |
| 10-11 | 6.1 | 6.2 | 6.4 | 6.6 | 6.8 | 7.0 | 7.3 | 7.5 | 7.7 | 7.9 | <.001 | 1.4 (1.3-1.5) |
| Hispanic | | | | | | | | | | | | |
| 5-7 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | <.001 | 1.4 (1.3-1.6) |
| 8-9 | 2.1 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.2 | <.001 | 1.7 (1.5-1.8) |
| 10-11 | 2.1 | 2.2 | 2.3 | 2.5 | 2.6 | 2.7 | 2.8 | 3.0 | 3.1 | 3.3 | <.001 | 1.7 (1.6-1.9) |
| Black | | | | | | | | | | | | |
| 5-7 | 1.5 | 1.7 | 1.8 | 1.9 | 2.0 | 2.2 | 2.3 | 2.5 | 2.6 | 2.8 | <.001 | 1.8 (1.4-2.2) |
| 8-9 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.4 | 4.6 | 4.8 | 5.0 | <.001 | 1.8 (1.5-2.1) |
| 10-11 | 3.3 | 3.4 | 3.6 | 3.8 | 4.0 | 4.2 | 4.3 | 4.5 | 4.8 | 4.9 | <.001 | 1.6 (1.4-1.9) |
| Asian/Pacific Island | | | | | | | | | | | | |
| 5-7 | 0.8 | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | <.001 | 0.8 (0.6-1.4) |
| 8-9 | 1.6 | 1.6 | 1.6 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | <.001 | 0.9 (0.6-1.2) |
| 10-11 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | <.001 | 1.3 (0.9-1.7) |
| Other | | | | | | | | | | | | |
| 5-7 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.8 | 1.9 | 2.0 | 1.9 | 1.9 | .07 | 1.0 (0.9-2.7) |
| 8-9 | 3.6 | 3.8 | 4.0 | 4.0 | 3.9 | 4.0 | 4.1 | 4.0 | 4.2 | 4.3 | .03 | 1.3 (1.1-2.2) |
| 10-11 | 3.9 | 4.0 | 4.0 | 4.2 | 4.5 | 4.5 | 4.5 | 4.6 | 4.6 | 4.5 | .15 | 1.3 (0.9-1.8) |

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; KPSC, Kaiser Permanent Southern California; RR, relative risk.
[a] Adjustments were made for child sex and median household income.

parents to seek help for their children who may not be fulfilling their expectations for schoolwork. The increasing rate of ADHD in girls is an interesting finding and could represent an effort by parents to get more help for their daughters. Rates of ADHD in this study, although lower than most previous estimates, are similar to some reports.[2,43,44] The lower rates in our study may be related to our use of more stringent diagnostic criteria.

Diagnoses of ADHD in this study were based on the *DSM-IV* criteria, requiring patients to be symptomatic for at least 6 months, impaired from symptoms in at least 2 settings (eg, home and school), and significantly affected by 1 or more clinical impairments.[12] The *DSM-IV* criteria were not strictly followed in many of the previous epidemiological studies reporting on ADHD. After surveying 3900 pediatricians and other primary care physicians, Wasserman et al[45] reported that only 38% of clinicians used *DSM-IV* criteria for diagnosing ADHD. This finding highlights the variability in diagnostic criteria among studies. The KPSC uses stringent criteria based on *DSM-IV* that must be met before diagnosis of ADHD.[46] These criteria include the following: (1) a Child Behavior Checklist must be completed by parents and teachers to describe the child behavioral and emotional problems, and (2) a clinical interview must be performed by a qualified mental health professional. In the KPSC, all health care professionals diagnosing ADHD in pediatric patients are expected to follow the guideline put forth by the Kaiser Permanente ADHD Guideline Development Team.[46] This guideline includes recommendations for use of the *DSM-IV* diagnostic criteria and the Vanderbilt ADHD Diagnostic Teacher and Parent Rating Scales as part of the evaluation and diagnosis of ADHD in children and adolescents. However, the Conners' Parent and Teacher Rating Scales and Achenbach Scales (Child Behavior Checklist, Teachers Report Form, and Youth Self-Report) are options that can be used in addition to the initial evaluation. Furthermore, the Achenbach and Vanderbilt behavioral rating scales can be used to evaluate the rates and patterns of comorbidity and behavioral problems, including disruptive behavior disorders, learning disorders, anxiety disorders, and mood disorders. These scales led to greater validity in the ADHD diagnoses made at the KPSC relative to those based on parent-teacher reports or diagnoses made by untrained health care professionals. A preliminary analysis of diagnosing-physician specialty for children diagnosed as having ADHD at the KPSC found 96% of children to have had their ADHD diagnosed by professionals trained in diagnosis and treatment of the disorder.

This large cohort study with children from diverse racial/ethnic and socioeconomic backgrounds provides assurance on the generalizability of our findings. One serious limitation of most other epidemiological ADHD studies to date has been misclassification of the disorder because of reliance on parent or teacher reports. According to data from the National Children's Health Survey, there was a 21.8% increase in the prevalence of parent-reported childhood ADHD between 2003 and 2007.[38] Teacher report has also been found to overestimate ADHD rates (23%).[36] This overreporting is primarily due to the lack of stringent diagnosis criteria, such as duration of

symptoms, age at onset, and demonstrated dysfunction in multiple settings (criterion C of *DSM-IV*). Unlike many previous studies, case identification in our study required a combination of (1) diagnosis on at least 2 occasions by specialized physicians or (2) diagnosis on 1 occasion and at least 2 refills of medications specific to ADHD. We believe this approach increases the specificity of case identification. The large amount of missing race/ethnicity data observed in our cohort (Table 1) is a significant limitation, which warrants some caution when interpreting the findings. However, sensitivity analyses after classifying children with missing race/ethnicity data in each year to each race/ethnicity group data within the same year yielded similar estimates.

The findings of this study suggest increasing trends in the clinical diagnosis of ADHD among children in the health plan. We also observed disproportionately high ADHD diagnosis rates among white children and notable increases in rates among black girls over time.

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