Published in final edited form as:
Arch Pediatr Adolesc Med. 2011 November ; 165(11): 987–992. doi:10.1001/archpediatrics.2011.127.

School-based BMI screening and parent notification: A statewide natural experiment

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Abstract

Objective—School districts nationwide are adopting school-based body-mass index (BMI) screening to address the pediatric obesity epidemic. The effect of school-based BMI screening and parental notification on pediatric obesity, however, remains unknown. We sought to assess the impact of 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 5th, 7th, and 9th grade, but parental notification of BMI screening results was optional.

Setting—Data from mandatory fitness testing in California public schools between 2001 and 2008.

Participants—Participants were 6,967,120 5th, 7th, and 9th grade youth (73% of enrolled).

Main outcome measure—BMI 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. BMI notification in 5th and/or 7th grade had no impact on subsequent BMI z-scores (95% CI -0.03, 0.01) compared to 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.

INTRODUCTION

The broad scope of the pediatric obesity epidemic[12, 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 (IOM) 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 Center for Disease Control and Prevention, the American Heart Association, and US Preventive Services Task Force do not include school-based BMI screening in their recommendations, citing a lack of evidence to support its effect.[7–9]

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 last decade, almost all California public schools have collected BMI data annually on 5th, 7th, and 9th 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. We used California's natural experiment 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.

METHODS

Study Population

We studied 5th, 7th, and 9th grade youth who underwent mandatory fitness testing in California public schools between 2001 and 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 5th, 7th, and 9th graders each spring in 1999 and from 2001–2008 using the FITNESSGRAMR.[12] The FITNESSGRAM, a battery of six fitness assessments including body composition, is widely used nationally; of 32 states that either require or recommend BMI or fitness assessment in schools, a majority (56%) 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 (personal communication from CDE). 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]

De-identified student-level FITNESSGRAM data were available from the CDE for the years 2001–2008. 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, were among a group of 10 or fewer students in their school district. BMI z-scores were calculated using the CDC's SAS program.[15]

District-Level Data

We obtained data directly from the CDE website[16] for total enrollment; percent of students eligible for free or reduced-price meals; urban level (based on an 8-point scale from the 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

We used structured telephone interviews to determine if, when and how districts notified parents of student fitness assessment results. Researchers called the main phone number for all 438 K-8 and 376 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 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 one or more questions and either referred researchers to another individual or sought information from another district employee in order to provide complete information.

Statistical Analyses

We used linear regression, adjusted for year and clustering by district code, to identify predictors of missing data (Table 1) and the Wilcoxon Rank Sum test to identify predictors of notification status in 2001 and 2008 (Table 2). To determine if parent notification when a child is in 5th grade predicts BMI z-score in 7th grade, and if notification in 7th grade predicts BMI z-score in 9th grade, we used 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. 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 two years prior. Prior notification was coded as 0 for all 5th graders; 7th and 9th grade students were assigned prior notification values based on their current district's prior notification policy. The full model included the following student-level factors: grade (5th grade as reference), sex, race/ethnicity (non-Hispanic white as reference), and cohort year (to account for temporal trends in obesity - categorical with students in 5th 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, we included an interaction term in the full model for prior notification*race/ethnicity. Statistical analyses were done in SAS version 9.2 (SAS Institute Inc., Inc., Cary, NC, USA).

Sensitivity analyses—To isolate the impact of timing of notification, we created a categorical term to compare no prior notification to notification in 5th only, notification in 7th only, and notification in both 5th and 7th. Additionally, we reran the full model restricting data to: 1) 380 districts with retention ≥95% (included 64% of enrolled students); 2) 700 districts with a retention index >87% (included 98.3% of enrolled students); 3) districts with enrollment ≤75,000 (excluded 4 large districts); 4) the years 2004–2008 (to account for potential lack of institutional memory for earliest years of FITNESSGRAM administration). Finally, we reran the full model 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 5th, 7th, and 9th graders enrolled over the years 2001–2008 (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 but significant 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).

Researchers conducted telephone interviews with 429 (98%) of 438 K-8 districts and 355 (94%) of 376 K-12 school districts. Districts that did not respond to interview requests were not different in enrollment, proportion of students eligible for free 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 (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), slightly more African-American and Asian students, and were more urban than districts that did not notify (Table 2). Associations between missing data and free meals or BMI z-score (Table 1) did not vary by notification status ($p>0.186$ for all interaction terms). To notify parents of FITNESSGRAM results, most districts sent a letter either via U.S. 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% CI -0.03, 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 value for interaction term = 0.64). To determine if the proportion of obese students in a district modified the effect of BMI reporting, we included an interaction term between prior notification and district-level quartiles for the proportion of obese students (mean proportion of students with a BMI ≥95th percentile across all data years). While there was significant interaction between prior notification and quartile of proportion of obese students ($p<0.001$), the effect was not significant within any quartile, nor was there a step-wise 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 5th and 7th grade students had an effect on pediatric obesity. While notifying parents of their child's weight status might be part of a multi-faceted approach to reducing obesity, these results suggest that current notification methods in 5th and 7th grade 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.[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 aren't 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 as 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 demonstrated this effect among both African American and white parents.[25] Chomitz et al further found that parents of children in Kindergarten through 8th grade reported being motivated to attempt lifestyle changes as a result of BMI reporting,[24] though it should be noted that the parents in Chomitz's study were of relatively high socioeconomic status. Also noteworthy is the fact that in Chomitz's study, 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 et al found that BMI reporting did not change parents' perceptions of their child's weight.[26] 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 around pediatric obesity that affect parents' willingness or ability to make changes. It will be particularly important to explore mental models among distinct race/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 one intervention difficult. A recent study employing a similar multi-faceted approach to alter the school environment demonstrated a significant impact on obesity, without implementing BMI screening and notification.[34] 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 high in fat or sugar during the school day appear 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 our 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.

Limitations

Several limitations should be considered in interpreting these findings. Misclassification of the predictor variable, which would decrease our ability to see an effect of BMI reporting, could occur if institutional memory is poor or if individual schools deviate from the district policy regarding notification. Additionally, if students changed districts between 5th and 9th grade and notification status differed between the old and new districts, their data would be 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 be misclassified, and sensitivity analyses would not address this.

We could not link data 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, due 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 meals; however, notification status did not modify this association so it is unlikely that this bias in missing data would affect our 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 vary (which will decrease precision of estimates), and may vary by school (which might bias results). Nonetheless, random error is not likely an issue given our 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 our results for the effect of notification.

The widespread use of BMI screening and reporting is heartening as 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 appear 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.

Acknowledgments

Support: RWJF Active Living Research Grant 65715, NICHD 1K23HD054470-01A1, and American Heart Association 0865005F. No funders were involved in any aspect of the analyses contained herein or in the preparation of this manuscript.

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TABLE 1

Enrollment and BMI record data

	2001	2002	2003	2004	2005	2006	2007	2008	Partial correlation[e] (p<0.05) for % data available and: FRPM	BMI z
# Districts included [a]	755	755	756	756	758	758	758	758		
Enrollment (000's), grades 5, 7, 9	1,148	1,170	1,205	1,212	1,226	1,220	1,210	1,191		
Valid BMI records (000's)	726.8	788.5	809.3	853.2	915.5	952.1	953.2	968.4		
African American	68.9	64.4	68.4	73.2	75.7	75.4	74.6	72.8		
American Indian	5.7	5.4	5.1	3.8	3.5	3.2	3.0	3.3		
Asian	84.3	96.5	99.7	105.6	116.1	123.7	122.5	125.3		
Hispanic	289.8	338.0	349.1	382.9	421.6	448.3	462.7	479.5		
Non-Hispanic white	238.1	256.7	262.9	267.8	279.6	280.9	274.4	271.2		
Other	40.0	27.5	24.1	19.8	18.9	20.7	16.0	16.4		
Valid BMI records as % 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[b]	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.13	0.15
Data redacted[c]	10.3%	7.0%	8.8%	7.7%	8.8%	8.2%	8.2%	8.5%	0.06	
Absent or Excused	11.5%	7.4%	6.5%	6.9%	6.8%	6.1%	5.6%	5.1%		
Other[d]	14.6%	18.0%	17.4%	15.0%	9.5%	7.3%	7.2%	4.9%	0.09	

[a] CA K8 and K12 districts interviewed with enrollment data available.

[b] Biologically implausible BMI, according to the CDC SAS program protocol.[15]

[c] 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.

[d] 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.

[e] FRPM: proportion students in district eligible for free or reduced-price meals; BMI z: mean student BMI z-score in district. Correlations did not differ significantly by year for any association.

Table 2

Differences in district-level factors by notification status in 2001 and 2008

	Notification Status in 2001			Notification Status in 2008		
	Yes (n=261)	**No (n=494)**		**Yes (n=386)**	**No (n=372)**	
	Mean ± SD or Median [IQR]*		**p-value**	**% or Mean ± SD or Median [IQR]**		**p-value**
Enrollment	566[95, 1679]	290[77, 1108]	**0.012**	530[101,1683]	199[51, 1006]	**<0.001**
% Valid data	68%[0%, 83%]	59%[0%, 79%]	**0.025**	85%[55%, 92%]	73%[0%, 88%]	**<0.001**
% Redacted data	8%[3%, 30%]	10%[3%, 37%]	0.897	6%[2%, 25%]	10% [2%, 43%]	**0.034**
% Missing/invalid data	11% [5%, 22%]	12% [4%, 26%]	0.414	6% [3%, 10%]	7% [3%, 17%]	**0.003**
% Students eligible for free or reduced- price meals	43% [22%, 65%]	46% [26%, 67%]	0.150	51% [32%, 72%]	56% [36%, 73%]	0.075
BMI z-score	0.57 ± 0.29	0.62 ± 0.27	**0.046**	0.59 ± 0.28	0.61 ± 0.28	0.442
% Students w/BMI ≥ the 95th percentile	16.3% ± 7.0%	16.2% ± 7.7%	0.856	18.9% ± 8.2%	18.9% ± 7.9%	0.980
Race/ethnicity (%)†:						
Hispanic	24% [9%, 47%]	23% [10%, 50%]	0.478	31% [13%, 60%]	28% [10%, 57%]	0.317
Non-Hispanic white	60% [30%, 78%]	60% [29%, 78%]	0.998	49% [20%, 67%]	50% [21%, 74%]	0.091
Asian	3% [2%, 9%]	2%[1%, 6%]	**<0.001**	3% [1%, 8%]	2% [1%, 6%]	**<0.001**
African-American	2% [1%, 4%]	1% [0%, 4%]	**0.022**	2% [1%, 4%]	1% [0%, 3%]	**0.001**
Native American/American Indian	1% [0%, 1%]	1% [0%, 2%]	0.443	1%[0%, 1%]	1%[0%, 2%]	0.925
Urban level**	4.0 [3.0, 7.0]	4.7 [3.0, 7.0]	**0.007**	4.0 [3.0, 7.0]	5.3 [3.0, 7.0]	**<0.001**

*Median and interquartile range (IQR) are displayed for non-normally distributed variables and the Wilcoxon Rank Sum (Mann-Whitney U) was used to test differences.

**Urban level was from 2007-2008 school year

†Race data come from district-level CDE records. Race for the balance of students was "Other."

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, +0.01]	0.21
Female	−0.11 [−0.12, −0.10]	<0.001
Students eligible for free or reduced-price meals(per 10% increase)	0.04 [+0.04, +0.05]	<0.001
Grade (vs. 5th grade)		
7th grade	−0.04 [−0.06, −0.03]	<0.001
9th grade	−0.04 [−0.06, −0.02]	<0.001
Race/Ethnicity (vs. Non-Hispanic white)		
African American	0.21 [+0.19, +0.22]	<0.001
American Indian	0.19 [+0.15, +0.23]	<0.001
Asian/PI	−0.08 [−0.10, −0.05]	<0.001
Hispanic	0.35 [+0.33, +0.37]	<0.001
Cohort year (vs. 2001)		
1999	−0.03 [−0.04, −0.01]	0.002
2000	−0.02 [−0.03, −0.00]	0.007
2002	0.00 [−0.01, +0.01]	0.70
2003	0.02 [+0.01, +0.02]	<0.001
2004	0.00 [−0.01, +0.01]	0.37
2005	0.02 [+0.01, +0.03]	<0.001
2006	0.02 [+0.01, +0.03]	0.001
2007	0.01 [+0.00, +0.02]	0.019
2008	0.02 [+0.01, +0.03]	<0.001

Table 4

Impact of prior notification on BMI z-score, by quartile of proportion of obese youth (mean over years 2001–2008)

Proportion of obese students	Coefficient [95% CI] for prior notification*	p value
Quartile 1: 168 Districts with 0% to13.33% obese youth	0.001 [−0.030, 0.033]	0.93
Quartile 2: 175 Districts with 13.35% to 18.18% obese youth	−0.022 [−0.050, 0.006]	0.13
Quartile 3: 175 Districts with 8.19% to 23.58% obese youth	0.007 [−0.181, 0.032]	0.58
Quartile 4: 171 Districts with 23.60% to 72.73% obese youth	−0.015 [−0.043, 0.012]	0.28

*Fully adjusted model