Using the Risk Ratio to Assess Racial/Ethnic Disproportionality in Special Education at the School-District Level

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The issue of the disproportionate identification and placement of racial/ethnic minorities in special education has been investigated extensively. One of the most useful tools in this research is the risk ratio, which compares one racial/ethnic group's risk of receiving special education and related services to that of all other students. The risk ratio can be used to calculate disproportionality at both the state and school-district levels. However, analysts often encounter difficulties in applying the risk ratio to district-level data due to variable demographic distributions and small numbers of students in either the racial/ethnic group or the comparison group. We propose two modifications to the risk ratio for dealing with these problems.

Racial/ethnic disproportionality in special education has been an issue of concern for more than 30 years. This issue was first brought to the forefront by Dunn (1968), who noted that approximately 60% to 80% of the students being taught by teachers in mild mental retardation classes that year were minority students from low socioeconomic backgrounds. Since that time, research examining disproportionality has consistently found that some racial/ethnic minorities are overrepresented in special education, while others are underrepresented (e.g., Heller, Holtzman, & Messick, 1982; Losen & Orfield, 2002; National Research Council, 2002). Specifically, Black students tend to be overrepresented in the mental retardation (MR) and emotional disturbance (ED) disability categories. Moreover, the overrepresentation is not isolated to a handful of states, but is widespread in many states across the country (Westat, 2003). In addition, there tends to be widespread underrepresentation of Asian/Pacific Islander students at the state level in many of the disability categories.

The disproportionate representation of certain racial/ethnic groups in special education is problematic for several reasons. Overrepresentation suggests that assessment procedures are not applied equally to all racial/ethnic groups, leading to some groups being inappropriately identified for special education (Heller et al., 1982). Furthermore, there are concerns about the detrimental effects of labeling and the tendency for certain racial/ethnic groups, specifically Black students, to be placed in more restrictive special education environments than those in which their peers are placed (Serwatka, Deering, & Grant, 1995). Underrepresentation is problematic when certain racial/ethnic groups are not being identified for special education and therefore are not receiving the services they need to help them achieve positive educational outcomes. Hence, both forms of disproportionality—overrepresentation and underrepresentation—suggest the likelihood that the educational needs of children of affected racial and ethnic backgrounds are not being met.

As a step toward ensuring that all students, regardless of race/ethnicity, receive an appropriate education, the Individuals with Disabilities Education Improvement Act of 2004 (IDEIA) requires that states

> provide for the collection and examination of data to determine if significant disproportionality is occurring within the State and the local educational agencies of the State with respect to the identification of children as children with disabilities…and the placement in particular educational settings of such children. (20 U.S.C. § 1418(d)(1))

Although IDEIA 2004 instructs states to collect and analyze both state- and district-level disproportionality data, it does not instruct them on how to analyze these data.

The problem of disproportionate representation in special education is very complex and most likely results from numerous factors functioning both separately and jointly (see National Research Council, 2002, for a discussion of some of these factors). In our view, the logical first step toward learning more about the causative factors of disproportionality is to be able to effectively measure and assess where disproportionality is occurring at both the state and district levels. It is

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only then that the problem of disproportionality can begin to be fully understood and potential solutions can be developed to ensure that students of all racial/ethnic backgrounds receive an appropriate education.

In response to these concerns, the Office of Special Education Programs (OSEP) convened a task force to develop methodologies for assisting states in reporting data on disproportionality. This task force met in 2003 and 2004 to review and discuss issues and potential approaches, culminating in a set of guidelines and recommendations (Westat, 2003, 2004) that have been available to state agencies and researchers in monograph form, but have not been published in the literature. This article consolidates and expands these guidelines.

Thus, the purposes of our research are twofold. First, we discuss the risk ratio as a measure of disproportionality and describe some of the challenges that may be faced when using this method to assess disproportionality at the local level. Second, we suggest two modifications to the risk ratio, along with some guidelines, to address these challenges.

The Risk Ratio as a Measure of Disproportionality

A variety of measures have been used to assess racial/ethnic disproportionality in the field of special education (Coutinho & Oswald, 2000; Hosp & Reschly, 2003; National Research Council, 2002). The more common measures are composition, risk, and the risk ratio. Sometimes these measures are used alone; other times, two or more measures are used in combination because each of these measures represents a different way of reporting the same data and each answers a different question about racial/ethnic representation in special education.

The first measure is a calculation of the racial/ethnic composition of a given disability category (e.g., the percentage of the category that is Black). Composition answers the question, What percentage of students receiving special education and related services for a particular disability are from a specific racial/ethnic group? To assess disproportionality, the racial/ethnic composition of the disability category is typically compared to the racial/ethnic composition of the total student enrollment to determine whether they are similar.

Risk measures the probability that students of a given racial/ethnic group will be identified as having a particular disability. Risk answers the question, What percentage of students from a specific racial/ethnic group receive special education and related services for a particular disability? To assess disproportionality, the risk for a particular racial/ethnic group must be compared to the risk for a comparison group. Typically, this comparison is made using a risk ratio.

The risk ratio compares a racial/ethnic group's risk of receiving special education and related services to the risk for a comparison group. It answers the question, What is a specific racial/ethnic group's risk of receiving special education and related services for a particular disability as compared to the risk for all other students?

The equation for the risk ratio is as follows:

$$\text{Risk ratio} = \frac{\text{Risk for racial/ethnic group}}{\text{Risk for comparison group}}$$

For example, to calculate the risk ratio for Black students for the MR disability category, the risk for Black students for MR is divided by the risk for all other students (i.e., all students who are not Black) for MR. The equation is as follows:

$$\text{Risk ratio} = \frac{\text{Risk for Black students for MR}}{\text{Risk for comparison group for MR}}$$

$$= \frac{\text{Black students in MR category} \div \text{All Black students}}{\text{All other students in MR category} \div \text{All other students}}$$

A risk ratio of 1.00 indicates no difference between the racial/ethnic group and the comparison group. In other words, the racial/ethnic group is no more likely than are students from all other racial/ethnic groups to receive special education and related services for a particular disability. A risk ratio greater than 1.00 indicates that the risk for the racial/ethnic group is greater than the risk for the comparison group is, whereas a risk ratio less than 1.00 indicates that the risk for the racial/ethnic group is less than the risk for the comparison group is.

The advantage of the risk ratio over other measures is that it is easier to interpret when used alone. For example, the risk index for one racial/ethnic group is only meaningful when compared with risks for other groups, since there is no established norm for risk of disability, and there tends to be a correlation between risk of identification for different demographic groups, at least when state-level data are considered (Westat, 2003). Similarly, the racial/ethnic composition of the disability category must be compared with the underlying demographic distribution to assess the extent of disproportionality. The risk ratio provides a unitless measure that can be evaluated without reference to other data.

It must be noted that "all other students" is not the only possible choice of comparison group. Some researchers prefer using "White students" as the comparison group. These researchers assert that White students should be used as the comparison group because Whites are the majority racial/ethnic group in the country, and discriminatory behavior is generally based on a comparison of practices with respect to individuals who are White (Coutinho & Oswald, 2000). As a general rule, there is little difference between risk ratios calculated with "White students" and "all other students" as denominators (Westat, 2003), particularly at the state level. However, this is not necessarily the case. For example, the National Center for Culturally Responsive Education Systems (NCCRESt) has demonstrated that sometimes the choice of denominator can make somewhat of a difference in findings

of disproportionality (Kozleski, 2005), particularly when calculating risk ratios for Black students in the southern states. Using "all other students" as the comparison group, however, enables risk ratios to be calculated for all racial/ethnic groups and allows the risk ratios to be calculated in the same manner for all racial/ethnic groups. Furthermore, risk ratios can be calculated in states or districts with diverse racial/ethnic distributions, including those with homogeneous distributions and those without a clear racial/ethnic majority.

Application of the Risk Ratio to State-Level Data

Using child count data (i.e., state-reported counts of students ages 6 through 21 receiving special education and related services under Part B of IDEIA) and student enrollment data from academic year 2001–2002, we calculated state-level risk ratios by race/ethnicity for three states for the MR category (see Note 1). While the states cannot be identified for confidentiality reasons, all are relatively populous states and represent a range of racial/ethnic student populations. State A has a fairly large population of Black students; the racial/ethnic distribution of this state is approximately 60% White students; 30% Black students; and 10% students from other racial/ethnic groups, including American Indian/Alaska Native, Asian/Pacific Islander, and Hispanic students. State B has a more multiracial student population with substantial populations of Black students (around 15%) and Hispanic students (around 15%); the remainder of the student population is composed mainly of White students (around 65%) and small percentages of students from other racial/ethnic groups (around 5%). State C has a large population of Hispanic students; the racial/ethnic distribution of this state is approximately 50% White students, 35% Hispanic students, and 15% students from other racial/ethnic groups.

According to the risk ratios in Table 1, Black students in State A are 3.02 times as likely as all other students are to receive special education and related services for MR. In State B, they are 2.55 times as likely, and in State C, they are 1.95 times as likely. Hispanic students are 0.63 times as likely as all other students in State A are to receive special education and related services for MR, but in State B they are 1.72 times as likely, and in State C they are 1.20 times as likely as all other students are to receive special education and related services for MR. The risk ratios for the other racial/ethnic groups, including American Indian/Alaska Native, Asian/Pacific Islander, and White students, are presented in Table 1 (see Note 2).

Application of the Risk Ratio to District-Level Data

Calculating risk ratios at the state level is fairly straightforward. However, assessing disproportionality at the state level is only a first step in addressing racial/ethnic disproportionality. States must also assess disproportionality at the local level to understand where disproportionality is occurring within the state. Furthermore, IDEIA requires that states collect and examine data to determine if significant disproportionality based on race/ethnicity is occurring in the state and the local educational agencies of the state (20 U.S.C. 1418 (d)(1)). Therefore, in addition to needing a method for assessing disproportionality at the state level, states also need a viable method for assessing disproportionality at the school-district level.

Unfortunately, assessing racial/ethnic disproportionality at the district level can prove challenging. School districts vary substantially with regard to student enrollment, special education identification rates, and racial/ethnic demographics. Tables 2 through 4 present district-level data on student enrollment and MR child count by race/ethnicity for States A, B, and C.

In State A, there are 133 districts with widely varying numbers of enrolled students by race/ethnicity. For example, the number of enrolled Black students ranges from 0 to 24,929, with a median of 702, and the number of Black students in the MR category ranges from 0 to 896, with a median of 17. State B has 169 districts, with enrollment again varying substantially by race/ethnicity; for example, the Hispanic enrollment ranges from 0 to 11,781, with a median of 42, and the MR child count ranges from 0 to 120, with a median of 0. Finally, State C has 432 districts, with Hispanic enrollment, for example, ranging from 0 to 29,256, with a median of 57, and MR child count ranging from 0 to 295, with a median of 0.

TABLE 1. Risk Ratios for States A, B, and C for Mental Retardation by Race/Ethnicity

State	American Indian/ Alaska Native	Asian/ Pacific Islander	Black (not Hispanic)	Hispanic	White (not Hispanic)
A[a]	0.27	0.36	3.02	0.63	0.43
B[b]	1.34	0.42	2.55	1.72	0.41
C[c]	1.22	0.55	1.95	1.20	0.70

[a]In State A, the primary racial/ethnic groups are White and Black. [b]In State B, the primary racial/ethnic groups are White, Black, and Hispanic. [c]In State C, the primary racial/ethnic groups are White and Hispanic.

Because of variations such as these, risk ratios of similar magnitude from different districts may have different meanings, due to variation in the racial/ethnic demographic distributions. Furthermore, it may not be possible to calculate a risk ratio in some districts due to small numbers of students in the district. We discuss each of these issues in more detail below.

Variations in Demographic Distributions. With unlimited resources, states could target all instances of racial/

TABLE 2. Descriptive Statistics for State A's District-Level Student Enrollment and Mental Retardation (MR) Child Count by Race/Ethnicity

	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
Statistic	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR
Maximum	600	2	27,010	109	24,929	896	23,812	156	87,997	336
95th %ile	100	0	1,080	3	14,025	182	1,760	11	20,142	121
90th %ile	66	0	419	2	5,377	135	843	7	10,127	77
75th %ile	15	0	86	0	1,790	42	178	1	5,203	45
Median	5	0	19	0	702	17	42	0	2,482	17
25th %ile	1	0	6	0	176	2	15	0	1,108	8
10th %ile	0	0	2	0	63	0	6	0	660	4
5th %ile	0	0	1	0	17	0	3	0	383	2
Minimum	0	0	0	0	0	0	0	0	111	0
M	25.4	0.1	397.9	1.4	2,385.4	45.2	539.7	3.4	5,423.8	35.2
SD	69.0	0.3	2,397.3	9.7	4,767.2	96.2	2,314.9	15.1	10,067.4	49.4

Note. State A has 133 districts.

TABLE 3. Descriptive Statistics for State B's District-Level Student Enrollment and Mental Retardation (MR) Child Count by Race/Ethnicity

	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
Statistic	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR
Maximum	116	2	861	4	11,347	295	11,781	120	7,549	55
95th %ile	35	1	319	2	1,914	25	2,363	19	6,169	35
90th %ile	22	0	228	1	1,213	18	950	6	4,948	26
75th %ile	9	0	137	0	137	1	175	1	3,392	14
Median	4	0	37	0	33	0	42	0	1,973	6
25th %ile	1	0	10	0	9	0	12	0	792	3
10th %ile	0	0	3	0	2	0	4	0	327	0
5th %ile	0	0	2	0	1	0	3	0	173	0
Minimum	0	0	0	0	0	0	0	0	71	0
M	9.4	0.1	98.5	0.3	448.3	6.2	451.4	4.6	2,297.9	10.5
SD	16.3	0.4	148.3	0.7	1,463.1	26.2	1,465.9	17.4	1,847.8	11.3

Note. State B has 169 districts.

ethnic disproportionality occurring at the district level. However, because they must face the reality of limited resources, states often need ways of targeting school districts and prioritizing technical assistance. One possible approach is to rank districts and compare them based on the size of their risk ratios.

Comparing risk ratios across districts is problematic, however, because the size of the risk ratio is affected by the district-level racial/ethnic demographics of the comparison group (see Note 3). The risk for the comparison group is jointly influenced by the racial/ethnic composition of the comparison group and the risk for each of those racial/ethnic

TABLE 4. Descriptive Statistics for State C's District-Level Student Enrollment and Mental Retardation (MR) Child Count by Race/Ethnicity

	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
Statistic	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR	Enrollment	MR
Maximum	4,252	39	1,596	10	4,093	86	29,256	295	48,888	409
95th %ile	683	7	173	1	483	10	4,077	36	4,147	34
90th %ile	275	3	52	0	144	3	1,606	14	1,897	15
75th %ile	37	0	9	0	25	0	264	2	390	3
Median	6	0	2	0	6	0	57	0	114	0
25th%ile	1	0	0	0	1	0	12	0	41	0
10th %ile	0	0	0	0	0	0	3	0	8	0
5th %ile	0	0	0	0	0	0	1	0	3	0
Minimum	0	0	0	0	0	0	0	0	0	0
M	137.0	1.4	44.1	0.2	97.6	1.5	740.2	7.0	1,071.3	7.5
SD	456.3	4.8	178.2	1.0	353.1	6.6	2,443.7	26.6	4,024.9	29.5

Note. State C has 432 districts.

TABLE 5. Influence of District Racial/Ethnic Demographics on Calculations of District-Level Risk Ratios: Racial/Ethnic Composition, Risk, and Risk Ratios for Three Fictitious Districts

Demographic	American Indian/ Alaska Native	Asian/ Pacific Islander	Black (not Hispanic)	Hispanic	White (not Hispanic)
Racial/ethnic composition (%)					
District X	0.00	5.00	10.00	35.00	50.00
District Y	0.00	5.00	5.00	80.00	10.00
District Z	0.00	15.00	30.00	15.00	40.00
State overall	1.00	3.00	12.00	14.00	70.00
Risk (%)					
District X	0.00	1.50	4.50	3.00	2.00
District Y	0.00	1.50	4.50	3.00	2.00
District Z	0.00	1.50	4.50	3.00	2.00
Risk ratio					
District X	0.00	0.57	1.91	1.28	0.63
District Y	0.00	0.50	1.60	1.20	0.67
District Z	0.00	0.49	2.14	1.07	0.59

groups. Thus, a racial/ethnic group may have the same risk in two districts, but substantially different risk ratios because of the variability in the district-level racial/ethnic demographic distributions.

To demonstrate this point, we present in Table 5 the racial/ethnic composition of three fictitious districts, along with the risk and risk ratio for each racial/ethnic group. We use fictitious data instead of actual data for this example because we want to create a situation in which the risk for each racial/ethnic group is the same across districts, but the racial/ethnic demographics vary. For example, the risk for Hispanic students is 3.00% in each district, but Hispanic students compose 35% of enrolled students in District X, 80% in District Y, and 15% in District Z. The risk for Black students is 4.50% in each district, but Black students compose 10% of enrolled students in District X, 5% in District Y, and 30% in District Z.

The resulting risk ratios for Hispanic students range from a low of 1.07 in District Z to a high of 1.28 in District X. Moreover, the risk ratios for Black students range from 1.60 in District Y to 2.14 in District Z. Thus, because of the variation in the racial/ethnic demographics of the three districts, the risk ratios for Hispanic students and Black students vary even though the risk for each racial/ethnic group is the same in each district.

Small Numbers of Students. Small numbers of students can also be problematic when both calculating and interpreting risk ratios at the district level. First, small numbers of students in a district may make it impossible to calculate risk ratios for one or more racial/ethnic groups. Specifically, a risk ratio for a particular racial/ethnic group cannot be calculated when there are no students from the comparison group enrolled in the district.

In Table 6, we present selected district-level child count and enrollment data from three school districts in State C. As shown in Table 6, there are 10 American Indian/Alaska Native students with MR in District 1, among 1,323 enrolled American Indian/Alaska Native students. However, there are no students from other racial/ethnic groups enrolled in the district. This means that the risk for the comparison group is impossible to calculate (risk = number of all other students in MR category ÷ number of all other enrolled students = 0 ÷ 0); consequently, a risk ratio for American Indian/Alaska Native students in District 1 cannot be calculated.

A risk ratio for a particular racial/ethnic group also cannot be calculated when there are no students from the comparison group receiving special education and related services in that district. As shown in Table 6, in District 2, there is one Black student with MR. There are 370 students from the other racial/ethnic groups enrolled in the district, but none of them receives special education and related services for MR. Therefore, the risk for the comparison group is zero (risk = 0 ÷ 370), which means that the risk ratio denominator is zero, and a risk ratio cannot be calculated for Black students in District 2.

In addition to problems with calculation, risk ratios are difficult to interpret when based on small numbers of students in either the racial/ethnic group or the comparison group. When risk ratios are based on small numbers, minor variations in the number of students in either the racial/ethnic group or the comparison group can produce dramatic changes in the size of the risk ratio. In District 3, there are 2 American Indian/Alaska Native students, 20 Asian/Pacific Islander students, and 6 Hispanic students, none of whom receives special education and related services for MR; as a result, the risk ratios are zero for each of these racial/ethnic groups (see Table 6). However, the risk ratio for Black students, of whom only one

TABLE 6. Mental Retardation (MR) Child Count, Student Enrollment Data, and Risk Ratios by Race/Ethnicity for Three Districts From State C

District/ data type	American Indian/ Alaska Native	Asian/ Pacific Islander	Black (not Hispanic)	Hispanic	White (not Hispanic)
District 1					
MR child count	10	0	0	0	0
Enrollment	1,323	0	0	0	0
Risk ratio	—	—	—	—	—
District 2					
MR child count	0	0	1	0	0
Enrollment	7	19	39	60	284
Risk ratio	0.00	0.00	—	0.00	0.00
District 3					
MR child count	0	0	1	0	2
Enrollment	2	20	110	6	1,363
Risk ratio	0.00	0.00	6.32	0.00	0.20

receives special education and related services for MR, is 6.32. If just 1 of the 20 enrolled Asian/Pacific Islander students were to begin receiving special education and related services for MR, the risk ratio for Asian/Pacific Islander students would increase from 0 to 24.68.

Table 7 shows this problem in a slightly different way. In the top part of Table 7, the possible values for a risk ratio are presented when the underlying risk is 2.0% for both the racial/ethnic group and the comparison group and when the size of the racial/ethnic group ranges from 5 to 15. For a group size of 15, for example, the risk ratio can range from 0.0 up to 13.3. The former value is the most likely, occurring about 74% of the time, while a risk ratio of 13.3 will occur only 2 times in 10,000. However, notice that the risk ratio will be 3.3 or greater purely by chance in about 23% of districts evaluated, assuming the group size is 15. The overall expected risk ratio is 1.0; however, for any given district evaluated, the risk ratio will be either 0.0 or at least 3.3—that is, for any given district, the risk ratio will be either substantially smaller or substantially greater than 1.0, despite the fact that the racial/ethnic group and the comparison group have the same underlying risk.

This phenomenon is due to the combination of low risk and small number of students in the racial/ethnic group for which the risk ratio is being calculated. The same situation holds when the underlying risk is 1.5% and for all group sizes considered. In fact, the phenomenon is even more pronounced when the group size is 5, with the risk ratio being either 0.0 or as large as 26.7.

Modified Risk Ratio Calculations

To address these potential problems that may be faced when applying the risk ratio to analysis of district-level data, we propose two modifications to the risk ratio calculation. First, to address the limitation of being unable to compare risk ratios across districts due to varying racial/ethnic demographics, we propose calculating a weighted risk ratio. Second, to address problems associated with small numbers at the district level, we propose calculating an alternate risk ratio. We discuss each of these modified risk ratio calculations below. In addition, we recommend some guidelines for calculating risk ratios when there are small numbers of students at the district level.

The Weighted Risk Ratio

As noted earlier, the denominator of the risk ratio (i.e., the risk for all other students) is influenced by the racial/ethnic composition of the comparison group. When racial/ethnic demographics vary substantially from one district to another, the resulting risk ratios are difficult to compare to one another. When calculating district-level risk ratios, we propose using a weighted risk ratio (Greenland & Rothman, 1998). The weighted risk ratio addresses this limitation by standardizing the demographic distribution to match that of the state to which the districts belong. The weighted risk ratio thus allows comparison of risk ratios across districts and enables states to rank districts when deciding how to target technical assistance.

TABLE 7. Evaluation of Risk Ratios for Small Group Sizes

Group size = 15		Group size = 10		Group size = 5	
Probability of occurrence	Risk ratio	Probability of occurrence	Risk ratio	Probability of occurrence	Risk ratio
		Risk of identification = 2.0%			
0.7386	0.0	0.8171	0.0	0.9039	0.0
0.2261	3.3	0.1667	5.0	0.0922	10.0
0.0323	6.7	0.0153	10.0	0.0038	20.0
0.0029	10.0	0.0008	15.0	0.0001	30.0
0.0002	13.3				
Expected risk ratio	1.00	Expected risk ratio	1.00	Expected risk ratio	1.00
SD	4.50	*SD*	6.18	*SD*	11.11
		Risk of identification = 1.5%			
0.7972	0.0	0.8597	0.0	0.9272	0.0
0.1821	4.4	0.1309	6.7	0.0706	13.3
0.0194	8.9	0.0090	13.3	0.0022	26.7
0.0013	13.3	0.0004	20.0		
0.0001	17.8				
Expected risk ratio	1.00	Expected risk ratio	1.00	Expected risk ratio	1.00
SD	5.65	*SD*	7.89	*SD*	14.46

The weighted risk ratio uses the district-level risk for the racial/ethnic group for the numerator and a weighted risk for all other students for the denominator. The weighted risk for all other students uses the district-level risks for each racial/ethnic group in the comparison group, weighted according to the racial/ethnic composition of the state.

For a given racial/ethnic group, *i*, the weighted risk ratio is calculated as follows:

$$\text{Weighted risk ratio} = \frac{R_j}{\sum_{j \neq i} w_j R_j}$$

Note that R_j is the risk for the *i*-th racial/ethnic group, and w_j is the weight for the *j*-th racial/ethnic group. Thus, the denominator is the weighted sum of the risks for students in all racial/ethnic groups other than the *i*-th one. The weights are calculated to sum to 1.0 and to be proportionate to the racial/ethnic composition at the state level. A shorthand calculation can be formulated as follows:

$$w_j = \frac{p_j}{\sum_{k \neq i} p_k} = \frac{p_j}{1 - p_i}$$

Note that *i* reflects the group for which the weighted risk ratio is being calculated, and p_j is the proportion of students in racial/ethnic group *j*. Substituting this into the formula given above, we have the following:

$$\text{Weighted risk ratio} = \frac{R_i}{\sum_{j \neq i} w_j R_j} = \frac{R_i}{\sum_{j \neq i} \frac{p_j}{1-p_i} R_j} = \frac{R_i}{\frac{1}{1-p_i} \sum_{j \neq i} p_j R_j} = \frac{(1-p_i)R_i}{\sum_{j \neq i} p_j R_j}$$

For the data in Table 5, we can calculate the weighted risk ratio for Black students as follows:

$$\text{Weighted risk ratio} = \frac{(1 - 0.12) \times 4.5}{(0.01 \times 0.0) + (0.03 \times 1.5) + (0.14 \times 3.0) + (0.70 \times 2.0)} = 2.12$$

Thus, in District X, Black students are 2.12 times as likely as all other students are to receive special education and related services when the risk ratio is weighted according to the racial/ethnic demographics of the state. This calculation is for District X, but one can easily verify that the weighted risk ratio in this case is 2.12 for Black students in all three districts.

The Alternate Risk Ratio

To address the problem of calculating risk ratios at the district level when there are no students in the comparison group (i.e., the risk for the comparison group cannot be calculated) or when there are no students in the comparison group receiving special education and related services (i.e., the risk for the comparison group is zero), we propose an alternate risk ratio. The alternate risk ratio uses district-level data to calculate the risk for the racial/ethnic group and state-level data to calculate the risk for the comparison group.

The equation of the alternate risk ratio is as follows:

$$\text{Alternate risk ratio} = \frac{\text{District-level risk for racial/ethnic group}}{\text{State-level risk for comparison group}}$$

As an example, we will calculate the risk ratio for American Indian (AI)/Alaska Native (AN) students in District 1 of State C using the data in Table 6. The risk for American Indian/Alaska Native students is calculated by dividing the number of American Indian/Alaska Native students in the MR category in District 1 by the number of enrolled American Indian/Alaska Native students in District 1. The risk for the comparison group is calculated by dividing the number of all other students (i.e., all students who are not American Indian/Alaska Native) in the MR category in State C by the number of all other students enrolled in State C. Thus, the alternate risk ratio can be calculated as follows (see Note 4):

$$\text{Alternate risk ratio} = \frac{\text{District-level risk for AI/AN students for MR}}{\text{State-level risk for comparison group for MR}} = \frac{\text{AI/AN students in MR category} \div \text{All AI/AN students}}{\text{All other students in MR category} \div \text{All other students}} = \frac{10 \div 1{,}323}{0.008} = 0.91.$$

Thus, in District 1, American Indian/Alaska Native students are 0.91 times as likely as all other students in State C are to receive special education and related services for MR.

Guidelines for Calculating Risk Ratios With Small Numbers

We also noted earlier that risk ratios based on small numbers can be highly variable due to minor variations in the numbers of students in either the racial/ethnic group or the comparison group. For this reason, we suggest that risk ratios be calculated only when there are at least 10 students in the racial/ethnic group of interest enrolled in the district.

Moreover, we recommend calculating an alternate risk ratio if there are at least 10 students in the racial/ethnic group but fewer than 10 students in the comparison group enrolled in the district, or if there are no students in the comparison group receiving special education and related services for the disability (i.e., the risk for the comparison group is zero). Finally, because the alternate risk ratio uses state-level data to calculate the risk for the comparison group, we recommend not calculating the alternate risk ratio if there are fewer than 10 students in the comparison group enrolled in the *state*, or if there are no students in the comparison group receiving special education and related services for the disability at the *state level*.

We arrive at a minimum group size of 10 by considering the data presented in Table 7. Table 7 provides a means of evaluating the stability of risk ratios for small groups of students. When evaluating minimum group sizes, there is a tradeoff between the number of districts that are excluded from the analysis (for a large minimum group size) versus the instability of the risk ratios (for a small minimum group size).

Most (if not all) disabilities are rare events, meaning that only a small percentage of students (e.g., 1% or 2%) will be identified as having them. As a result, when analyzing district-level data, many districts will have no students with a given disability (e.g., mental retardation) for racial/ethnic groups with smaller numbers of students; however, if even one student is identified as having a particular disability, the risk ratio can be large, simply because one student represents a large proportion of the students in that racial/ethnic group. Therefore, even when the risk ratio for the state overall is 1.0, most districts will have risk ratios of 0.0 (no students identified), whereas a small number of districts may have quite large risk ratios. This is due to the random distribution of rare events: Relatively few students are identified with disabilities, but when they are, the result is often a large risk ratio for any district in which the students are identified.

Table 7 shows the distributions of risk ratios when the risk of identification is either 2.0% or 1.5% and when the size of the racial/ethnic group ranges from 5 to 15 students, under the assumption that students with disabilities are distributed randomly among the districts. When the group consists of five students, the risk ratio will be 0.0 for about 90% of the districts, since no students will be identified with the disability. In about 9% of the districts, one student will be identified, resulting in a risk ratio of 10.0; there is a very small chance (less than 1%) that two or more students will be identified, yielding risk ratios of 20.0 or greater. When the group size is increased to 10, the proportion of districts with risk ratios of 0.0 decreases to about 82%; in about 17% of the districts, one student would be identified, resulting in a risk ratio of 5.0; in about 1.6% of the districts, two or more students would be identified, and the risk ratio would be 10.0 or greater.

Statistical distributions with rare events, such as disabilities, are difficult to analyze and tend to exhibit the type of instability shown in Table 7, in which risk ratios vary from 0.0 for the great majority of the population to 5.0 or 10.0 for a small number of districts. As the number of students being analyzed increases, the distribution becomes more stable. This can be seen in Table 7 from the standard deviations, which decrease from 11.11 to 6.18 to 4.50 as the group size increases from 5 to 10 to 15. (These numbers are quoted for an underlying risk of 2.0%, but the numbers for an underlying risk of 1.5% are similar.)

However, increasing the minimum group size creates another difficulty in analyzing racial/ethnic groups with low prevalence, such as Asian/Pacific Islander or American Indian/Alaska Native. Because districts often have small numbers of students from these racial/ethnic groups, more districts are excluded from the analysis as the minimum group size increases. For example, looking back to the enrollment data for State A (see Table 2), we see that a minimum group size of 15 would mean eliminating 75% of districts when calculating risk ratios for American Indian/Alaska Native students, almost 50% of districts for Asian/Pacific Islander students, and 25% of districts for Hispanic students.

As far as stability of distributions, most of the decrease in standard deviation occurs between group sizes of 5 and 10, with only a marginal improvement for groups of 15. There is also a slightly wider variation in values that the risk ratio can take on when the group size is 10 rather than 5. The value of 10 for the minimum group size is proposed as a compromise between stability of statistical distributions and the inclusion of as many districts as possible. However, it is important to realize that large risk ratios (conventional or weighted) can still occur even when the minimum group size is 10, particularly when there is only one race/ethnicity in the comparison group. Large risk ratios should always be evaluated to assess the number of enrolled students and students with disabilities that are used in the calculations. When small group sizes yield misleadingly large risk ratios, the alternate risk ratio should be used in place of weighted or conventional risk ratios.

Application of Modified Risk Ratio Calculations

To demonstrate the utility of using the weighted and alternate risk ratios, we examined district-level data for States A, B, and C. Using academic year 2001–2002 district-level child count data and student enrollment data for each state, we first calculated initial risk ratios for each racial/ethnic group for the MR category. The initial risk ratios were calculated using the risk ratio equation presented earlier.

Using the same district-level data, we next calculated weighted risk ratios for each racial/ethnic group for the MR category. For a weighted risk ratio to be calculated, there had to be at least 10 students from the racial/ethnic group enrolled in the district. If there were at least 10 students from the racial/ethnic group enrolled in the district but fewer than 10 students from the comparison group enrolled in the district or if no students from the comparison group received special education and related services for MR, an alternate risk ratio was calculated instead of a weighted risk ratio, as long as the state-level conditions for calculating the alternate risk ratio were met. If these conditions were not met, then no district-level risk ratio was calculated.

Tables 8 through 10 present summaries of the risk ratios calculated for States A, B, and C. For each state, the descriptive statistics are presented for each racial/ethnic group for the initial risk ratios and the weighted or alternative risk ratios.

Several patterns can be seen in all three states. First, looking at the initial risk ratios, the number of districts for which risk ratios could be calculated is smaller than the total

TABLE 8. State A: District-Level Risk Ratios for MR by Race/Ethnicity[a]

	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
Statistic	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate
Maximum	5.31	3.72	18.03	5.99	18.35	20.58	20.87	5.21	3.39	4.87
95th %ile	0.48	1.27	0.94	0.81	7.47	7.66	3.17	2.04	1.57	1.75
90th %ile	0.00	0.60	0.47	0.62	5.61	6.13	1.43	1.40	1.11	1.17
75th %ile	0.00	0.00	0.00	0.00	4.11	4.32	0.68	0.80	0.58	0.65
Median	0.00	0.00	0.00	0.00	2.77	2.86	0.00	0.00	0.40	0.42
25th %ile	0.00	0.00	0.00	0.00	1.42	1.41	0.00	0.00	0.27	0.30
10th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.17
5th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.05
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Districts[b]	109	46	124	89	126	130	127	110	117	133

[a]State A has 133 districts. [b]This row refers to the total number of districts for which risk ratios could be calculated for that racial/ethnic group.

TABLE 9. State B: District-Level Risk Ratios for MR by Race/Ethnicity[a]

	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
Statistic	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate
Maximum	43.45	12.72	20.56	28.12	26.65	32.40	51.18	58.16	1.63	4.31
95th %ile	4.19	6.86	2.18	2.00	7.21	8.41	3.92	4.70	1.33	1.34
90th %ile	0.00	2.74	1.19	1.23	4.62	5.58	2.47	2.62	1.09	1.14
75th %ile	0.00	0.00	0.00	0.00	2.24	2.73	1.18	1.31	0.78	0.68
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.39
25th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.19
10th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00
5th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Districts[b]	134	42	148	128	145	124	144	134	81	169

[a]State B has 169 districts. [b]This row refers to the total number of districts for which risk ratios could be calculated for that racial/ethnic group.

number of districts in the state. State A has 133 districts, but initial risk ratios could only be calculated in 109 to 127 of them; State B has 169 districts, but initial risk ratios could only be calculated in 81 to 148 of them; and State C has 432 districts, but initial risk ratios could only be calculated in 180 to 208 of them. This discrepancy exists because risk ratios cannot be calculated for a racial/ethnic group when there are no students from the comparison group enrolled in the district or when there are no students in the comparison group receiving special education and related services for MR.

Second, in some instances, initial risk ratios could be calculated for more districts than could weighted or alternate risk ratios. Although the alternate risk ratio allows risk ratios to be calculated when it would be impossible to do so otherwise,

TABLE 10. State C: District-Level Risk Ratios for MR by Race/Ethnicity[a]

Statistic	American Indian/ Alaska Native		Asian/ Pacific Islander		Black (not Hispanic)		Hispanic		White (not Hispanic)	
	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate	Initial	Weighted/ alternate
Maximum	110.00	19.56	15.81	21.16	125.00	29.61	13.96	29.85	23.00	52.66
95th %ile	3.75	3.77	1.36	1.89	6.01	4.94	3.13	3.83	3.11	3.37
90th %ile	2.49	2.39	0.79	1.17	3.39	3.15	2.10	2.40	1.78	1.68
75th %ile	1.12	1.40	0.00	0.36	1.70	1.68	1.36	1.15	1.13	0.86
Median	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.55	0.00
25th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5th %ile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Districts[b]	202	185	180	106	202	180	208	341	196	385

[a]State C has 432 districts. [b]This row refers to the total number of districts for which risk ratios could be calculated for that racial/ethnic group.

districts with fewer than 10 students enrolled from the racial/ethnic group of interest were excluded from the analyses. Thus, in districts with small student enrollments, there were instances in which an initial risk ratio could not be calculated for a racial/ethnic group, but an alternate risk ratio could. There were also instances in which an initial risk ratio was calculated, but a weighted or alternate risk ratio was not because there were fewer than 10 students in the racial/ethnic group.

Third, the initial risk ratios that were calculated tend to have more extreme values than the weighted or alternate risk ratios. For example, in State A, the initial risk ratios for Hispanic students ranged from 0 to 20.87, but the weighted or alternate risk ratios ranged from 0 to 5.21 (see Table 8). In some cases, the more stable weighted or alternate risk ratios are due to the use of weights to standardize the denominator of the risk ratio (i.e., the risk for the comparison group). However, the difference is primarily due to the exclusion of risk ratios calculated for racial/ethnic groups with fewer than 10 students enrolled in the district, since, as we saw earlier, these small populations tend to have risk ratios with more extreme values.

Fourth, the largest initial risk ratios tend to be larger than the largest weighted or alternative risk ratios. For example, the largest initial risk ratio for Asian/Pacific Islander students in State A is 18.03, whereas the largest weighted or alternate risk ratio is 5.99. However, the other values tend to be smaller for initial risk ratio, rather than for weighted or alternative risk ratios. For instance, for American Indian/Alaska Native students in State A, the 90th percentile for the initial risk ratio is 0.0 versus 0.60 for the weighted or alternate risk ratio. There are two reasons for this phenomenon. The weighted risk ratio is inherently more stable, in a statistical sense, since it eliminates variability due to demographic distributions between districts. Also, when populations with fewer than 10 students are excluded from the analyses, there is a tendency to reduce the number of districts with risk ratios that are zero.

Fifth, racial/ethnic groups with state-level risk ratios near 1.0 or less (see Table 1) tend to follow the pattern established in Table 7—most district-level risk ratios (whether initial risk ratios or weighted or alternate risk ratios) for those groups are 0.0, with a handful of risk ratios that take on values substantially larger than 1.0. For example, in Table 8, the median risk ratio is 0.0 for all racial/ethnic groups except Black students and White students, but each racial/ethnic group has a few very high risk ratios. These data indicate that some districts may have very high risk ratios through natural variation and small numbers of students, even when the actual overall state-level risk ratio is 1.0 or less.

Discussion

According to IDEIA, states must collect and examine disproportionality data at both the state and the district level. One method for assessing disproportionality is the risk ratio. Applying the risk ratio to state-level data is fairly uncomplicated, but as the district-level data from our analyses demonstrate, applying the risk ratio to district-level data is more challenging.

First, it is difficult to compare risk ratios across districts because the size of the risk ratio is affected by variations in the district-level racial/ethnic demographics of the compari-

son group. The weighted risk ratio addresses this limitation by adjusting for district variability in the racial/ethnic demographics of the comparison group. The weighted risk ratio thus allows comparison of risk ratios across districts and enables states to rank districts when deciding how to target technical assistance. We, therefore, propose calculating weighted risk ratios when analyzing district-level disproportionality data.

Second, it is impossible to calculate risk ratios if there are no students in the comparison group (i.e., the risk for the comparison group cannot be calculated) or if none of the students in the comparison group receives special education and related services either for the disability or in the educational environment (i.e., the risk for the comparison group is zero). In our selected states, risk ratios could not be calculated for some racial/ethnic groups in some districts. Under these circumstances, we propose calculating an alternate risk ratio that uses the district-level risk for the racial/ethnic group in the numerator and a state-level risk for the comparison group in the denominator. Using the alternate risk ratio allows risk ratios to be calculated when they would be impossible to calculate otherwise.

Third, risk ratios are difficult to interpret when they are based on small numbers of students (either in the racial/ethnic group or the comparison group). When risk ratios are based on small numbers, minor variations in the number of students in either the racial/ethnic group or the comparison group can produce dramatic changes in the size of the risk ratio. Therefore, we propose calculating risk ratios only when there are at least 10 students from the racial/ethnic group enrolled in the district.

To some extent, other measures of disproportionality might be used to alleviate some of these problems. For example, the risk is fairly robust to demographic variations (e.g., see Table 5). Composition can also be used to evaluate disproportionality when demographic distributions vary from one district to another, since it must be used in conjunction with the overall demographic distribution of the district being evaluated. However, neither of these measures has the "standalone" property and ease of interpretation of the risk ratio. Moreover, risk and composition can be just as difficult to analyze as the risk ratio when subgroup sizes are small. Considering the example of District 3 in Table 6, the risk for Black students is about 1%, approximately seven times greater than that of White students, which is roughly 0.15%. However, since only three students are identified as having mental retardation, we would argue that these risks do not reliably indicate that there is disproportionality. Similarly, with regard to composition, Black students compose 33.3% of the MR category, but only 7.3% of all students in the district. Again, the small number of identified students makes it difficult to draw a firm conclusion regarding the presence of disproportionality.

Both of the proposed risk ratio modifications are based on the idea of utilizing state-level data when data at the district level are absent or not sufficiently reliable. The primary rationale of the risk ratio is that it provides a measure of the risk of one group relative to the risk of another group. Neither the weighted nor the alternate risk ratio departs radically from this basic concept. The weighted risk ratio uses district-level data that are weighted in accordance with state-level racial/ethnic distributions to create a more stable measure of risk for the comparison group (which here comprises "all other" students). The alternate risk ratio uses the risk for the comparison group at the state level when none is available at the district level. In each case, the risk for the target group is measured against the risk for a comparison group, which is the basis for the risk ratio as a measure of disproportionality.

Unfortunately, some problems due to small population sizes remain. One problem is that some districts may have too few students in a particular racial/ethnic group to calculate a reliable risk ratio at the district level, even with the use of the weighted or the alternate risk ratio. In these districts, states may need to make case-by-case reviews to determine if significant disproportionality exists for a specific racial/ethnic group. It would be helpful if future research focused on methods for such reviews or on other techniques for assessing disproportionality when a group is sparsely distributed.

Another problem is that since there are fairly low identification rates for many disability categories, risk ratios will be inherently unstable for racial/ethnic groups with only a few students. For example, when identification rates are low, it is expected that there will be many cases where the risk ratio is zero at the district level. When there are also small racial/ethnic group sizes, the risk ratio will tend to be either zero or quite large, making it difficult to evaluate trends in disproportionate identification. Even with the recommended modifications to the risk ratio calculation, it is necessary that states investigate districts with large risk ratios to determine the number of students on which the risk ratio is based.

Due to space limitations, we have restricted this analysis to three states and to a single disability category, mental retardation. While we believe that these examples are sufficient to demonstrate the usefulness of the proposed modifications of the risk ratio, we recognize that the specific patterns of disproportionality observed here are affected by the choice of states and disability category. Regardless of the tools used to measure them, patterns of disproportionality vary by both demographic characteristics and disability (Losen & Orfield, 2002; National Research Council, 2002; Westat, 2003). Future research efforts might be directed at investigating other state data sources and other disability categories.

Another issue to consider would be changes over time. Longitudinal research is useful to evaluate trends and to assess stability, since student populations may change due to either demographic changes or student mobility. The proposed disproportionality measures are intended to improve stability of district estimates by using state-level data when district-level populations are small. Thus, we propose that the alternate and weighted risk ratios would be beneficial in longitudinal studies, since state data are likely to be less volatile over time

than district data are, in particular for subgroups that are small at the district level.

Finally, while a risk ratio larger than 1.0 indicates increased disability identification risk for the racial/ethnic group in relation to the comparison group, the question remains as to what size risk ratios should require administrative action: Does a risk ratio of 1.50 indicate serious disproportionality, or should a risk ratio of 1.25 be used? This question is one of policy and beyond the scope of this article. Here we propose technical modifications to the risk ratio that make it more suitable for analyzing district-level data. It remains for administrators and policymakers to make the difficult choice of what cutoff should be a guide to action.

Racial/ethnic disproportionality in special education remains an important topic of research. It is imperative that others continue this line of research to fully understand the causes of disproportionality and how to assess and address it at both the state and the district level. Only then can we truly ensure that the educational needs of children of all racial/ethnic backgrounds are being met and improve outcomes and results for all students.

NOTES

1. We chose to use the MR disability category in our examples because this is one of the disability categories that historically has had a higher representation of minority students (National Research Council, 2002). We could have easily chosen to focus our examples on a different disability category.
2. Currently, the Office of Special Education Programs (OSEP) uses five racial/ethnic categories for reporting the race/ethnicity of students with disabilities: White, not Hispanic; Black, not Hispanic; Hispanic; Asian/Pacific Islander; or American Indian/Alaska Native. When states report race/ethnicity, all students are reported in one of the five racial/ethnic categories and no student is reported in more than one category. It should be noted, however, that classifying students in this manner is potentially problematic, as it has been suggested that these racial/ethnic categories are arbitrary (Phinney, 1996) and that a large amount of variation exists across states and districts in how these racial/ethnic categories are applied to students (MacMillan & Reschly, 1998). As an example, Asian and Pacific Islander students are classified together into one category, when they are actually two culturally diverse groups. Reporting these groups as a single category may obscure findings for the particular subgroups included in this category (e.g., Artiles, Harry, Reschly, & Chinn, 2002). In November 1997, the Office of Management and Budget (OMB), in its revision of *Race and Ethnic Standards for Federal Statistics and Administrative Reporting,* announced that there would be five racial categories—American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and White—and one ethnic category—Hispanic or Latino. Additionally, OMB announced that individuals would be allowed to select as many race/ethnicity categories as were applicable. Under the new reporting requirements, a single, multiracial category cannot be used. OSEP is actively working with other offices within the Department of Education to determine what categories will be used for reporting aggregated data and anticipates that final decisions on reporting these data will be made soon.
3. This same phenomenon also affects state-level risk ratios when states are compared to one another. However, it has considerably less impact because racial/ethnic demographic distributions at the state level generally exhibit less extreme variability than those at the district level do.
4. The risk for all other students in State C is 0.008. To protect the anonymity of State C's identity, we do not include the numbers we used to calculate the risk.

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