Elevated Body Mass Index and Obesity among Ethnically Diverse Adolescents

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Objective: To examine trends in prevalence and odds of elevated body mass index (BMI) and obesity among ethnically diverse adolescents.

Design and Setting: Data from countywide (Miami-Dade) health screenings from 1999–2005. Weight, height, days/week of vigorous activity, hours/day of sedentary activity, parental hypertension, and eating habits were reported.

Participants: 77,050 adolescents, average age 15.6 years (51% girls, 9.4% White non-Hispanic, 59.2% White Hispanic, 16.4% African American, 7% Black Hispanic, and 8% Black Caribbean).

Outcome Measures: Prevalence and ethnic differences in odds of obesity (BMI≥95th percentile) and elevated BMI (BMI≥85th percentile), adjusting for academic years, days/week of vigorous activity, and hours/day of sedentary activity.

Results: Prevalence of elevated BMI and obesity increased from 1999–2005. Overall, White non-Hispanics had lower odds of obesity and elevated BMI than African Americans and White Hispanics. African American girls displayed higher odds of obesity and elevated BMI than Black Hispanic girls and higher odds of elevated BMI than Black Caribbean girls. African American boys showed higher odds of obesity and elevated BMI than Black Caribbean boys. Black Hispanic girls had greater odds of obesity and elevated BMI than White Hispanic girls, but boys were similar.

Conclusions: This study is among the first to examine BMI status in both Black and Hispanic subgroups. Viewing Black and Hispanic ethnic subgroups as homogeneous obscures important weight-related differences. Further research is warranted to determine factors contributing to differential risk. (*Ethn Dis*. 2011;21(2):176–182)

Key Words: Body Mass Index, Obesity, Health Disparities, Adolescents

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Introduction

The increase in overweight and obesity is of considerable public health concern.[1,2] For adolescents, national data indicate that prevalence of overweight (body mass index [BMI]≥85th and <95th percentile), obesity (BMI≥95th percentile), and elevated BMI (BMI≥85th percentile; ie, overweight plus obesity), determined by measurement or self-report, is significant.[1–3] The NHANES data for 1999–2000 through 2007–2008 show that obesity rates based on direct measurements have risen from 14.8% to 18.1% while the Youth Risk Behavior Surveillance survey (YRBS) indicates that self-reported values have increased from 10.7% to 12.0% from 1999–2009.[2–4] Excess weight may have long-term health consequences as these youth risk becoming obese adults.[5] Furthermore, obesity is more common among minorities than White non-Hispanics.[2,3,6] Obesity is implicated in current as well as future health disparities including greater insulin resistance and diabetes in Hispanic and Black adults and hypertension in Black adults.[5,7] To date, most research examining large samples of minority youth has focused on or oversampled African Americans and Mexican Americans.[2,4,8] Consequently, little is known about whether the obesity and elevated BMI prevalence characteristic of African Americans and Mexican Americans persists in other Black or Hispanic subgroups. Enhanced understanding of ethnic subgroups is essential for devising and implementing optimal targeted interventions that best address community needs.

Obesity prevalence differs across sex and ethnicity categories; for adolescents, Black non-Hispanic girls and Mexican American boys have among the highest rates while White non-Hispanic girls have the lowest.[2] Sex and ethnic differences have also been reported for elevated BMI.[6] Moreover, behavioral factors implicated in pediatric obesity, such as physical and sedentary activity, may also vary as a function of ethnicity and sex, and contribute to group-related differences in BMI status.[9,10]

The purpose of the present study was to examine the prevalence and odds of obesity and elevated BMI in ethnically diverse adolescents.

The purpose of the present study was to examine the prevalence and odds of obesity and elevated BMI in ethnically diverse adolescents. This study extends previous research by examining self-report derived prevalence in a countywide sample of public high school students in Miami-Dade County from 1999–2005. The demographics of this school system, made up of White Hispanic (primarily of Cuban, Central American, or South American origin), Black Hispanic, Black Caribbean, African American, and White non-Hispanic adolescents, reflect the community's diversity. This heterogeneity permits comparisons among groups absent or underrepresented in past research. The following questions were addressed: 1) Does the prevalence of obesity and elevated BMI change in the 6-year period beginning in 1999? 2) What are the rates for vigorous and sedentary activity by ethnicity and sex? 3) Does

obesity and elevated BMI vary as a function of ethnicity in boys and girls? and 4) Do correlates of obesity status vary as a function of ethnicity in boys and girls?

METHODS

Participants

A total of 88,912 (~49% boys and 51% girls) students were screened during annual health screenings over a 6-year period, 1999–2005, under a service contract to the first author. Students were eligible for screening if they were enrolled in 10th grade classes and attended a public school in Miami-Dade County. Each year 36–39 schools were screened. Mean age across years was 15.6 (*SD*=.75). Given the small yearly *n* of American Indians (1%), Asians (~1.4%,), and self-identified 'others' (~4–6%,), together with the inability to meaningfully interpret findings for the 'other' group, these students (*n*=6199) were excluded. Only students identifying as White non-Hispanic, White Hispanic, African American, Black Hispanic, or Black Caribbean were included in the analyses.

Based on YRBS procedures for using self-reported height and weight data,[11] students were excluded from analyses if BMI was missing (*n*=2870) or if BMI was <11 kg/m^2 (*n*=450) or >55 kg/m^2 (*n*=24). Students were also excluded if they did not respond to the ethnicity (*n*=805), sex (*n*=153), or vigorous (*n*=776) or sedentary activity (*n*=585) items. There were no significant differences in ethnicity, sex, or BMI for those with and without vigorous and/or sedentary activity responses. Based on the criteria above, data from 77,050 adolescents were included in the analyses. Across years, the sample was 51% girls, 9.4% White non-Hispanic, 59.2% White Hispanic, 16.4% African American, 7% Black Hispanic, and 8% Black Caribbean.

A negative response permission procedure was utilized as was routine in the school district for health screenings. Parents were sent a letter outlining the screening procedures and an opt-out form to be returned to the principal if they did not want their children to participate. The letter and opt-out form were provided in English, Spanish, and Creole. Approval to conduct retrospective analyses of archival data reported in this paper was provided by the University of Miami Institutional Review Board.

Procedures

The screening team consisted primarily of undergraduate and graduate research assistants and full-time research staff who completed didactic and laboratory training and demonstrated proficiency implementing the assessment procedures prior to being permitted to conduct assessments at the schools. Students were free to decline to attend the screening and to complete the 2-page self-report questionnaire. The questionnaire requested sociodemographic, family history, and health habits information as well as self-reported weight (pounds) and height (feet and inches). Height was measured at the request of the student or at the screener's discretion for a separate component of the screening. Each student met individually with a screener who reviewed the student's responses for completeness.

Body mass index in kg/m^2 was calculated after converting self-reported weight to kilograms and height to meters. Obesity and elevated BMI criteria were based on sex-specific BMI for age growth charts from the Centers for Disease Control and Prevention.[12] The degree of vigorous activity was determined by the number of days/week reported in activities leading to sweating or breathing hard for at least 20 minutes. Sedentary activity was based on reported number of hours/day spent watching television, using a computer, or playing video games. Response options included 0–1 hours, 2–3 hours, 4–5 hours, or >5 hours.

Data Analyses

Data were analyzed using SAS version 9.1. Analytic strategy was influenced by the analyses reported by Ogden.[2] To this end, trends in prevalence of obesity and elevated BMI over the 6 academic years were examined using logistic regression analyses. Models consisted of academic years as an ordinal variable and included four dummy vectors for the five ethnic groups as control variables. Trends were tested for the total sample as well as boys and girls separately.

Rates for vigorous and sedentary activity by sex and ethnicity for each year were also examined. Vigorous activity rate was defined as activity ≥3 times a week. Sedentary activity rate was operationalized as screen time for ≥4 hours/day. Furthermore, ethnic differences in trends for prevalence of obesity and elevated BMI were assessed controlling for academic years and group-related differences in vigorous and sedentary activity. African Americans were treated as the reference group. Although unconventional, this permitted examining between ethnic group comparisons and within race group differences (ie, African Americans vs Black Hispanics and Black Caribbeans) that would not have been possible with White non-Hispanics as the reference. In additional analyses, White Hispanics were the reference group for comparisons with White non-Hispanics and Black Hispanics. Finally, correlates of obesity status (ie, parental hypertension, number of days/week of vigorous activity, number of hours/day of sedentary activity, and typical daily consumption of fatty meats and chips, fries, and sweets) were examined within each ethnic group by sex.

RESULTS

Detailed prevalence rates for obesity and elevated BMI for each year are

Table 1. Prevalence (%) of elevated body mass index* (BMI) and obesity† for Miami-Dade County 10th graders by sex and ethnic groups for each school year, 1999–2005

	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005
All						
Elevated BMI						
Boys	33.2	35.2	36.4	35.1	37.6	38.2
Girls	24.4	23.5	25.9	24.4	26.6	25.9
Obese						
Boys	15.4	16.5	17.7	17.1	18.0	18.9
Girls	7.9	7.8	9.5	8.6	9.9	9.4
White non-Hispanic						
Elevated BMI						
Boys	29.9	29.8	31.1	26.9	30.6	32.4
Girls	14.5	14.3	18.5	18.3	16.3	17.1
Obese						
Boys	11.5	12.2	15.1	12.4	11.7	14.5
Girls	3.3	3.4	5.7	5.4	6.8	5.1
White Hispanic						
Elevated BMI						
Boys	33.7	37.1	37.2	37.2	39.7	39.6
Girls	21.5	20.7	22.3	20.8	24.1	23.5
Obese						
Boys	16.0	17.3	17.4	18.2	19.1	19.4
Girls	5.6	5.8	7.2	6.4	8.0	7.5
African American						
Elevated BMI						
Boys	33.7	34.9	37.0	33.8	37.4	38.6
Girls	33.4	34.3	37.1	35.2	35.6	33.5
Obese						
Boys	16.3	16.5	19.8	17.3	19.0	20.6
Girls	15.1	14.5	15.3	16.1	14.1	13.9
Black Caribbean						
Elevated BMI						
Boys	30.8	29.6	36.3	30.0	30.8	35.8
Girls	31.0	28.0	30.4	31.9	35.2	33.4
Obese						
Boys	12.5	15.1	18.0	14.9	15.4	17.3
Girls	11.7	12.2	13.7	12.5	16.8	14.5
Black Hispanic						
Elevated BMI						
Boys	34.4	33.1	35.9	37.3	38.0	37.1
Girls	28.6	29.7	31.7	30.1	30.9	30.5
Obese						
Boys	15.9	17.4	17.9	16.2	18.8	18.4
Girls	9.0	10.3	13.2	9.2	12.8	14.0

* BMI≥85th percentile.
† BMI≥95th percentile.

presented in Table 1. There was a significant linear trend in the prevalence of obesity ($P<.0001$) and elevated BMI ($P<.0001$) for the total sample across years (1999–2005) controlling for ethnicity. This pattern was also observed for boys. For girls, prevalence of elevated BMI significantly increased ($P<.001$), but obesity ($P=.11$) did not.

Figures 1 and 2 present the percentage of boys and girls by ethnic group reporting vigorous activity and sedentary activity across years. Over 50% of boys and 40% of girls were active at least 3 days/week. White non-Hispanic and White Hispanic boys and girls were more likely than other groups to have been active. At least 25% of boys and 13% of girls were sedentary 4 or more hours/day. African Americans had the highest rates of sedentary activity.

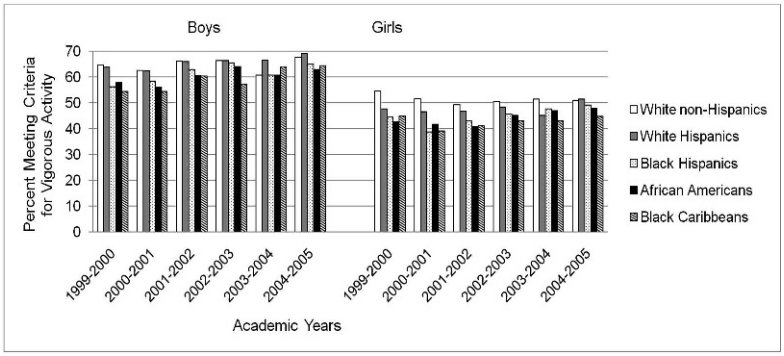

Fig 1. Percent engaged in vigorous activity (at least 20 minutes of physical activity 3 times/week) among boys and girls by ethnicity for each academic year

Given the differential group rates for vigorous and sedentary activity, the number of days/week of vigorous activity and hours/day of sedentary activity, in addition to academic years, were adjusted in separate logistic regression models testing ethnic group differences in obesity and elevated BMI in boys and girls (Table 2). Among boys, higher levels of physical activity were associated with lower odds of obesity and elevated BMI while higher levels of sedentary activity were associated with higher odds of obesity and elevated BMI. Girls demonstrated similar findings for odds of obesity but not elevated BMI. African American boys had higher odds of obesity and elevated BMI than White non-Hispanic and Black Caribbean boys, but did not differ from Black Hispanic boys. While White Hispanic boys were similar to African American boys in odds of obesity, they had higher odds of elevated BMI (see Table 2 for comparisons with African Americans as the reference group). In two separate analyses, odds of obesity and of elevated BMI were examined comparing White non-Hispanic and Black Hispanic boys to White Hispanic boys (reference group). White non-Hispanic boys had lower odds of obesity (odds ratio [OR]=.68; 95% confidence interval [CI], .62–.75) and elevated BMI (OR=.71; 95% CI, .66–.77) compared to White Hispanic boys. There were no differences between Black Hispanic and White Hispanic boys.

Among girls, African Americans (reference group) had higher odds of obesity and elevated BMI relative to White non-Hispanics, White Hispanics, and Black Hispanics. Although there was no difference in odds of obesity between African American and Black Caribbean girls, African American girls had greater odds of elevated BMI than Black Caribbean girls (Table 2). Furthermore, in two separate analyses, White non-Hispanic girls had lower odds of obesity (OR=.73; 95% CI, .62–.86) and elevated BMI (OR=.70; 95% CI, .63–.77) compared to White Hispanic girls (reference group). In contrast, Black Hispanic girls had higher odds of obesity (OR=1.78; 95% CI, 1.55–2.03) and of elevated BMI (OR=1.53; 95% CI, 1.39–1.67) relative to White Hispanic girls.

Potential correlates of obesity status were also examined within ethnic groups by sex (Table 3). Parental hypertension was associated with increased odds of obesity for all boys and girls except White non-Hispanic girls and Black Caribbean boys. More days/week of physical activity was associated with lower odds of obesity in White Hispanic boys, whereas more hours/day of sedentary activity was associated with higher odds of obesity in White non-Hispanic and White Hispanic boys. Furthermore, increased consumption of fatty meats and chips, fries, and sweets was associated with greater odds of obesity among Black Caribbean girls, and White Hispanic and African American boys and girls.

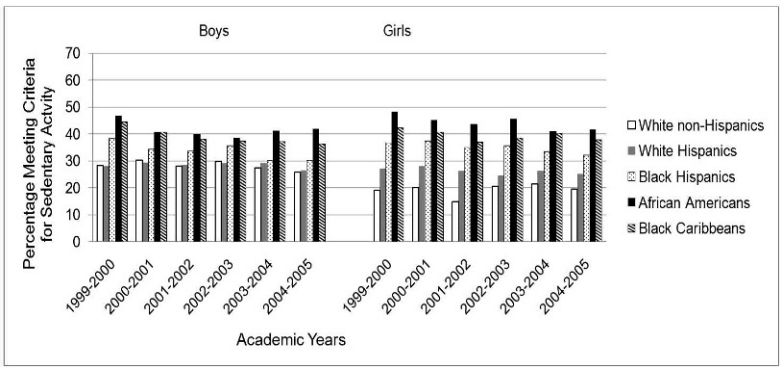

Fig 2. Percent engaged in sedentary activity (4 hours or more/day) among boys and girls by ethnicity for each academic year

Youth from Black ethnic groups reported the highest rates of sedentary activity while White non-Hispanics and White Hispanics reported the highest rates of vigorous activity.

Table 2. Logistic regression of obesity and elevated body mass index (BMI) for adolescents*

	Obesity†		Elevated BMI‡	
	Girls	Boys	Girls	Boys
African American	1.00	1.00	1.00	1.00
White non-Hispanic	.30 (.26–.36)	.69 (.61–.77)	.37 (.33–.41)	.78 (.71–.85)
White Hispanic	.42 (.38–.46)	1.01 (.94–1.09)	.53 (.50–.56)	1.09 (1.03–1.16)
Black Hispanic	.74 (.64–.86)	.97 (.86–1.09)	.81 (.73–.89)	1.03 (.94–1.12)
Black Caribbean	.90 (.80–1.01)	.84 (.74–.95)	.86 (.79–.94)	.86 (.78–.94)
Physical activity	.98 (.96–.99)	.97 (.96–.98)	1.00 (.99–1.01)	.99 (.98–.99)
Sedentary activity	1.04 (1.01–1.07)	1.08 (1.06–1.12)	1.01 (.99–1.03)	1.04 (1.02–1.06)

* Table contains odds ratios (95% confidence interval) adjusted for six academic years (1999–2005), number of days engaged in physical activity, and number of hours/day engaged in sedentary activity.
† BMI≥95th percentile.
‡ BMI≥85th percentile.

DISCUSSION

This study examined the prevalence of obesity and elevated BMI in an ethnically diverse sample of adolescents. From 1999–2005, the prevalence of elevated BMI increased for boys and girls while the prevalence of obesity increased for boys, but was stable for girls. Youth from Black ethnic groups reported the highest rates of sedentary activity while White non-Hispanics and White Hispanics reported the highest rates of vigorous activity. Overall, in analyses adjusting for activity and academic year, youth from minority backgrounds had greater odds of obesity than White non-Hispanic youth and differences among minority groups were apparent. For girls, elevated BMI was most common among African Americans and least common among White non-Hispanics. Elevated BMI for boys was most prevalent among White Hispanics and least frequent among White non-Hispanics.

The positive trajectory for adolescents meeting criteria for obesity and elevated BMI from 1999–2005 is consistent with reports from nationally representative samples over a similar time period.[2,3] The percentage of obese adolescents was lower than that observed in NHANES, where BMI was directly measured.[3,13] Nevertheless, the percentage of adolescents with elevated BMI, while also less, approximated NHANES. Obese adolescents in the present study may have underreported weight while still meeting elevated BMI criterion.[14] The optimal comparison, however, is with the YRBS given the self-report assessments and the availability of data restricted to high school students. Obesity rates for the entire sample are approximately 1% greater than reported for the YRBS for the same period. Although it was not possible to directly compare sedentary activity rates across the two studies, the 2005 YBRS rates of vigorous activity exceeded those of the present study.[15] For both vigorous physical activity and sedentary activity, the pattern of ethnic and sex differences observed in YBRS is comparable to the current study. [15]

Consistent with past research, ethnic background was differentially associated with obesity and elevated BMI for adolescent boys and girls.[8,13] While it

Table 3. Correlates of obesity by sex within ethnic groups across school years, 1999–2005*

	White non-Hispanic	White Hispanic	African American	Black Hispanic	Black Caribbean
Boys					
Parent hypertension	1.34 (1.01–1.74)	1.55 (1.41–1.71)	1.60 (1.34–1.92)	1.54 (1.18–2.01)	1.13 (.87–1.48)
Physical activity†	.95 (.90–1.01)	.94 (.92–.96)	1.01 (.98–1.05)	1.04 (.98–1.09)	1.02 (.96–1.08)
Sedentary activity‡	1.13 (1.01–1.27)	1.12 (1.07–1.17)	1.06 (.99–1.14)	1.06 (.95–1.19)	1.06 (.95–1.18)
Poor diet§	.96 (.89–1.02)	.93 (.91–.95)	.93 (.90–.97)	.95 (.89–1.02)	.94 (.89–1.01)
Girls					
Parent hypertension	1.45 (.92–2.28)	1.38 (1.19–1.60)	1.31 (1.08–1.59)	1.63 (1.13–2.36)	1.35 (1.02–1.80)
Physical activity	.93 (.84–1.03)	.98 (.95–1.02)	.97 (.93–1.01)	.95 (.88–1.03)	1.04 (.98–1.10)
Sedentary activity	.97 (.79–1.18)	1.05 (.99–1.11)	.96 (.90–1.03)	1.15 (1.00–1.31)	.99 (.89–1.09)
Poor diet	.90 (.79–1.02)	.91 (.88–.95)	.95 (.91–.98)	.96 (.88–1.03)	.94 (.88–.99)

* Table contains odds ratios (95% confidence interval) of obesity prevalence.
† Number of days engaged in physical activity.
‡ Number of hours per day watching TV, playing video games or using a computer.
§ Composite of number of times/day (ie, none, once, or twice or more) participant ate fatty meats and chips, fries and sweets.

was anticipated that ethnic differences would emerge among White non-Hispanic, White Hispanic, and African American youth, our findings demonstrate that differences in BMI status are also apparent among subgroups of Black youth and Hispanic youth. Furthermore, a sex and ethnic group interaction was evident among specific groups. For obesity, differential rates between boys and girls were most apparent among White non-Hispanic and White Hispanic youth and least apparent among Black groups. In addition, White non-Hispanic boys and girls showed the largest rate differences for elevated BMI while African American and Black Caribbean youth showed the smallest. Though the literature suggests that adolescent girls are more likely than boys to underestimate weight, the ethnic group differences may be related to cultural perceptions concerning body size.[14,16] Observed relationships were consistent across years supporting the reliability of the findings.

Examination of correlates of obesity status demonstrated that parental hypertension was associated with increased odds of obesity in boys and girls in most ethnic groups. This suggests that when confronted with genetic risk for a cardiovascular disease comorbid with obesity, it is critical for adolescents to adopt healthy behaviors. In this context, the data suggests that White Hispanic boys might lower their odds by increasing physical activity and decreasing sedentary activity and improving diet. Similarly, White Hispanic, African American, and Black Caribbean girls and African American boys may benefit from dietary intervention. While the correlates in the current study were limited, they provide a starting point for future work directed at designing and implementing relevant interventions. As such, culturally sensitive and targeted interventions to reduce weight by promoting relevant lifestyle behaviors may be more acceptable and effective than comprehensive multiple risk factor approaches.

Findings clearly suggest that viewing Blacks and Hispanics as homogeneous groups, as has been done in past research, obscures important differences among subgroups. Unique social, cultural, and economic factors likely contribute to differential BMI status and other health disparities observed in individuals from ethnic subgroups and may explain why African American adolescents, and White Hispanic and Black Hispanic boys are particularly at risk.[16,17] Furthermore, the composition of our White and Black Hispanic groups also warrants comment. Based on the demographics of Miami-Dade County, adolescents who identify as Hispanic are largely from Cuba and Central and South America. These are groups that have typically been inadequately recruited in previous research and may have differential health risk associated with acculturation and other factors relative to the widely studied Mexican Americans. Research from the National Longitudinal Study of Adolescent Health bears on this issue and shows that prevalence of obesity is greater for Mexicans and Puerto Ricans compared to Cubans (girls only) or Central and South Americans.[17] Future research, such as results from the ongoing Hispanic Community Health Study, may clarify the issue of disparate risk among the diverse Hispanic community.

We acknowledge that our approach in deriving BMI from self-reported weight and mostly self-reported height is limited and less precise than directly measuring weight and height. The literature shows that for adolescents, self-reported weight is often underestimated and the findings for self-reported height are mixed contributing to underestimates of BMI.[14] Notwithstanding these limitations, self-reported and measured assessments are highly correlated.[14] Goodman and colleagues demonstrated 96% agreement in categorizing BMI status derived from self-report compared to direct measurement of adolescents in a national study, supporting the position that self-report provides a valid marker of measured values.[14]

In conclusion, the prevalence of obesity and elevated BMI characteristic of American adolescents of diverse ethnic backgrounds warrants attention. Since minority adolescents are most disadvantaged with respect to BMI status, they may be particularly vulnerable to associated comorbidities that may appear during adolescence and are likely to emerge during adulthood. The findings underscore the necessity to develop targeted interventions to address the needs of diverse adolescents and to direct efforts at the individual, family, local, and national levels to curb pediatric obesity. Education and intervention are vital to reducing future health disparities.

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AUTHOR CONTRIBUTIONS

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Manuscript draft: Saab, Fitzpatrick, Lai, McCalla
Statistical expertise: Fitzpatrick, Lai
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