



Diet quality of elementary and middle school teachers is associated with healthier nutrition-related classroom practices

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ABSTRACT

Many schools have implemented policies and programs to address childhood obesity. However, few have evaluated obesity-related health behaviors among teachers, or how these behaviors may be associated with teachers' nutrition-related practices in the classroom setting. This cross-sectional study utilized data from teachers employed in 20 schools representing three public school districts in a mid-Atlantic state from 2017 to 2019 to examine associations between teachers' diet quality and their nutrition-related classroom practices (e.g. rewarding students with food; modeling healthy diet behaviors). Measures included: one 24-h dietary recall summarized via healthy eating index (HEI-2015; higher scores indicate better diet quality; Range: 0–100); demographics, self-reported height/weight (BMI; $\geq 25 \text{ kg/m}^2$ = overweight/obese), and nutrition-related classroom practices (10 item survey; sum score range: 0–40; alpha = 0.65; higher score = more health-promoting practices). Associations between HEI and nutrition-related classroom practices were assessed in multilevel models, adjusting for covariates (gender, race/ethnicity, age, income, BMI, years teaching) and controlling for within-school effects. Of 331 teachers recruited, 116 (35.0%) completed both the optional dietary recall and incentivized survey (analytic sample: 89% female; 45% black; 79% overweight/obese; BMI = 30.5 ± 7.1 ; aged 41.1 ± 11.8 years). Means and standard deviations were calculated for HEI (52.2 ± 12.2) and nutrition-related classroom practices sum score (25.4 ± 5.9). For every one-unit increase in HEI, there was a 0.20 increase in nutrition-related classroom practices score (SE = 0.05; $p < 0.001$), which remained significant in the adjusted model. To better inform obesity prevention efforts, future studies should collect data among both students and teachers and explore the mechanisms through which teacher health behaviors may impact student health behaviors.

1. Introduction

Children spend a larger portion of their time at school than in any other environment outside the home, consuming up to 50% of their total daily calories during school hours (Story et al., 2009). Thus, school environments play a critical role in promoting healthy eating (McGuire, 2012; Waters et al., 2011), and are commonly targeted for obesity prevention programs. Teachers can exert a large influence on students'

dietary intake and health-related behaviors, given that over half of obesity-prevention programs involving nutrition or dietary behaviors are intended for implementation by teachers (Ickes et al., 2014).

In addition to serving as delivery agents for structured programs, teachers serve as role models for their students, given their close proximity and interaction throughout the school day (Swinburn et al., 1999). They may support healthy student behaviors through role modeling healthy eating behaviors, incorporating personal nutrition

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knowledge into daily classroom activities, and avoiding unhealthy classroom food practices (i.e., food rewards or food-based celebrations) (Kubik et al., 2002; Food & Nutrition Service U, 2016).

Despite this influence, teachers' own obesity-related behaviors, particularly during the school day, are understudied. Further, few studies have examined the relationship between teachers' individual dietary behaviors and their classroom practices related to healthy eating. Studies in small, regional samples suggest that teacher dietary behaviors may not align with national dietary recommendations, with frequent consumption of a high fat diet and purchasing sugary beverages or calorically-dense snacks from school vending machines (Kubik et al., 2002; Hartline-Grafton et al., 2009). To improve school-based obesity prevention efforts, more information is needed about teachers' dietary behaviors, and how those behaviors are associated with nutrition-related classroom practices. This study explores these relationships; we hypothesized that teachers with healthier diet quality (i.e. balanced diet largely meeting national dietary guidelines) would incorporate more positive nutrition-related practices into the classroom.

2. Materials and methods

2.1. Recruitment

Teachers and staff employed at schools participating in the Wellness Champions for Change (WCC) study (Lane et al., 2018) were eligible to participate in a supplemental study of teacher and staff health behaviors. WCC is a school-based cluster randomized controlled trial examining the impact of school wellness policy implementation on student health behaviors. Elementary ($n = 11$), Middle ($n = 5$) and mixed Elementary/Middle ($n = 4$) schools were recruited from three school districts. Teachers and staff were invited to participate through lunch meetings hosted by WCC staff, school staff meetings, e-mails, and print advertisement. Participants received a \$10 gift card incentive for completing a survey. Completion of the dietary recall was not financially incentivized and was therefore included as an optional component of the study. Teachers who completed the voluntary dietary recall were offered a free dietary assessment with a registered dietitian (RD) as a means to increase participation. Only classroom teachers and teaching assistants participating in the larger study were included in this analysis.

2.2. Teacher survey

Teachers provided written informed consent and were emailed electronic survey links [Qualtrics Version 2017.11 (Provo, UT)].

Nutrition-related Classroom Practices. Teachers completed an adapted version of the Perceptions of the Environment at School (PEAS) survey (Lane et al., 2018). This survey consists of 40 items assessing students' perceptions of policies, physical environment, and practices related to healthy eating and physical activity at school, including a 16-item subscale focused specifically on the classroom. For teachers, questions were slightly adapted (e.g., "my teacher is a good role model for healthy eating" to "I am a good role model for healthy eating"). Analyses used a subscale of 10 nutrition-related items (removing 6 physical activity-specific items; nutrition-related items listed in Table 1). Survey responses consisted of 5-option Likert-type response sets (0 = "never" to 4 = "always"). Responses were summed (Range: 0–40); higher scores indicated healthier practices.

Demographics. Self-reported demographic data included teacher gender, race/ethnicity, age, income, role in school and length of time working in schools.

Weight Status. Height and weight were self-reported and used to calculate Body Mass Index ($BMI = \text{weight}/\text{height}^2$).

2.3. Dietary intake

Dietary intake data for one 24-h recall were collected and analyzed using the Automated Self-Administered 24-h (ASA24) Dietary Assessment Tool (version 2016) developed by the National Cancer Institute, Bethesda, MD (Kirkpatrick et al., 2014; Subar et al., 2012). Data analysis files provide data on energy, 64 nutrients, and 37 USDA Food Patterns components, including total energy (kcal), daily servings of fruits and vegetables, added sugar (tsp), and sodium (mg) intakes (Subar et al., 2012). Teachers were prompted at random via email to complete the ASA-24. The dietary recall was used to calculate diet quality using the HEI-2015 (Krebs-Smith et al., 2018) which includes 13 components reflecting key recommendations from the 2015 to 2020 Dietary Guidelines for Americans. Total scores ranged from 0 to 100; higher scores indicated higher overall diet quality. Higher scores for nine components indicate higher daily consumption: Total fruits (5 points); Whole fruits (5); Total vegetables (5); Greens and beans (5); Whole grains (10); Dairy (10); Total protein foods (5); Seafood and plant proteins (5); Fatty acids (10). For four components, higher scores indicate lower daily consumption: Refined grains (10); Sodium (10); Added sugars (10); Saturated fats (10).

2.4. Statistical analysis

Data were analyzed using SAS version 9.4 (SAS, Cary, NC). Means and standard deviations were calculated for continuous variables and presented unless otherwise specified, and frequencies were calculated for categorical variables. Cronbach's alpha described internal consistency for the nutrition-related classroom practices sum score. Multilevel models were used to determine associations between the dependent variable, nutrition-related classroom practices sum score and the independent variable, HEI, including a random intercept at the school level to account for clustering within schools. Crude models adjusting only for the random intercept were run, followed by full models including covariates (gender, race/ethnicity, age, income, BMI, years teaching).

3. Results

Of the 331 classroom teachers and teaching assistants recruited from 20 schools, 318 (96.1%) had complete survey data. Of these, 116 (36.5%) also completed the voluntary dietary recall. There were no significant differences between teachers who completed the survey and optional dietary recall compared to teachers who completed the survey alone in PEAS sum score, gender, race/ethnicity, age, income, and BMI (p 's ≥ 0.05).

The sample was primarily female (89%), white (49%) or non-Hispanic black (45%), with a mean age of 41.1 ± 11.8 years (Range: 22–68), and 79% self-reported height and weight classifiable as overweight/obese (mean BMI $30.5 \pm 7.1 \text{ kg}/\text{m}^2$). The majority (70%) had worked in schools for more than five years.

The mean HEI score was 52.2 ± 12.2 (Range: 26.8–85.2). Mean daily energy intake was $1804 \pm 815 \text{ kcal}$. On average, teachers consumed fewer than 3 combined daily servings of fruits (0.89 ± 1.0) and vegetables (1.8 ± 1.5) and consumed approximately 14 teaspoons of added sugar daily (13.6 ± 13.2). Mean daily sodium intake was $3260 \pm 1554 \text{ mg}$ (data not shown). BMI was negatively associated with HEI score ($r = -0.21$; $p = 0.04$), but age, gender, income, and number of years teaching were unrelated to HEI score (p 's > 0.10).

The mean nutrition-related classroom practices score was 25.4 ± 5.9 ($\alpha = 0.65$; Range: 3–38; Table 1). Approximately half of teachers reported that they always agree with the statement, "I care about making my school a healthier place" (48%) and 41% reported that they are a good role model for healthy eating always or most of the time. While 96% of teachers reported drinking water in front of their students during the school day, most (77%) reported rewarding

Table 1
Percentage of teachers reporting nutrition-related classroom practices from a mid-Atlantic state, 2017–2019.

Nutrition-related Classroom Practices	Never	Once in a while	Sometimes	Most of the time	Always
I let my students drink water in class	5.2%	7.0%	11.3%	23.5%	53.0%
I let my students eat snacks in class	23.7%	36.8%	20.2%	10.5%	8.8%
I give my students treats like candy when they do a good job in class*	23.5%	38.3%	27.8%	8.7%	1.7%
I tell my students it is important to eat healthy foods	6.3%	17.9%	25.9%	31.3%	18.8%
I eat healthy meals or snacks in front of my students during the school day	19.1%	13.9%	27.8%	17.4%	21.7%
I drink water in front of my students during the school day	3.5%	10.4%	18.3%	23.5%	44.4%
I drink sugary drinks or non-diet soda in front of my students during the school day*	59.1%	25.2%	10.4%	3.5%	1.7%
I care about making my school a healthier place	0.9%	1.7%	19.1%	30.4%	47.8%
I am a good role model for healthy eating	2.6%	18.3%	38.3%	27.8%	13.0%
I allow my students to eat things like candy, chips, cupcakes or desserts when my class has parties or celebrations during the school day*	15.7%	25.2%	26.1%	22.6%	10.4%

* Item reverse coded in sum score.

students with treats and allowing sugary foods during classroom parties and celebrations (84%). Approximately 40% reported drinking sugary beverages in front of students.

When accounting for the influence of school-level factors in a crude regression model, for every one-unit increase in HEI, there was a 0.19 increase in nutrition-related classroom practices score (SE = 0.04; $p < 0.001$; Table 2). After additional adjustment for all covariates, for every one-unit increase in HEI score, there was a 0.20 increase in nutrition-related classroom practices score (SE = 0.05; $p < 0.001$). Because the HEI score ranges from 0 to 100, for every 10-point increase in HEI, the nutrition related classroom sum score increased by 2.0 points indicating higher dietary quality was associated with healthier nutrition-related classroom practices. BMI, age, gender, income, and number of years teaching were unrelated to nutrition-related classroom practices (p 's > 0.10).

4. Discussion

In this study, the overall diet quality of teachers in our sample was low. This adds to the limited literature regarding dietary habits and overall dietary quality of teachers. There are approximately 3.7 million full-time elementary and secondary school teachers engaged in classroom instruction in the U.S. who have the potential to influence nearly 56.6 million students (Statistics NCFE, 2019). Our study demonstrated

Table 2
Crude and Adjusted Associations between HEI Score and Nutrition-related classroom practices sum score of teachers from a mid-Atlantic state, 2017–2019.

	Nutrition-related Classroom Practices Sum Score*			Adjusted Nutrition-related Classroom Practices Sum Score*		
	B	SE	p	B	SE	p
Total HEI Score	0.189	0.04	< 0.001	0.201	0.05	< 0.001
BMI				-0.083	0.09	0.40
Age				-0.049	0.07	0.51
Gender (Male vs female)				-1.270	1.82	0.49
Race (Black vs other)				0.313	1.29	0.81
Income (0–69,999)				ref		
Income (70,000–89,999)				1.369	1.77	0.44
Income (≥ 90,000)				-0.746	1.51	0.62
Years teaching (First year to 5 years)				ref		
Years teaching (6–15 years)				-1.937	1.58	0.22
Years teaching (≥ 16 years)				0.933	2.18	0.67

* Adjusted for school as random intercept.

that diet quality had a small but significant relationship with teachers' nutrition-related classroom practices. Previous studies demonstrate that improving teacher behavior can improve student behaviors, including one study that found students were more likely to drink water if their teachers reported drinking water in front of students during the school day (Laguna et al., 2019). In our sample, the majority of teachers reported drinking water in front of students. Few, however, reported consistently role-modeling healthy eating in the classroom. There is evidence that role-modeling healthy dietary behaviors may make a difference in students' diet. For example, another study documented an increase in fruit intake of children whose teachers consumed fruit during the school day, an effect that was sustained over a 1 year period (Perikkou et al., 2013). Dietary intake in our study was similar to prior reports in teachers (Hartline-Grafton et al., 2009) and aligns with a pattern consisting of few fruits and vegetables alongside high consumption of added sugars and sodium. Likewise, this is consistent with our finding that many reported low diet quality and consumption of sugary drinks or non-diet soda in front of students. The majority of the teachers in our study reported that they cared about making their school a healthier place. Given the strong associations between healthier dietary intake and reduced chronic disease risk (Wiseman, 2008), interventions to improve teacher dietary behaviors are warranted, as intervention benefits may benefit both teachers and students' health-related behaviors.

In addition to personally modeling healthy eating behaviors, teachers are in a unique and important position to support healthy behaviors for students by avoiding unhealthy classroom practices, and creating environments more conducive to healthy eating (Ickes et al., 2014; Kubik et al., 2002; Findholt et al., 2016). Our study demonstrated that allowing sugary foods during classroom parties and celebrations, as well as rewarding students with foods such as candy occurred regularly. Such practices may continue if teachers experience personal, social, or environmental barriers to healthy eating, such as limited knowledge or a personal aversion toward healthy foods (Schultz et al., 2019). Because implementation of best-practices in schools often relies on teachers, it is vital that future studies include not only student-specific outcomes, but also teacher-specific outcomes whenever feasible. In addition to using novel instruments like our PEAS survey, which asks teachers about their classroom practices rather than relying on administrators who may be unaware of individual teacher classroom practices, we recommend the use of qualitative and/or mixed methods. Such methods would improve the limited understanding of the complex barriers teachers face in not only improving their own diet quality, but also implementing healthier nutrition-related classroom practices that benefit their students.

We acknowledge several limitations. This study is subject to the well-known limitations related to underreporting energy intake in self-reported dietary intake data (Schoeller et al., 1990). However, the ASA24 program was created from NHANES What We Eat In America Automated Multiple Pass Method which has been validated for energy

and sodium against objective measures (Moshfegh et al., 2008). Foods containing added sugars and sodium are thought to be underreported, whereas fruits and vegetables may be overreported (Macdiarmid and Blundell, 1998). Therefore, it remains possible that reported dietary quality in our population of teachers was overestimated, despite the fact our sample reported a high intake of added sugars, sodium and low intakes of fruits and vegetables, consistent with national reports of sub-optimal dietary intakes. Reasons for low diet quality among teachers should be explored in future studies. The participation rate for the dietary recall was low, so there may be participation bias. However, recall respondents did not demographically vary from non-responders. Future studies should incorporate dietary recalls into survey instruments to improve response rates. Another limitation is the reliance on self-reported height and weight, as individuals tend to underreport weight and over report height. Given these assumptions, it is possible that the rate of overweight and obesity is even higher than what is reported. Finally, despite having a fairly diverse sample by age and race/ethnicity, our study was limited to one mid-Atlantic state and was predominantly female. The gender distribution in our study is slightly higher than the female gender reported nationally among public school teachers (77% overall) (Goldring et al., 2014).

In summary, to our knowledge, this is novel in that it assessed teachers' diet quality in association with food-specific classroom behaviors. Results show that teachers had fairly unhealthy personal dietary habits, and those with the least healthy diets were more likely to engage in classroom practices that could adversely impact their students' dietary patterns. The significant association between dietary quality of teachers and their current classroom practices may have practical implications for the physical health of students and for developing future studies to explore the mechanisms through which teacher health behaviors may impact student health behaviors. Further work is also needed to identify effective interventions to improve teachers' nutrition-related classroom practices, however, the current work helps to identify those who may stand to benefit the most from such interventions.

CRedit authorship contribution statement

Elizabeth A. Parker: Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Project administration, Funding acquisition. **Termeh M. Feinberg:** Formal analysis, Writing - review & editing. **Hannah G. Lane:** Writing - review & editing, Supervision. **Rachel Deitch:** Supervision, Project administration, Writing - review & editing. **Amy Zemanick:** Data curation, Writing - review & editing. **Brit I. Saksvig:** Writing - review & editing. **Lindsey Turner:** Writing - review & editing. **Erin R. Hager:** Supervision, Writing - review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Authorship

E.A.P., as principal investigator, secured project funding to collect data among teachers and is the primary author. R.D. and A.Z. were responsible for data collection and data management. T.M.F. contributed to statistical analyses. B.I.S. and L.T. advised on all aspects of the manuscript and contributed to manuscript revisions. E.R.H. is the principal investigator on the larger parent study, Wellness Champions for Change and advised on all aspects of the manuscript and contributed to manuscript revisions.

Ethical standards disclosure

This study was conducted according to the guidelines from the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the University of Maryland IRB and the IRBs of the participating state counties. Written informed consent was obtained from all subjects/patients.

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