

The Potential for Sociocultural Factors in the Diagnosis of ADHD in Children

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ABSTRACT

Purpose: The nongenetic contributors to attention deficit/hyperactivity disorder (ADHD) remain to be identified. A previous study in eastern Wisconsin (prevalence 13.5%) suggested that male gender, white race, lower block group median household income and population density, and greater distance to the nearest park were factors predictive of ADHD diagnosis. We performed a similar study in Dane County, Wisconsin.

Methods: Cross sectional study of children age 5-17, with and without ADHD diagnosis, who received well child care in Dane County UW Family Medicine clinics (N=7954) 2007-2008. Street addresses were geocoded to 2000 Census block group. Univariate analysis was done by chi-square test or Mann-Whitney U test, multivariate analysis by logistic regression.

Results: ADHD diagnosis was present in 309 (3.9%) children (74.1% male; $P=0.000$, compared to females) and more frequently diagnosed in black children (6.8% of black children had ADHD diagnosis) than white (4%), Native American (2.7%), Hispanic (1.6%), or Asian (1.3%) children. In contrast to eastern Wisconsin and to Milwaukee County (a subset of the eastern Wisconsin study where black rates were identical to that of Dane County), black race rather than white race was predictive of ADHD in Dane County, while median household income, population density, and distance to nearest park were not associated. The range of ADHD within school district boundaries was 2.4%-7.1% (for $N > 100/\text{district}$). In the group of districts with $>4\%$ ADHD diagnosis, the increased rates were largely among whites.

Conclusion: ADHD diagnosis was much less common in this Dane County cohort than in eastern Wisconsin and was more common among blacks, but not predicted by other geo-demographic factors. Like eastern Wisconsin, ADHD diagnosis prevalence varied with apparent school district boundaries.

INTRODUCTION

Attention deficit/hyperactivity disorder (ADHD) is a persistent neurodevelopmental disorder that manifests in childhood. The exact etiology is unknown, but both genetic and environmental

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factors traditionally have been implicated.¹ Some have found little support for a biomedical model for ADHD and there is controversy regarding the consideration of this diagnosis as solely or partially a cultural or social construct.²⁻⁵ A number of sociocultural, access, payment, and provider-related factors also help determine rates of ADHD diagnosis.⁶⁻¹¹

The mean prevalence rates for parent-reported ADHD diagnosis in the United States among children ages 4-17 in 2007 was 9.5% (95% CI: 9.0-10.0) (9.9% in Wisconsin; range among states, 5.6%-15.6%). Rates in this study¹² were not statistically different between white (9.9%) and black (10.1%) children, but differed between Hispanic (5.6%) and non-Hispanic (10.5%) children. Rates were increased with lower income, based on poverty level.

A recent study (data from August 16, 2004 to August 15, 2006) of 6833 eastern Wisconsin children with ADHD diagnosis and 43,630 controls revealed that ADHD was diagnosed more frequently in white

children (17.3%) than in blacks (10.6%), Hispanics (9.4%) or Asians (3.7%). Overall, male gender, white race, lower block group median household income and population density, and greater distance to nearest park were more predictive of ADHD. Rates appeared to vary by school district boundaries. Similarly, in urban Milwaukee County (865 cases/10,493 controls) male gender, white race, suburban residence, and younger age were more predictive of ADHD.⁶

If findings in Dane County were to confirm the geographic and demographic disparities found in this previous work, they would strongly favor a sociocultural model of ADHD in Wisconsin, and call for reflection upon the basis for, and implications of, a diagnosis of ADHD. By better understanding factors and disparities leading to a diagnosis of ADHD (whether socioeconomic, racial/ethnic, environmental, or issues of access), bet-

Table 1. Demographic Data: Children with Attention Deficit/Hyperactivity Disorder (ADHD) vs Controls, All Dane County Subjects, Madison Metro Subset, and Dane County Subsets of School Districts with ADHD Diagnosis Prevalence <4% and >4%

| | Dane County | | Subset: Madison Metro | | Subset: ADHD < 4% | | Subset: ADHD > 4% | |
|-----------------------|-----------------------|------------------|-----------------------|------------------|----------------------|------------------|-----------------------|------------------|
| | ADHD No. (%) | Controls No. (%) | ADHD No. (%) | Controls No. (%) | ADHD No. (%) | Controls No. (%) | ADHD No. (%) | Controls No. (%) |
| Gender | | | | | | | | |
| Male | 229 (74) ^a | 3675 (48) | 46 (79) ^a | 855 (45) | 92 (74) ^a | 1923 (47) | 137 (74) ^a | 1750 (49) |
| Female | 80 (26) | 3970 (52) | 12 (20) | 1011 (54) | 33 (26) | 2159 (53) | 47 (26) | 1811 (51) |
| Race/Ethnicity | | | | | | | | |
| White | 247 (80) | 5984 (78) | 25 (43) | 960 (51) | 87 (70) | 2917 (71) | 160 (87) | 3065 (86) |
| Black | 46 (15) | 629 (8) | 29 (50) | 402 (22) | 33 (26) | 471 (12) | 13 (7) | 158 (4) |
| Hispanic | 7 (2) | 420 (5) | 2 (3) | 214 (11) | 2 (2) | 294 (7) | 5 (3) | 126 (4) |
| Native American | 1 (0) | 36 (0) | 0 (0) | 13 (1) | 0 (0) | 25 (1) | 1 (0) | 11 (0) |
| Asian | 4 (1) | 303 (4) | 2 (3) | 195 (10) | 2 (2) | 247 (6) | 2 (1) | 56 (2) |
| Other | 0 (0) | 8 (0) | 0 (0) | 2 (0) | 0 (0) | 2 (0) | 0 (0) | 6 (0) |
| Unknown | 4 (1) | 265 (3) | 0 (0) | 80 (4) | 1 (1) | 126 (3) | 3 (2) | 139 (4) |
| Age | | | | | | | | |
| Mean | 11.47 | 11.45 | 11.36 | 11.80 | 12.30 | 11.40 | 11.70 | 11.50 |
| Median | 12.00 ^b | 12.00 | 11.50 | 11.00 | 12.00 | 12.00 | 11.50 | 12.00 |

All percentages refer to the percentage of the column subset for that numerical value.

All *P*-values refer to the comparison of ADHD cases vs their respective controls, within each set or subset.

^a *P*<0.001

^b *P*<0.05

Table 2. Attention Deficit/Hyperactivity Disorder (ADHD) Prevalence Rates Within Race/Ethnic Groups

| | Dane County No. (%) | Madison Metro No. (%) | ADHD<4% Districts No. (%) | ADHD>4% Districts No. (%) |
|-----------------|-----------------------|-----------------------|---------------------------|---------------------------|
| White | 247 (4.0) | 25 (2.5) | 87 (2.9) | 160 (5.0) ^c |
| Black | 46 (6.8) ^a | 29 (6.7) ^a | 33 (6.6) ^a | 13 (7.6) |
| Hispanic | 7 (1.6) ^b | 2 (0.9) | 2 (0.7) ^b | 5 (3.8) |
| Native American | 1 (2.7) | — | — | 1 (8.3) |
| Asian | 4 (1.3) ^b | 2 (1.0) | 2 (0.8) | 2 (3.5) |
| Unknown | 4 (1.5) | — | 1 (0.8) | 3 (2.1) |

^a *P*<0.001, compared to white in respective column

^b *P*<0.05, compared to white in respective column

^c *P*<0.001, compared to white in ADHD <4% districts

ter decisions regarding appropriate treatment can be made and families, health care workers, educators, funders, and policy makers be better informed.

METHODS

Setting

Dane County is located in south-central Wisconsin and by US Census Bureau 2011 estimates has a population of 495,959 (82% white, 5% black, and 6% Hispanic). The median household income is \$60,519 and 45% of persons 25 or older have a bachelor's degree or higher. Madison is the largest city, with a population of 236,901 (76% white, 7% black, and 7% Hispanic), a median household income of \$52,550 and 52% with a bachelor's degree or higher. By comparison, Milwaukee County, located in southeastern Wisconsin, has a population of 952,532, is 54% white, 27%

black, and 14% Hispanic, and has a median household income of \$43,215 and a rate of 27% with a bachelor's degree or higher.

Data and Analysis

The general methods were similar to that of the previous work.⁶ The study population was assembled from a data warehouse, which included all 22 University of Wisconsin Department of Family Medicine community clinics in Dane County, Wis. Subjects included all Dane County children ages 5-17 who received well child care in these clinics in calendar years 2007 and 2008 (N=7954). Cases included those with the diagnosis ADHD (ICD-9 codes 314.0 – 314.9) at any encounter during the study period. Control subjects included all children in this age range without ADHD diagnosis. As in our previous study,⁶ it must be emphasized that this was a study of potential disparities regarding ADHD *diagnosis* as captured by billing codes.

Demographic data was geocoded and mapped using ArcGIS (Esri; Redlands, CA). Individual data obtained for each subject included age, street address, and race/ethnicity. US Census 2000 block group level demographic, population density, median household income, percent owner-occupied housing, and average household size data was linked to each subject by street address. In addition, school district assignment and distances to nearest park and waterway were determined for each home address. Statistical analysis was performed with the assistance of MINITAB software (Minitab; State College, PA). Normality tests utilized the Anderson-Darling method. A chi-square test (with Yates correction for 2 x 2 tables) or 2-tailed Fisher exact test was used for categorical data and *t* tests (normally distributed) and

the Mann-Whitney U test (non-normally distributed) were utilized for comparison of continuous variables. *P* values <0.05 were considered statistically significant. Multivariate analysis was performed utilizing binary logistic regression models that included age, gender, race/ethnicity category and any variable which was statistically significant in univariate analysis.

This study was approved by the University of Wisconsin-Madison Health Sciences Institutional Review Board.

RESULTS

Table 1 summarizes demographic comparisons of children diagnosed with ADHD and controls. Of the 7954 children included in the entire study population, the mean and median age was 11.5 and 12.0 years, respectively. Using the same age groupings as in the Centers for Disease Control and Prevention (CDC) report¹² (except our study did not include 4 year olds), there was a non-significant increase in ADHD diagnosis prevalence with increasing age group: ages 5-10, 3.6%; 11-14, 4.0%; 15-17, 4.1% (*P*-values >0.4 for all group comparisons). Overall, 4050 (50.9%) of the study population were female, and the race/ethnicity breakdown was as follows: white, 6231 (78.3%); black, 675 (8.5%); Hispanic, 427 (5.4%); Asian, 307 (3.9%); Native American, 37 (0.5%); and unknown/other, 277 (3.5%). ADHD diagnosis was present in 309 (3.9%) children (74.1% male; *P*=0.000, compared to females) and within the study population was more prevalent among black children (6.8%) than white (4%; *P*<0.001), Hispanic (1.6%; *P*<0.001), Asian (1.3%; *P*<0.001) or Native American (2.7%; *P*=0.5) children. All statistical comparisons are to black children. In contrast to eastern Wisconsin,⁶ where white race was predictive of ADHD diagnosis, in Dane County black race was predictive of ADHD.

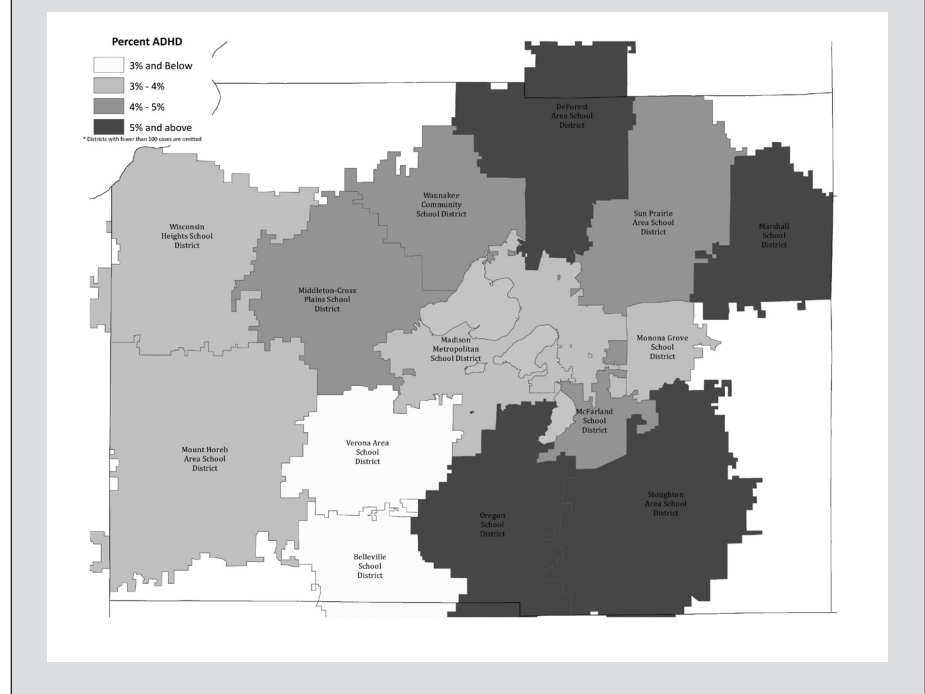
The first column of Table 2 lists Dane County ADHD prevalence rates among race/ethnicity groups, with white children as the comparison group.

Median household income, population density, and distance to the nearest park were not associated with ADHD diagnosis in Dane County by univariate analysis (Table 3).

The range of ADHD diagnosis within school district boundaries was 2.4%-7.1% (for districts with >100 subjects/district); however, there was not an obvious geographical distribution pattern, except that all districts with >4% ADHD rates were suburban districts (Figure 1).

The study population was divided into several subsets, the first

Figure 1. Geographic Distribution of Attention Deficit/Hyperactivity Disorder (ADHD) Diagnosis Among Dane County School Districts



of which was Madison Metropolitan School District, which is the most urban area of Dane County (Tables 1 and 2). Within this subset, the population had an ADHD prevalence of 3.0% with more frequent diagnosis in black children (6.7%) compared to white children (2.5%; *P*<0.001). There were no significant differences in linked population density, median household income, percent owner occupied housing, household size, or household distance to nearest park or waterway, when comparing children with ADHD diagnosis to controls (Table 3).

The entire study population was then divided into subsets by school district boundaries with ADHD diagnosis prevalence >4% and <4% (Tables 1 and 2).

In school districts with rates <4%, the prevalence was 2.9% among white children and 6.6% among black children (*P*<0.001). In the >4% subset, prevalence among white children increased to 5.0% (*P*<0.001, compared to white children in the <4% subset), while no significant increase in prevalence was demonstrated among black children (7.6%; *P*=0.8, compared to black children in the <4% subset). Small numbers of subjects in these subgroups prohibited meaningful comparisons of race/ethnic groups other than black or white. Although the total number of black children within the >4% districts was considerably lower (Table 1), the rate of ADHD diagnosis among black children remained similar to the <4% group (*P*=0.8, as above), despite sociodemographic differences between the 2 groups of school districts.

Table 4 lists individually linked geographic and US Census sociodemographic data for Dane County school districts with

Table 3. Individually Linked Geographic and Census-Derived Sociodemographic Data: All Subjects and Madison Metropolitan School District Only

| | Dane County | | Subset: Madison Metro | |
|--|---------------|-------------------|-----------------------|-------------------|
| | ADHD (Median) | Controls (Median) | ADHD (Median) | Controls (Median) |
| Population density (persons/square mile) | 692.2 | 741.0 | 4,391 | 4,119 |
| Median household income (\$) | 60,136 | 60,136 | 44,531 | 47,219 |
| Percent owner occupied housing | 0.74 | 0.76 | 0.48 | 0.59 |
| Average household size | 2.63 | 2.63 | 2.36 | 2.34 |
| Distance to nearest park (miles) | 0.63 | 0.66 | 0.56 | 0.53 |
| Distance to nearest waterway (miles) | 0.41 | 0.43 | 0.40 | 0.40 |

Abbreviation: ADHD, Attention deficit/hyperactivity disorder
 No comparisons between ADHD cases and controls were statistically significant (all *P* values > 0.23).

Table 4. Individually Linked Geographic and Census-Derived Sociodemographic Data: Dane County School Districts with ADHD Prevalence <4% vs School Districts with ADHD Prevalence >4%

| | ADHD <4% Districts | | ADHD >4% Districts | |
|--|--------------------|-------------------|---------------------|-------------------|
| | ADHD (Median) | Controls (Median) | ADHD (Median) | Controls (Median) |
| Population density (persons/square mile) | 975.5 | 975.5 | 473.8 | 457.7 |
| Median household income (\$) | 55,536 | 55,385 | 60,294 ^a | 61,932 |
| Percent owner occupied housing | 0.74 | 0.74 | 0.75 | 0.78 |
| Average household size | 2.57 | 2.54 | 2.72 | 2.76 |
| Distance to nearest park (miles) | 0.68 | 0.71 | 0.54 | 0.57 |
| Distance to nearest waterway (miles) | 0.47 | 0.45 | 0.40 | 0.42 |

Abbreviation: ADHD, Attention deficit/hyperactivity disorder
^a*P*<0.05, ADHD cases, compared to control, districts with ADHD prevalence >4%.

ADHD prevalence <4% vs school districts with >4% ADHD prevalence. In the >4% subset only, linked median household income was lower among those with ADHD diagnosis than without this diagnosis (\$60,294 vs \$61,932; *P*<0.05); however, in a multivariate logistic regression model including age, gender, and race/ethnicity, this variable was not significant (*P*=0.095). For all subjects (cases and controls) in school districts with ADHD diagnosis prevalence >4%, there was significantly lower population density (458 vs 976), higher median income (\$61,932 vs 55,385), higher percent owner occupied housing (0.78 vs 0.74), and increased household size (2.76 vs 2.54). All *P*-values <0.001 compared to districts with <4% prevalence; however, the absolute differences in the latter 2 comparisons were small.

DISCUSSION

The overall prevalence of ADHD diagnosis in this Dane County, Wisconsin cohort of children ages 5-17 was 3.9%. This figure is substantially lower than that reported for the entire state of Wisconsin for children 4-17 (9.9%), based on parental report in a national survey,¹² and that previously reported for eastern Wisconsin (13.5%), based on clinical billing data of children seen in primary care clinics.⁶ This was despite the Dane County

data reflecting a period an average of 17 months later than of the eastern Wisconsin cohort, at a time when national rates were increasing.¹² ADHD diagnosis was most prevalent among black children in Dane County, but not predicted by other individually linked sociodemographic factors. Similar to the eastern Wisconsin cohort, ADHD diagnosis prevalence varied with apparent school district boundaries. In addition, lower population density (similar to eastern Wisconsin) and higher median income typified the higher prevalence rate school district subgroup in the present study. The Dane County data also may be compared to the Milwaukee subset of the previous study.⁶ In Dane County, the prevalence of ADHD diagnosis among black children was 6.8%, the same as was seen in the Milwaukee county subset. In contrast, the prevalence among white children in Dane County was 4.0%, but was 12.6% in Milwaukee County.⁶

In Dane County school districts with ADHD prevalence >4.0% the total number and percentages of black children residing within these districts was considerably

lower, but the prevalence was non-significantly higher compared to the <4.0% subset, while the rates of white children were significantly increased.

Taken together, these findings suggest that families in certain school districts or suburban areas may be more likely to get an ADHD diagnosis for their children than families in an urban setting. Obviously, there are many possible explanations for this finding, including geographic differences regarding adequacy of medical home and insurance coverage, clinician diagnostic habits and use of ADHD diagnostic codes, cultural and school district norms, and parental involvement, expectations and aggressiveness in seeking ADHD diagnosis for their children with poor school performance, as discussed in previous reports.^{3-7,9-11,13,14}

One explanation for the remarkably lower Dane County prevalence (3.9%), compared to Milwaukee County (7.7%), and the City of Milwaukee (6.6%) could be a difference in school-based infrastructure available to assist in diagnosis of ADHD. Information provided by the various Dane County school districts in July 2011 revealed that some Dane County school districts appoint 1 psychologist to a maximum of 4 schools, while others may have 1 per school. All of the schools follow a procedure that includes a coordinated effort where the parents, school

psychologist and a physician share information to come to a diagnosis or verify an existing diagnosis and treatment. Overall, there were 172 schools and 102 full- and part-time psychologists among the Dane County school districts. This ratio did not vary much among the districts and did not seem to explain the higher ADHD prevalence rates among school districts with > 4% ADHD rates. Similar data from Milwaukee Public Schools revealed that 184 schools shared 158 psychologists. There was no data regarding the proportion of part-time psychologists, or clinician-school coordination. Resources, philosophy, coordination and access to care, parent availability for appointments, and completion of specialist referrals may be contributing factors to ADHD prevalence rates in particular school districts.

This study has several weaknesses. The data includes only children from 1 group of UW Family Medicine clinics, and has a relatively low sample size for certain subset analyses. Like the previous study in eastern Wisconsin,⁶ our data was limited to the information in diagnostic codes for encounters during the study time period, and does not include information on whether the ADHD diagnosis originated with the practitioner or a specialist, or if the diagnosis was validated. The data was not analyzed for co-existing behavioral disorders or sleep disorders, and does not include clinical data from specialists or school psychologists. These are weaknesses in both studies; however, the assumptions and methods of data collection were similar in both studies, suggesting usefulness of comparison.

In summary, ADHD diagnosis rates were significantly lower in this Dane County cohort than reported for eastern Wisconsin, but were similarly varied by school district boundaries. While diagnosis rates among blacks were similar between the 2 counties, rates for whites were 3 times lower in Dane County than Milwaukee County. Further studies are needed to determine if such differences exist among large communities in other states, and if regional and cultural family expectations, school resources and communications, diagnostic practices, community education, or other factors explain these disparities. Clinicians would be well served to be aware of regional differences in ADHD diagnosis prevalence, and the potential underlying sociocultural constructs, when entertaining or questioning the diagnosis of ADHD in children in their practice.

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REFERENCES

1. Millichap JG. Etiologic classification of attention-deficit/hyperactivity disorder. *Pediatrics*. 2008;121(2):e358-365. DOI: 10.1542/peds.2007-1332.
2. Timimi S, Moncrieff J, Jureidini J, et al. A critique of the international consensus statement on ADHD. *Clin Child Fam Psychol Rev*. 2004;7(1):59-63.
3. Timimi S, Taylor E. ADHD is best understood as a cultural construct. *Br J Psychiatry*. 2004;184:8-9.
4. Cohen EF, Morley CP. Children, ADHD, and citizenship. *J Med Philos*. 2009;34(2):155-180.
5. Rohde LA, Szobot C, Polanczyk G, Schmitz M, Martins S, Tramontina S. Attention-deficit/hyperactivity disorder in a diverse culture: do research and clinical findings support the notion of a cultural construct for the disorder? *Biol Psychiatry*. 2005;57(11):1436-1441.
6. Baumgardner D, Schreiber AL, Havlena JA, Bridgewater FD, Steber DL, Lemke MA. Geographic analysis of diagnosis of attention deficit/hyperactivity disorder in children: Eastern Wisconsin, USA. *Int J Psychiatry Med*. 2010;40(4):363-382.
7. Evink B, Crouse BJ, Elliott BA. Diagnosing childhood attention-deficit/hyperactivity disorder. Do family practitioners and pediatricians make the same call? *Minn Med*. 2000;83(6):57-62.
8. Rushton JL, Felt BT, Roberts MW. Coding of pediatric behavioral and mental disorders. *Pediatrics*. 2002;110(1 Pt 1):e8. DOI: 10.1542/peds.110.1.e8.
9. Kielbasa AM, Pomerantz AM, Krohn EJ, Sullivan BF. How does clients' method of payment influence diagnostic decisions? *Ethics Behav*. 2004;14(2):187-195.
10. Bussing R, Koro-Ljungberg ME, Gary F, Mason DM, Garvan CW. Exploring help-seeking for ADHD symptoms: a mixed-methods approach. *Harv Rev Psychiatry*. 2005;13(2):85-101.
11. Evans R. Ethnic differences in ADHD and the mad/bad debate. *Am J Psychiatry*. 2004;161(5):932.
12. Centers for Disease Control and Prevention (CDC). Increasing prevalence of parent-reported attention-deficit/hyperactivity disorder among children – United States, 2003 and 2007. *MMWR Morb Mortal Wkly Rep*. 2010;59(44):1439-1443.
13. Morley CP. The effects of patient characteristics on ADHD diagnosis and treatment: A factorial study of family physicians. *BMC Fam Pract*. 2010;11:11.
14. Fremont WP, Nastasi R, Newman N, Roizen NJ. Comfort level of pediatricians and family medicine physicians diagnosing and treating child and adolescent psychiatric disorders. *Int J Psychiatry Med*. 2008;38(2):153-168.

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