Variation in the Influence of Selected Sociodemographic Risk Factors for Mental Retardation

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ABSTRACT

Objectives. This study explored the utility of subdividing mental retardation into groups based on the presence of other neurological conditions.

Methods. Data were abstracted from birth certificates as part of a case–control study of mental retardation among 10-year-old children. The study sample included 458 case children and 563 control children selected from public schools. Case children were subdivided on the basis of intelligence quotient (IQ) score and the presence of other neurological conditions.

Results. Other neurological conditions were more common with severe mental retardation than with mild mental retardation. Regardless of IQ level or the presence of other neurological conditions, boys were more likely than girls to have mental retardation. Older mothers were more likely than younger mothers to have a child with mental retardation accompanied by another neurological condition. High birth order, Black race, and low maternal education were associated with a higher prevalence of isolated mental retardation.

Conclusions. These findings suggest that sociodemographic risk factors for mental retardation vary according to the presence of other neurological conditions and that subdivisions based on medical or physical criteria may be useful in epidemiologic studies of mental retardation. (*Am J Public Health.* 1995;85:329–334)

Introduction

Previous studies have consistently shown that individuals of low socioeconomic status are overrepresented among those with mild mental retardation (i.e., those having an intelligence quotient [IQ] of 50 to 70).[1–9] Some investigators have even suggested that mild mental retardation rarely occurs among individuals from the upper socioeconomic groups unless other underlying neurological conditions are present.[2,7–9] In contrast, a relationship between severe mental retardation (i.e., an IQ of less than 50) and socioeconomic status has not been consistently found.[10–15] One plausible explanation for the observed differences in the effect of socioeconomic factors on the occurrence of mild and severe mental retardation is that they are different entities.[1–9,15]

Defining subtypes of mental retardation on the basis of IQ level alone may not be the best method of distinguishing between those types of mental retardation that are related to socioeconomic status and those that are not. Distinguishing subgroups of mental retardation on the basis of an IQ level of 50 is somewhat arbitrary.[16,17] Further, a single cause of mental retardation, such as Down syndrome, may result in both mild and severe mental retardation.[18] Thus, in etiological studies, categorizing mental retardation according to criteria other than, or in addition to, IQ may be preferable. For example, risk factors for mental retardation may be different for children who also have other developmental disabilities or other neurological conditions and for children who have only mental retardation.[2,3,12,19]

The goal of this study was to investigate the relationship between selected socioeconomic and demographic factors and subgroups of mental retardation. Further, we hoped to identify types of mental retardation with similar epidemiological patterns.

Methods

The data for these analyses are from the Metropolitan Atlanta Developmental Disabilities Study, which included a case–control study of mental retardation among 10-year-old children born in metropolitan Atlanta and living there in 1985 or 1986.[20–22] For this analysis, case children (n = 526) were children with an IQ of 70 or less and were identified by reviewing records at public schools and various health and social service agencies.[22] Control children (n = 650) were randomly selected from a listing of 10-year-old children attending public school in the Atlanta area in 1985 or 1986.[22]

Initially, we used IQ level to divide children with mental retardation into two groups: those with mild mental retardation (defined as an IQ from 50 to 70; n = 379) and those with severe mental retardation (defined as an IQ of less than 50; n = 147). Subsequently, we divided

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Editor's Note. See related editorial by Zigler (p 302) and annotation by Satcher (p 304) in this issue.

TABLE 1—Characteristics of 10-Year-Old Children with Mental Retardation (MR), Metropolitan Atlanta, 1985 through 1986

	Mild MR[a] (n = 330)		Severe MR[b] (n = 128)	
	No.	%	No.	%
Age at first diagnosis, y				
<6	70	21.2	87	68.0
6–7	142	43.0	23	18.0
8–10	118	35.8	18	14.1
IQ				
60–70	200	60.6	...	...
50–59	130	39.4	...	...
35–49	...	...	76	59.4
≤34	...	...	52	40.6
Other neurological conditions				
None	273	82.7	43	33.6
≥1	57	17.3	85	66.4

[a]IQ of 50 to 70.
[b]IQ of less than 50.

case children on the basis of whether or not they were known to have one or more other neurological conditions. The selected other neurological conditions included the other developmental disabilities ascertained in this study[20] (i.e., cerebral palsy, epilepsy, hearing impairment, and visual impairment) and structural, chromosomal, or metabolic birth defects affecting the central nervous system (CNS). We identified other neurological conditions by reviewing all available medical records of children with mental retardation, including records of those children in the Metropolitan Atlanta Congenital Defects Program.[23] The Appendix lists all of the CNS birth defects and developmental disabilities found among the case children in this study. We defined isolated mental retardation as mental retardation that existed in children who were not known to have any of these other neurological conditions. None of the control children had any of the neurological conditions included in our definition.

We abstracted information on sex, maternal age, birth order, maternal race, and maternal education from birth certificates. We estimated family economic status from census data.[22,24] We excluded from the analyses 155 children (49 children with mild mental retardation, 19 children with severe mental retardation, and 87 control children) whose records were missing information on any of the study variables other than birth order. Thus, our final sample consisted of 458 children with mental retardation and 563 control children.

To estimate the strength of relationships with mental retardation, we used exposure odds ratios (ORs) and 95% confidence intervals (CIs) computed by logistic regression.[25,26] All variables were entered into these models as bivariate indicator variables,[22] and the same control group was used in all analyses. We included all variables in all regression models. We did not use either backward or forward selection to identify variables to be included.

Results

Children with severe mental retardation tended to have been diagnosed earlier than children with mild mental retardation (Table 1). Most (n = 316) of the children with mental retardation were not known to have another neurological condition, but such conditions were strongly associated with level of mental retardation. Two thirds (n = 85) of the children with severe mental retardation, but less than 20% (n = 57) of the children with mild mental retardation, were known to have another neurological condition. Moreover, among children with other neurological conditions, those with severe mental retardation were more likely than those with mild mental retardation to have multiple neurological conditions. For example, among children with at least one other neurological condition, only 9% of the children with mild mental retardation, compared with 53% of the children with severe mental retardation, had two or more such conditions (data not shown).

Table 2 displays adjusted odds ratios for each of the six study variables when cases were divided into two groups according to IQ. Boys, children with two or more older siblings, Black children, and children whose mothers had not completed high school were more likely to have both mild and severe mental retardation than were girls, firstborn children, White children, and children with college-educated mothers. Older maternal age was associated with an increased prevalence of severe mental retardation; low economic status was associated primarily with mild mental retardation.

The contrast between subgroups of children was even more pronounced when children with mental retardation were subdivided into two groups based on the presence of other neurological conditions. For example, the odds ratio for race was 1.8 for mild mental retardation and 1.4 for severe mental retardation; the odds ratio for race was 2.3 for isolated mental retardation and 0.9 for mental retardation with other neurological conditions. High birth order and low maternal education were also associated predominantly with isolated mental retardation. On the other hand, older maternal age was associated with an increased prevalence of mental retardation that was accompanied by other neurological conditions, but not with isolated mental retardation.

Table 3 shows the relationship between mental retardation and the six study variables when case children were divided into four groups on the basis of both IQ score and the presence of other neurological conditions. With few exceptions, the patterns seen in Table 2 when cases were subdivided by the presence of other neurological conditions held within the two IQ levels of mental retardation. Specifically, boys were more likely than girls to be in each of the four case groups. High birth order, Black race, and low maternal education were associated primarily with isolated mental retardation, regardless of IQ level. Older maternal age was associated with both mild and severe mental retardation when other neurological conditions were present. The latter finding was not due to the presence of children with Down syndrome among those with other neurological conditions, because the strength of these associations was essentially unchanged after children with Down syndrome were removed from the analysis (OR = 1.8 for mild mental retardation and 2.1 for severe mental retardation). In addition, none of the findings in Table 3 are due to confounding by birthweight. Neither limiting our analyses to children with normal birthweights

TABLE 2—Adjusted Odds Ratios between Sociodemographic Characteristics and Mental Retardation (MR) among 10-Year-Old Children: Divided First by IQ and Then by the Presence of Other Neurological Conditions

	Control Children, % (n = 563)	Children with MR, Divided by IQ Level				Children with MR, Divided by the Presence of Other Neurological Conditions			
		Mild MR[a] (n = 330)		Severe MR[b] (n = 128)		Isolated MR (n = 316)		MR with Other Neurological Conditions[c] (n = 142)	
		%	OR (95% CI)[d]	%	OR (95% CI)[d]	%	OR (95% CI)[d]	%	OR (95% CI)[d]
Sex									
Male	47.4	60.3	1.6 (1.2, 2.2)	59.4	1.7 (1.1, 2.5)	60.4	1.7 (1.2, 2.3)	59.2	1.6 (1.1, 2.4)
Female	52.6	29.7	1.0	40.6	1.0	39.6	1.0	40.8	1.0
Maternal age, y									
<20	21.0	26.1	0.8 (0.5, 1.2)	21.1	1.0 (0.6, 1.9)	28.5	0.9 (0.6, 1.3)	16.2	0.7 (0.4, 1.3)
20–29	61.5	57.9	1.0	49.2	1.0	56.6	1.0	52.8	1.0
≥30	17.6	16.1	0.9 (0.6, 1.4)	29.7	1.8 (1.1, 3.1)	14.9	0.8 (0.5, 1.3)	31.0	2.0 (1.2, 3.3)
Birth order									
1st	41.2	35.1	1.0	31.3	1.0	34.5	1.0	33.1	1.0
2nd	37.7	28.8	1.0 (0.7, 1.4)	32.0	1.1 (0.7, 1.9)	28.5	1.1 (0.7, 1.4)	32.4	1.0 (0.6, 1.5)
≥3rd	21.1	36.1	1.6 (1.1, 2.5)	36.7	1.7 (0.9, 3.1)	37.0	1.9 (1.2, 2.9)	34.5	1.2 (0.7, 2.2)
Race									
Black	47.4	70.3	1.8 (1.3, 2.6)	60.9	1.4 (0.9, 2.3)	74.7	2.3 (1.6, 3.3)	52.1	0.9 (0.6, 1.4)
White	52.6	29.7	1.0	39.1	1.0	25.3	1.0	47.9	1.0
Economic status									
Low	34.8	56.7	1.6 (1.0, 2.5)	48.4	1.1 (0.6, 2.0)	58.5	1.4 (0.8, 2.2)	45.1	1.6 (0.9, 3.0)
Middle	33.0	29.4	1.4 (0.9, 2.3)	24.2	0.8 (0.5, 1.4)	27.5	1.3 (0.8, 2.0)	28.9	1.2 (0.7, 2.0)
High	32.1	13.9	1.0	27.3	1.0	13.9	1.0	26.1	1.0
Maternal education, y									
<12	27.7	53.6	4.1 (2.4, 6.9)	39.1	1.7 (0.9, 3.2)	55.7	4.9 (2.8, 8.5)	35.9	1.6 (0.9, 3.0)
12	43.5	36.7	1.8 (1.1, 2.9)	39.8	1.2 (0.7, 2.0)	36.4	2.1 (1.2, 3.4)	40.1	1.1 (0.7, 1.9)
>12	28.8	9.7	1.0	21.1	1.0	7.9	1.0	23.9	1.0

[a]IQ of 50 to 70.
[b]IQ of less than 50.
[c]Other neurological conditions include cerebral palsy, epilepsy, hearing impairment, visual impairment, and structural, chromosomal, and metabolic birth defects affecting the central nervous system.
[d]Odds ratios (ORs) and 95% confidence intervals (CIs) were computed by a logistic regression model that included all six study variables.

(i.e., ≥ 2500 g) nor adjusting for birthweight (< 2500 g vs ≥ 2500 g) changed the observed patterns.

Discussion

Like other investigators, we found differences in the influence of sociodemographic variables on the prevalence of mild and severe mental retardation.[1–15] In our data, Black race and low level of maternal education were associated primarily with mild mental retardation. Older maternal age, on the other hand, was associated only with severe mental retardation. These distinctions, however, were accentuated when case children were subdivided according to the presence or absence of other neurological conditions. Epidemiological patterns for isolated mild mental retardation were similar to those of isolated severe mental retardation, and mild mental retardation with other neurological conditions was epidemiologically similar to severe mental retardation with other neurological conditions.[3,12] Our data support the notion that there are at least two distinct types of mental retardation. These types could correspond to isolated mental retardation, which is primarily influenced by sociodemographic factors, and mental retardation with other neurological conditions, which is primarily influenced by biological or pathological factors.[1,4,5,27]

These findings have led us, and others, to hypothesize that there are at least two populations with distinct IQ distributions.[5,27] The larger population, consisting of people without substantial CNS damage, would have a bell-shaped IQ distribution with a mean of 100. The second, smaller population would include people with substantial CNS damage and would have an IQ distribution with a much lower mean IQ. However, one cannot use an IQ score (say 50) to completely separate people with CNS damage from those without such damage because the tails of these distributions would overlap.[27]

The strong association that we found between selected sociodemographic factors, such as birth order, race, and maternal education, and isolated severe mental retardation is noteworthy and may be surprising to some investigators who have grouped mental retardation cases solely on the basis of IQ score. Thus, when all children with an IQ of less than 50 are grouped together in epidemiological studies, variables that are associated with isolated severe mental retardation may be masked by the lack of such relationships among the majority of children with severe mental retardation who also have other neurological conditions. Further, these data suggest that sociodemographic factors may shift the entire IQ curve when there is no obvious biological evidence of CNS damage.[3,28] These shifts could result from a variety of potential biases in IQ

TABLE 3—Adjusted Odds Ratios between Sociodemographic Characteristics and Mental Retardation (MR) among 10-Year-Old Children: Divided by Both IQ and the Presence of Other Neurological Conditions

	Isolated Mild MR[a] (n = 273)		Mild MR[a] with Other Neurological Conditions[b] (n = 57)		Isolated[a] Severe MR[c] (n = 43)		Severe MR[c] with Other Neurological Conditions[b] (n = 85)	
	%	OR (95% CI)[d]	%	OR (95% CI)[d]	%	OR (95% CI)[d]	%	OR (95% CI)[d]
Sex								
Male	60.8	1.7 (1.2, 2.3)	57.9	1.5 (0.9, 2.7)	58.1	1.5 (0.8, 2.9)	60.0	1.7 (1.1, 2.8)
Female	39.2	1.0	42.1	1.0	41.9	1.0	40.0	1.0
Maternal age, y								
≤20	27.8	0.8 (0.5, 1.2)	17.5	0.5 (0.2, 1.3)	32.6	1.4 (0.6, 3.5)	15.3	0.8 (0.4, 1.8)
20–29	58.2	1.0	56.1	1.0	46.5	1.0	50.6	1.0
≥30	13.9	0.7 (0.4, 1.2)	26.3	1.9 (0.9, 4.1)	20.9	1.3 (0.5, 3.3)	34.1	2.0 (1.1, 3.7)
Birth order								
1st	35.2	1.0	35.1	1.0	30.2	1.0	31.8	1.0
2nd	27.8	1.0 (0.7, 1.5)	33.3	0.9 (0.4, 1.8)	32.6	1.5 (0.6, 3.6)	31.8	1.0 (0.5, 1.8)
≥3rd	37.0	1.9 (1.2, 3.0)	31.6	0.9 (0.4, 2.2)	37.2	2.2 (0.8, 6.2)	36.5	1.5 (0.7, 3.1)
Race								
Black	73.6	2.1 (1.4, 3.1)	54.4	0.9 (0.4, 1.7)	81.4	3.8 (1.5, 9.5)	50.6	1.0 (0.5, 1.7)
White	26.4	1.0	45.6	1.0	18.6	1.0	49.4	1.0
Economic status								
Low	58.2	1.5 (0.9, 2.5)	49.1	2.2 (0.9, 5.6)	60.5	0.7 (0.3, 1.8)	42.4	1.3 (0.6, 2.8)
Middle	28.9	1.5 (0.9, 2.4)	31.6	1.6 (0.7, 3.7)	18.6	0.5 (0.2, 1.4)	27.1	1.0 (0.5, 1.9)
High	12.8	1.0	19.3	1.0	20.9	1.0	30.6	1.0
Maternal education, y								
<12	56.0	4.9 (2.7, 8.7)	42.1	2.7 (1.0, 6.9)	53.5	4.9 (1.2, 19.9)	31.8	1.2 (0.6, 2.5)
12	35.9	2.0 (1.2, 3.4)	40.4	1.5 (0.6, 3.4)	39.5	2.8 (0.7, 10.5)	40.0	1.0 (0.5, 1.8)
>12	8.1	1.0	17.5	1.0	7.0	1.0	28.2	1.0

[a]IQ of 50 to 70.
[b]Other neurological conditions include cerebral palsy, epilepsy, hearing impairment, visual impairment, and structural, chromosomal, and metabolic birth defects affecting the central nervous system.
[c]IQ of less than 50.
[d]Odds ratios (ORs) and 95% confidence intervals (CIs) were computed by a logistic regression model that included all six study variables.

testing and referral, as well as exposure to causal factors.[22]

Our findings also support the notion that isolated mild mental retardation rarely occurs among children from higher socioeconomic groups unless the child has sustained some biological damage.[2,7–9] In our data, only 8 (3%) of the 273 children with isolated mild mental retardation lived in census block groups with the highest median incomes and had mothers with more than 12 years of education.

Economic status was associated with isolated mental retardation in crude analyses, but this association was not strong after we controlled for maternal education. This finding may reflect limitations in our method of measuring economic status (i.e., estimating it from the median income of families in a neighborhood rather than by measuring it for each of the individual families).[22] Alternatively, characteristics of the child's home environment that are related to cognitive development, such as child-rearing practices, may be somewhat independent of economics.[29]

Older maternal age (≥30 years) was associated with mental retardation that coexisted with other neurological conditions. This finding was not due to the known relationship between older maternal age and Down syndrome, since removing children with Down syndrome from the analysis had little impact on our results. Thus, in addition to known chromosomal anomalies, other underlying biological causes of mental retardation accompanied by other neurological conditions may be associated with older maternal age.

The consistency of the association between mental retardation and sex across IQ levels and across categories defined by the presence of other neurological conditions is striking. Studies based on subjects with mental retardation identified through service providers have consistently shown boys to have a higher prevalence of mental retardation than girls.[2,7,12,30–34] Some investigators attribute the higher number of cases of mild mental retardation among boys to sex-based differences in testing and referral patterns.[35] Studies such as the Collaborative Perinatal Project, which tested all children from a defined cohort, have found sex-related differences in the prevalence of severe mental retardation but not in the prevalence of mild mental retardation.[9] The sex-related differences in severe mental retardation may be partly attributed to an excess of sex-linked disorders such as fragile X syndrome among boys.[32,36]

One should be cautious in using our results to estimate the influence of sociodemographic factors on the *risk* of mental retardation, because they are based on prevalence data and because we identified case children by reviewing existing records.[21,22] Differences in prevalence rates of mental retardation among 10-year-old children may reflect differential losses from the birth cohort caused by emigration or mortality. Further, given the method through which case children were identified, the prevalence of mental retardation, especially isolated mild mental retardation, may be affected by biases in

referral and placement practices.[21,22,35] However, the educational and racial differences that we observed for isolated severe mental retardation are unlikely to be related to differential diagnostic and referral patterns, because severe mental retardation is unlikely to remain undiagnosed even when no other neurological conditions are present.[5]

Finally, our results should not be interpreted as suggesting that this classification scheme is optimal for epidemiological studies of mental retardation. It would be preferable to study the epidemiology of mental retardation that results from a specific etiology. Adequate numbers of such cases, however, may rarely be available, and the etiology of mental retardation remains unknown for the majority of cases in many series.[30,37] In addition, in the present study, children with diagnoses such as fragile X syndrome may be misclassified as having isolated mental retardation because this condition was not well known or diagnosed among children born in the mid-1970s. Even so, we found striking differences in risk factors for isolated mental retardation and mental retardation accompanied by other neurological conditions. Thus, we believe that more epidemiologically homogeneous subgroups of persons with mental retardation can be identified by means of biological criteria, such as the presence or absence of other neurological conditions, than by IQ score alone. □

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References

1. Penrose LS. *Biology of Mental Defect.* London, England: Sidgwick & Jackson Ltd; 1963.
2. Birch HG, Richardson SA, Baird D, Horobin G, Illsley R. *Mental Subnormality in the Community: A Clinical and Epidemiologic Study.* Baltimore, Md: Williams & Wilkins; 1970.
3. Broman S, Nichols PL, Shaughnessy P, Kennedy W. *Retardation in Young Children: A Developmental Study of Cognitive Deficit.* Hillsdale, NJ: Lawrence Erlbaum Associates; 1987.
4. Lewis EO. Report on an investigation into the incidence of mental deficiency in six areas, 1925–1927. Part 4. *Report of the Mental Deficiency Committee.* London, England: His Majesty's Stationery Office; 1929.
5. Kushlick A, Blunden R. The epidemiology of mental subnormality. In: Clarke AM, Clarke ADB, eds. *Mental Deficiency: The Changing Outlook.* New York, NY: Macmillan; 1974:31–81.
6. Kiely M. The prevalence of mental retardation. *Epidemiol Rev.* 1987;9:194–218.
7. Stein Z, Susser M. The families of dull children and classification for predicting careers. *Br J Prev Soc Med.* 1960;14:83–88.
8. Stein Z, Susser M. Families of dull children. II. Identifying family types and subcultures. III. Social selection by family type. IV. Increments in intelligence. *J Ment Sci.* 1960;106:1296–1319.
9. Stein Z, Susser M. The social distribution of mental retardation. *Am J Ment Def.* 1963;67:811–821.
10. Cooper B, Lackus B. The social class background of mentally retarded children: a study in Mannheim. *Soc Psychiatry.* 1984;19:3–12.
11. Bayley M. *Mental Handicap and Community Care: A Study of Mentally Handicapped People in Sheffield.* London, England: Routledge & Kegan Paul; 1973.
12. Drillien CM, Jameson S, Wilkinson EM. Studies in mental handicaps, part 1: prevalence and distribution by clinical type and severity of defect. *Arch Dis Child.* 1966;41: 528–538.
13. Martindale A. The distribution of the mentally handicapped between districts of a large city. *Br J Ment Subnormality.* 1980;26:9–20.
14. Rantakallio P. Social class differences in mental retardation and subnormality. *Scand J Soc Med.* 1987;15:63–66.
15. Fryers T. *The Epidemiology of Severe Intellectual Impairment.* London, England: Academic Press; 1984.
16. Cooper B, Liepmann MC, Marker KR, Schieber PM. Definition of severe mental retardation in school-age children: findings of an epidemiologic study. *Soc Psychiatry.* 1979;14:197–205.
17. Lipkin PH. Epidemiology of the developmental disabilities. In: Capute A, Accardo PJ, eds. *Developmental Disabilities in Infancy and Childhood.* Baltimore, Md: Paul H. Brookes Publishing Co; 1991.
18. Carr J. *Young Children with Down's Syndrome.* London, England: Butterworths; 1975.
19. Robinson RO. Associated handicap and mild mental retardation. *Ups J Med Sci Suppl.* 1987;44:99–102.
20. Yeargin-Allsopp M, Murphy CC, Oakley GP, Sikes RK, The Metropolitan Atlanta Developmental Disabilities Study Staff. A multiple-source method for studying the prevalence of developmental disabilities in children: the Metropolitan Atlanta Developmental Disabilities Study. *Pediatrics.* 1992;89:624–630. [Published erratum appears in *Pediatrics.* 1992;90:1001.]
21. Murphy CC, Yeargin-Allsopp M, Decouflé P, Drews CD. The administrative prevalence of mental retardation in 10-year-old children in metropolitan Atlanta, 1985 through 1987. *Am J Public Health.* 1995;85: 319–323.
22. Yeargin-Allsopp M, Drews CD, Decouflé P, Murphy CC. Mild mental retardation in Black and White children in metropolitan Atlanta: a case–control study. *Am J Public Health.* 1995;85:324–328.
23. Edmonds LD, Layde PM, James LM, Flynt JW, Erickson JD, Oakley GP Jr. Congenital malformations surveillance: two American systems. *Int J Epidemiol.* 1981;10:247–252.
24. *Census Use Study: Health Information System-II.* Washington, DC: US Dept of Commerce, Bureau of the Census; 1971. Report no. 12.
25. Harrell FE Jr. The LOGIST procedure. In: *SUGI Supplemental Library User's Guide.* Version 5 ed. Cary, NC: SAS Institute Inc; 1986:269–293.
26. Kleinbaum DG, Kupper LL, Morgenstern H. *Epidemiologic Research: Principles and Quantitative Methods.* Belmont, Calif: Lifetime Learning Publications; 1982.
27. Zigler E. Familial mental retardation: a continuing dilemma. *Science.* 1967;155:292–298.
28. Broman SH, Nichols PL, Kennedy WA. *Preschool IQ: Prenatal and Early Developmental Correlates.* Hillsdale, NJ: Lawrence Erlbaum Associates; 1975.
29. Scarr S. *IQ, Race, Social Class and Individual Differences.* Hillsdale, NJ: Lawrence Erlbaum Associates; 1981.
30. McLaren J, Bryson SE. Review of recent epidemiologic studies of mental retardation: prevalence, associated disorders and etiology. *Am J Ment Retard.* 1987;92:243–254.
31. Munro JD. Epidemiology and the extent of mental retardation. Psychiatric perspectives on mental retardation. *Psychiatr Clin North Am.* 1986;9:591–624.
32. Baird PA, Sadovnik AD. Mental retardation in over half-a-million consecutive live births: an epidemiological study. *Am J Ment Defic.* 1985;89:323–330.
33. Richardson SA, Katz M, Koller H. Sex differences in number of children administratively classified as mildly mentally retarded: an epidemiological review. *Am J Ment Defic.* 1986;91:250–256.
34. Innes G, Kidd C, Ross HS. Mental subnormality in North East Scotland. *Br J Psychiatry.* 1968;114:35–41.
35. Mercer JR. *Labeling the Mentally Retarded.* Berkeley, Calif: University of California Press; 1973.
36. Herbst DS, Miller JR. Nonspecific X-linked mental retardation, II: the frequency in British Columbia. *Am J Med Genet.* 1980;7:461–469.
37. Abramowicz HK, Richardson ST. Epidemiology of severe mental retardation in children: community studies. *Am J Ment Defic.* 1975;80:18–39.

Continued

APPENDIX—Number of Children with Mental Retardation (MR) and Other Specific Neurological Conditions

Other Neurological Conditions	Mild MR[a] (n = 330)	Severe MR[b] (n = 128)
None	273	43
Epilepsy	21	49
Cerebral palsy	13	35
Visual impairment	3	12
Hearing impairment	3	3
Hydrocephaly	6	8
Microcephaly	9	18
Other anomalies of the central nervous system		
Hydranencephaly	0	1
Klippel-Feil syndrome with holoprosencephaly	0	2
Porencephaly/hydrocephaly	0	1
Spina bifida	2	2
Hypothyroidism	1	0
Down syndrome	6	18
Cri-du-chat syndrome	0	1
Fragile X syndrome	1	0

Note. Numbers in columns may not add up to total n's because children may have more than one condition.
[a]IQ of 50 to 70.
[b]IQ of less than 50.