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School-Based Body Mass Index Screening and Parent Notification

A Statewide Natural Experiment

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Objective: To assess the impact of body mass index (BMI) screening with parental notification on weight status for California public school students.

Design: A natural experiment wherein nearly all California school districts conducted annual BMI screening in the fifth, seventh, and ninth grades, but parental notification of BMI screening results was optional.

Setting: Data from mandatory fitness testing in California public schools for 2001 through 2008.

Participants: A total of 6 967 120 fifth-, seventh-, and ninth-grade youth (73% of enrolled students).

Intervention: School-based BMI screening with optional parent notification.

Main Outcome Measure: Body mass index *z* score was the main outcome in adjusted mixed-effects linear regression models, assessing whether notifying parents of their child's BMI in a given year predicted BMI *z* score 2 years hence.

Results: Rates of parental notification of BMI screening results increased from 35% in 2001 to 52% in 2008. Body mass index notification in fifth and/or seventh grade had no impact on subsequent BMI *z* scores (95% confidence interval, −0.03 to 0.01) compared with no notification. No differences in the impact of notification were seen by race/ethnicity. Results did not vary with sensitivity analyses.

Conclusions: These findings suggest that while BMI screening itself could have benefits, parental notification in its current form may not reduce pediatric obesity. Until effective methods of notification are identified, schools should consider directing resources to policies and programs proven to improve student health.

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THE BROAD SCOPE OF THE PEdiatric obesity epidemic[1-3] calls for public health approaches.[4] School-based strategies have the potential to reach the vast majority of youth and may address increasing racial and ethnic disparities in obesity.[5] The Institute of Medicine recommends school-based body-mass index (BMI) screening with parental notification of results as a public health means of reducing pediatric obesity.[6] Theoretically, notifying parents of BMI screening results can inform parents that their child is at risk, thereby allowing parents to take effective action to improve their child's weight status. However, the Centers for Disease Control and Prevention,[7] the American Heart Association,[8] and the US Preventive Services Task Force[9] do not include school-based BMI screening in their recommendations, citing a lack of evidence to support its effect.

Despite the lack of evidence, as of 2006, 41% of school districts nationwide mandated height and weight assessments, and 72% of those districts required reporting results to parents.[10] The state of California was an early adopter of BMI screening. For the past decade, almost all California public schools have collected BMI data annually on fifth-, seventh-, and ninth-grade students. However, notifying parents of BMI screening results remains optional. Mandated screening with optional notification creates a natural experiment through which to examine the effect of the now widespread use of parental notification. California's natural experiment was used to determine if notifying parents of school-based BMI screening results reduces obesity at the population level and if notification has the potential to reduce health disparities.

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METHODS

STUDY POPULATION

Participants were fifth-, seventh-, and ninth-grade youth who underwent mandatory fitness testing in California public schools from 2001 through 2008. The Committee on Human Research at the University of California, San Francisco, certified this study as exempt.

FITNESS ASSESSMENT DATA

Pursuant to California Education code,[11] California public schools assessed the fitness status of fifth, seventh, and ninth graders each spring in 1999 and from 2001 through 2008 using the FITNESSGRAM.[12] The FITNESSGRAM, a battery of 6 fitness assessments, including body composition, is widely used nationally; of 29 states that either require or recommend BMI or fitness assessment in schools, 15 (52%) recommend use of the FITNESSGRAM.[13] The California Department of Education (CDE) allows schools to use BMI, skin-fold measures, or bioelectrical impedance to estimate body composition; over 95% of California schools use BMI (e-mail communication from the CDE, April 2010). School districts are required to send student-level data to the CDE and may contract with outside vendors to obtain student-level reports of FITNESSGRAM performance to provide to parents.[14]

Deidentified student-level FITNESSGRAM data were available from the CDE for the years 2001 through 2008. Individual identifiers were not available, and data from an individual student could not be linked across years. Data records include student grade, sex, age in years, height to the nearest inch, weight to the nearest pound, and race/ethnicity (African American, American Indian/Alaskan Native, Asian, Filipino, Hispanic/Latino, Pacific Islander, or white–not of Hispanic origin). To protect student confidentiality, the CDE included Filipino and Pacific Islander students in the Asian category. The CDE redacted data for students who, based on sex, grade, and race/ethnicity, were among a group of 10 or fewer students in their school district. The BMI *z* scores were calculated using the CDC's SAS program.[15]

DISTRICT-LEVEL DATA

Data were obtained directly from the CDE Web site[16] for total enrollment; percentage of students eligible for free or reduced-price meals; urban level (based on an 8-point scale from the US Census Bureau, ranging from a large city to a rural area); and an index of retention (the percentage of students enrolled in the district continuously from October 2007 until standardized testing in spring 2008).

INTERVIEWS WITH DISTRICTS

Structured telephone interviews were used to determine if, when, and how districts notified parents of student fitness assessment results. Researchers called the main telephone number for all 438 kindergarten through eighth-grade (K-8) and 376 kindergarten through 12th grade (K-12) school districts and asked to speak to the person with the greatest knowledge of physical fitness test procedures. The identified individual was asked if the current district policy was to notify parents of FITNESSGRAM results and, if so, in what year notification began, and by what method parents were notified. Interviewees who stated that their district did not currently notify parents of results were asked if that policy had ever changed. All interviewees were asked if they thought any schools within the district deviated from the district-level policy regarding parent notification. Interviewees in 17 districts reported not knowing the answer to 1 or more questions and either referred researchers to another individual or sought information from another district employee in order to provide complete information.

STATISTICAL ANALYSIS

Linear regression, adjusted for year and clustering by district code, identified predictors of missing data (**Table 1**) and the Wilcoxon rank sum test identified predictors of notification status in 2001 and 2008 (**Table 2**). To determine if parent notification when a child is in fifth grade predicts BMI *z* score in seventh grade, and if notification in seventh grade predicts BMI *z* score in ninth grade, a mixed-effects linear regression model with a random effect for district (to account for repeated measures within districts over time and clustering of students within districts) and a random intercept was used. The primary outcome was student-level BMI *z* score, and the primary predictor was district-level prior notification, a time-varying binary indicator of a district's notification status 2 years before. Prior notification was coded as 0 for all fifth graders; seventh- and ninth-grade students were assigned prior notification values based on their current district's previous notification policy. The full model included the following student-level factors: grade (fifth grade as reference), sex, race/ethnicity (non-Hispanic white as reference), and cohort year (to account for temporal trends in BMI *z* score with students in fifth grade in 2001 as reference group). The model was adjusted for district-level factors: proportion of students eligible for free or reduced-price meals, and urban level (categorical, with large city as reference). To determine if parent notification might reduce health disparities, an interaction term was included in the full model for prior notification × race/ethnicity. Statistical analyses were performed with SAS software (version 9.2; SAS Institute Inc, Cary, North Carolina).

SENSITIVITY ANALYSES

To isolate the impact of timing of notification, a categorical term compared no prior notification with notification in fifth grade only, notification in seventh grade only, and notification in both fifth and seventh grades. In addition, the full model was rerun restricting data to (1) 380 districts with a retention index of at least 95% (which included 65% of valid data), (2) 700 districts with a retention index higher than 87% (which included 97% of valid data), (3) districts with enrollment of 75 000 or less (which excluded 4 large districts), (4) the years 2004 through 2008 (to account for potential lack of institutional memory for earliest years of FITNESSGRAM administration). Finally, the full model was rerun, excluding 106 districts reporting that individual schools might deviate from the districts' policy or reporting that the district did not have a policy requiring notification and left the decision to individual schools.

RESULTS

Valid BMI data were available for 6 967 120 students, representing 72.7% of all fifth, seventh, and ninth graders enrolled during the years 2001 through 2008 (Table 1). The number of districts with no FITNESSGRAM data records available declined from 70 in 2001 to 29 in 2008 (representing 4.5% and 0.2% of enrolled students, respectively). There were small district-level correlations between the amount of missing data and the proportion of students eligible for free and reduced-price meals and the mean student BMI *z* score (Table 1).

Table 1. Enrollment and Body Mass Index (BMI) Record Data

Characteristic	2001	2002	2003	2004	2005	2006	2007	2008	Partial Correlation[a] ($P<.05$) for % Data Available and FRPM	BMI z Score
Districts included, No.[b]	755	755	756	756	758	758	758	758	NA	NA
Enrollment, grades 5, 7, 9, thousands of students	1148	1170	1205	1212	1226	1220	1210	1191	NA	NA
Valid BMI records, thousands	726.8	788.5	809.3	853.2	915.5	952.1	953.2	968.4	NA	NA
Race/ethnicity										
African American	68.9	64.4	68.4	73.2	75.7	75.4	74.6	72.8	NA	NA
American Indian/Alaskan Native	5.7	5.4	5.1	3.8	3.5	3.2	3.0	3.3	NA	NA
Asian/Pacific Islander/Filipino	84.3	96.5	99.7	105.6	116.1	123.7	122.5	125.3	NA	NA
Hispanic/Latino	289.8	338.0	349.1	382.9	421.6	448.3	462.7	479.5	NA	NA
Non-Hispanic white	238.1	256.7	262.9	267.8	279.6	280.9	274.4	271.2	NA	NA
Other	40.0	27.5	24.1	19.8	18.9	20.7	16.0	16.4	NA	NA
Valid BMI records, % of enrolled	63.3	67.4	67.1	70.2	74.6	78.1	78.8	81.3	−0.11	−0.07
Missing/invalid data, % of enrolled										
Biologically implausible[c]	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.13	0.15
Data redacted[d]	10.3	7.0	8.8	7.7	8.8	8.2	8.2	8.5	0.06	NA
Absent or excused	11.5	7.4	6.5	6.9	6.8	6.1	5.6	5.1	NA	NA
Other[e]	14.6	18.0	17.4	15.0	9.5	7.3	7.2	4.9	0.09	NA

Abbreviations: CDE, California Department of Education; FRPM, free or reduced-price meals; NA, not applicable.
[a] Partial correlation (adjusted for year) between percentage of data available and proportion of students in district eligible for FRPM or mean student BMI z score in district. Correlations did not differ significantly by year.
[b] California kindergarten to eighth grade and kindergarten to twelfth grade districts interviewed with enrollment data available.
[c] Biologically implausible BMI, according to the Centers for Disease Control SAS program protocol (version 9.2; SAS Institute Inc, Cary, North Carolina).[15]
[d] To protect student privacy, if there were fewer than 11 students of a given grade, sex, and race/ethnicity within a district, the CDE redacted data for those students.
[e] Includes students missing data for unknown reasons, students missing age or sex (<1% of enrolled), students from districts with no data records, students who had body composition assessed via alternate method (estimated to be <5% of enrollment in participating districts, based on communication from CDE), and potential discrepancies between CDE enrollment numbers and number of students enrolled at time of assessment.

Table 2. Differences in District-Level Factors by Notification Status in 2001 and 2008[a]

Characteristic	Notification Status in 2001: Yes (n=261)	No (n=494)	P Value	Notification Status in 2008: Yes (n=386)	No (n=372)	P Value
Enrollment	566 [95-1679]	290 [77-1108]	.01	530 [101-1683]	199 [51-1006]	<.001
Valid data, %	68 [0-83]	59 [0-79]	.03	85 [55-92]	73 [0-88]	<.001
Redacted data, %	8 [3-30]	10 [3-37]	.90	6 [2-25]	10 [2-43]	.03
Missing/invalid data, %	11 [5-22]	12 [4-26]	.41	6 [3-10]	7 [3-17]	.003
Students eligible for FRPMs, %	43 [22-65]	46 [26-67]	.15	51 [32-72]	56 [36-73]	.08
BMI z score	0.57 (0.29)	0.62 (0.27)	.046	0.59 (0.28)	0.61 (0.28)	.44
Students with BMI ≥ the 95th percentile, %	16.3 (7.0)	16.2 (7.7)	.86	18.9 (8.2)	18.9 (7.9)	.98
Race/ethnicity, %[b]						
Hispanic/Latino	24 [9-47]	23 [10-50]	.48	31 [13-60]	28 [10-57]	.32
Non-Hispanic white	60 [30-78]	60 [29-78]	>.99	49 [20-67]	50 [21-74]	.09
Asian/Pacific Islander/Filipino	3 [2-9]	2 [1-6]	<.001	3 [1-8]	2 [1-6]	<.001
African American	2 [1-4]	1 [0-4]	.02	2 [1-4]	1 [0-3]	.001
Native American/Alaskan Native	1 [0-1]	1 [0-2]	.44	1 [0-1]	1 [0-2]	.93
Urban level[c]	4.0 [3.0-7.0]	4.7 [3.0-7.0]	.01	4.0 [3.0-7.0]	5.3 [3.0-7.0]	<.001

Abbreviations: CDE, California Department of Education; FRPM, free or reduced-price meals; IQR, interquartile range.
[a] Data are given as mean (SD) or median [IQR]. Medians [IQRs] are displayed for nonnormally distributed variables, and the Wilcoxon rank sum (Mann-Whitney test) was used to test differences.
[b] Data come from district-level CDE records. Race/ethnicity for the balance of students was "Other."
[c] From the 2007-2008 school year.

Researchers conducted telephone interviews with 429 of 438 K-8 districts (98%) and 355 of 376 K-12 school districts (94%). Districts that did not respond to interview requests were not different in enrollment, proportion of students eligible for free or reduced-price meals, or mean BMI z score in 2008 from districts interviewed. The number of districts notifying parents of BMI screening results increased from 261 (35%) in 2001 to 386 (51%) in 2008 (the proportion notifying in 2008 was 53% when 26 districts that did not know notification status prior to 2008 were included). Districts that notified were larger, had fewer missing FITNESSGRAM data, lower mean student BMI z score (in 2001 but not in 2008), and slightly more African American and Asian students, and were more

Table 3. Regression Coefficients From Mixed-Effects Model Predicting BMI *z* Score

Predictor Variable	Coefficient (95% CI) for BMI *z* Score	*P* Value
Prior notification vs none	−0.01 (−0.03 to 0.01)	.21
Female	−0.11 (−0.12 to −0.10)	<.001
Students eligible for FRPMs, per 10% increase	0.04 (0.04 to 0.05)	<.001
Grade vs fifth grade		
Seventh grade	−0.04 (−0.06 to −0.03)	<.001
Ninth grade	−0.04 (−0.06 to −0.02)	<.001
Race/ethnicity vs non-Hispanic white		
African American	0.21 (0.19 to 0.22)	
Native American/Alaskan Native	0.19 (0.15 to 0.23)	<.001
Asian/Pacific Islander/Filipino	−0.08 (−0.10 to −0.05)	<.001
Hispanic/Latino	0.35 (0.33 to 0.37)	<.001
Cohort year vs 2001		
1999	−0.03 (−0.04 to −0.01)	<.001
2000	−0.02 (−0.03 to −0.00)	.007
2002	0 (−0.01 to 0.01)	.70
2003	0.02 (0.01 to 0.02)	<.001
2004	0.00 (−0.01 to 0.01)	.37
2005	0.02 (0.01 to 0.03)	<.001
2006	0.02 (0.01 to 0.03)	.001
2007	0.01 (0.00 to 0.02)	.02
2008	0.02 (0.01 to 0.03)	<.001

Abbreviations: BMI, body mass index; CI, confidence interval; FRPMs, free or reduced-price meals.

Table 4. Impact of Prior Notification on Body Mass Index *z* Score, by Quartile of Proportion of Obese Youth (Mean Over Years 2001-2008)

Proportion of Obese Students	Coefficient (95% CI) for Prior Notification[a]	*P* Value
Q1: 168 districts with 0% to 13.33% obese youth	0.001 (−0.03 to 0.03)	.93
Q2: 175 districts with 13.35% to 18.18% obese youth	−0.02 (−0.05 to 0.01)	.13
Q3: 175 districts with 18.19% to 23.58% obese youth	0.01 (−0.18 to 0.03)	.58
Q4: 171 districts with 23.60% to 72.73% obese youth	−0.02 (−0.04 to 0.01)	.28

Abbreviations: CI, confidence interval; Q, quartile.
[a] Fully adjusted model.

urban than districts that did not notify parents (Table 2). Associations between missing data and free meals or BMI *z* score (Table 1) did not vary by notification status ($P > .19$ for all interaction terms). To notify parents of FITNESSGRAM results, most districts sent a letter either via US mail (70% of those notifying) or with students to bring home to their parents (19%). Of all districts that ever notified, only 12 stopped doing so.

In the mixed-effects model, prior parental notification had no impact on subsequent BMI *z* scores (effect size, −0.01 BMI *z* score units; 95% confidence interval [CI], −0.03 to 0.01) after adjusting for grade, sex, race/ethnicity, urban level, and free or reduced-price meal eligibility (**Table 3**). In a similarly adjusted model with type of notification as a categorical predictor, neither mailing a letter nor sending a letter home with the child significantly affected BMI *z* score, nor were the effects different from each other in a pair-wise comparison. No differences in the impact of notification were seen by race/ethnicity ($P = .64$ value for interaction term). To determine if the proportion of obese students in a district modified the effect of BMI reporting, an interaction term between prior notification and district-level quartiles for the proportion of obese students (mean proportion of students with a BMI at or above the 95th percentile across all data years) was included. While there was significant interaction between prior notification and quartile of proportion of obese students ($P < .001$), the effect was not significant within any quartile, nor was there a stepwise effect with increasing proportion of obese students (**Table 4**). No other sensitivity analyses yielded results that differed from the primary model.

COMMENT

This study, which took advantage of California's statewide natural experiment, did not find that notifying parents of school-based BMI screening results for fifth- and seventh-grade students had an effect on pediatric obesity. While notifying parents of their child's weight status might be part of a multifaceted approach to reducing obesity, these results suggest that current notification methods used in the fifth and seventh grades are not sufficiently effective to warrant the practice on a large scale. California, which is home to almost 1 in 8 youth living in the United States, has the largest Latino population in the country.[17] This study, therefore, provided a unique opportunity to evaluate the impact of school-based BMI screening and notification in one of the ethnic groups most susceptible to obesity and type 2 diabetes mellitus.[18]

Theoretically, BMI screening and reporting can notify parents that their child is overweight or obese and prompt them to act on this knowledge. There is consistent evidence demonstrating that many parents of overweight and obese children are not cognizant of their child's weight status.[19] However, perceptions of weight status and the risks associated with obesity are complex and may not be changed by experts' reports of risk.[20] Many adults who are obese or otherwise at risk for cardiovascular disease do not perceive themselves to be at increased risk, despite experts' opinions to the contrary.[21,22] The long-term risks of childhood obesity are particularly difficult to convey because parents frequently believe their child will "grow into their weight."[23]

Two studies have demonstrated that BMI reporting can improve the accuracy of parents' perceptions of their child's weight status.[24,25] West et al[25] demonstrated this effect among both African American and white parents. Chomitz et al[24] further found that parents of children in kindergarten through eighth grade reported being motivated to attempt lifestyle changes as a result of BMI reporting, although it should be noted that the parents in the study by Chomitz et al[24] were of relatively high socioeconomic status. Also noteworthy is the fact that in the study by Chomitz et al,[2,4] 1 to 6 weeks after a BMI report was sent, only 63% of parents recalled having received the report, suggesting that BMI reporting may be a weak intervention. In a large-scale effort among a diverse population in West Virginia, Harris and Neal[26] found that BMI reporting did not change parents' perceptions of their child's weight. Further work to enhance the impact of BMI reporting should explore parents' perceptions of the causes of obesity, its associated risks, and what can and should be done at the individual, family, and community levels. This "mental models" approach has been successfully used to improve risk communications in other arenas.[27] A better understanding of parents' mental models might suggest communication methods to provide critical missing information and dispel misconceptions about pediatric obesity that affect parents' willingness or ability to make changes. It will be particularly important to explore mental models among distinct racial/ethnic and socioeconomic subgroups, given these factors' impact on weight perception.[28]

Even if BMI reporting can alter perceptions in diverse groups, school-based BMI reporting fails one of the most salient aspects of a useful screening test: having an effective therapy if the disease (or condition) is detected.[29] Lifestyle interventions to treat pediatric obesity are largely ineffective,[30] and recommending individual behavior change is unlikely to meet with success, if the experience of multidisciplinary pediatric obesity clinics is any guide.[31,32] Thus, expecting a single BMI report to parents to have a meaningful effect on a child's weight status, in the absence of environmental changes, may be wishful thinking.

Arkansas did see a halt in the progression of obesity after implementing BMI screening and notification as part of Act 1220 of 2003.[33] However, Act 1220 simultaneously called for changes in cafeteria food offerings, increased physical activity requirements, and healthier vending machine options, making attribution to any 1 intervention difficult. A recent study[34] using a similar multifaceted approach to alter the school environment demonstrated a significant impact on obesity, without implementing BMI screening and notification. There is evidence that focused interventions can have a positive impact on pediatric obesity. For example, policies banning the sale of sugar-sweetened beverages and snacks that are high in fat or sugar during the school day seem to be related to declines in obesity seen after 2005 in California.[35] Increased quality and quantity of physical education has been associated with decreased obesity and improved fitness.[36-38] Until a cost-effective method of BMI notification can be found, notification resources would be better invested in changing youths' environment, particularly in low-income communities.

The present study could not assess the impact of BMI screening itself, and it is possible that screening alone may heighten community awareness, which, in turn, could lead to changes in school or community policies over a period of years. These changes might have an impact on obesity that the present model, which looked to see if notification predicted weight status 2 years hence for a cohort of children, could not detect. It will be important to study the impact of screening itself on obesity.

STUDY LIMITATIONS

Several limitations should be considered in interpreting these findings. Misclassification of the predictor variable, which would make it more difficult to detect an effect of BMI reporting, could occur if institutional memory was poor or if individual schools deviated from the district policy regarding notification. In addition, if students changed districts between fifth and ninth grades and notification status differed between the old and new districts, their data would have been misclassified. Sensitivity analyses to address misclassification (limiting data to the most recent years, excluding districts indicating that individual schools might deviate from district policy and excluding districts with high mobility) yielded similar findings. Parents who did not receive results as intended would have been misclassified, and sensitivity analyses would not have addressed this.

Data could not be linked across years for individual students, and while it would be unusual, associations at the student level could be different from those at the district level owing to confounding at either the student or district level. Data were differentially missing for districts with heavier students and districts with a higher proportion of students eligible for free or reduced-price meals; however, notification status did not modify this association, so it is unlikely that this bias in missing data would have affected the findings beyond potentially limiting generalizability.

The quality of school-based BMI screening data is unknown. There is no surveillance of FITNESSGRAM test administration, and the integrity of data collection methods likely varies (which will decrease precision of estimates) and may vary by school (which might bias results). Nonetheless, random error is not likely an issue given the very small 95% CI for the effect. Bias in measurements is possible, but unless there is also bias in the change over time, it should not affect results for the effect of notification.

The widespread use of BMI screening and reporting is heartening because it reflects schools' willingness to dedicate resources to address the obesity epidemic. However, current methods of reporting school-based BMI screening results to parents do not seem to have an impact on pediatric obesity. While BMI screening itself may have value, further work to evaluate different approaches to providing parents with BMI screening information should be pursued before BMI reporting is implemented on a large scale. In addition, research could explore how this type of information might be used more broadly with other stakeholders and in policy. In the meantime, schools will likely see greater benefits if resources are used to increase opportunities for physical activity and improve nutrition.

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