Social Science & Medicine 191 (2017) 151–159

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Exploring associations between state education initiatives and teachers' sleep: A social-ecological approach

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ARTICLE INFO

Article history:
Received 2 June 2017
Received in revised form
7 September 2017
Accepted 11 September 2017
Available online 12 September 2017

Keywords:
Health Impact Assessment
Teacher stress
Policy

ABSTRACT

Social policies that are not specifically aimed at impacting health can still have health consequences. State education reforms, such as standardized testing and stringent accountability for schools and teachers, may affect teacher health by changing their working conditions. This study explores associations between state education initiatives and teachers' sleep, an important predictor of productivity and chronic health conditions. The Behavioral Risk Factor Surveillance System 2013 and 2014 data sets provided sleep and demographic data for 7836 teachers in 29 states in the United States. We linked the teacher data to state education reform data from the U.S. Department of Education. Logistic regression was used to estimate odds ratios (ORs) of reporting inadequate sleep (i.e., <6.5 h and <5.5 h) associated with state education policies after adjusting for demographic characteristics. Teachers had significantly higher odds of reporting inadequate sleep if their state financed professional development, sanctioned or rewarded schools based on student performance, and regulated classroom materials for state-wide common core standards (ORs ranging from 1.25 to 1.84). More strictly defined inadequate sleep (<5.5 h) had generally higher ORs than less strict definition (<6.5 h). The Race-to-the-Top award, a US federal grant designed to encourage states to implement reforms through regulations and legislations, was also associated with inadequate sleep (OR = 1.41, $p < 0.01$, for <6.5 h; OR = 1.55, $p < 0.01$, for <5.5 h). Although this exploratory study did not have district- and school-level implementation data, the results suggest that some state education policies may have impacts on teacher sleep. Consequences of education reform for teacher health deserve more attention.

Published by Elsevier Ltd.

1. Introduction

Some social policies are directly aimed at impacting health and safety, such as seat belt laws and smoking bans, and thus are evaluated for their intended effects (Brownson et al., 2009). However, other policies (e.g., transportation, housing, immigration) can also have health impacts by changing social processes. Health implications of such policies are important to evaluate as well. For example, Hatzenbuehler et al. (2017) examined state-level immigration-related policies (e.g., access to driver's license, eligibility for workers' compensation) and reported that restrictive policies are associated with poor mental health among Latinos, regardless of their immigration status. Various public health institutions, including the U.S. Centers for Disease Control and Prevention (CDC), have adopted the Health Impact Assessment (HIA), or the movement to assess all public policies for their population health impacts (Dannenberg et al., 2008; Krieger et al., 2003). So far in the United States, HIAs have been conducted mainly in regards to land-use and housing-development policies (Dannenberg et al., 2008). Expanding the scope of HIA, this study explores state-level education reforms for their potential impacts on teacher health.

Recent education reforms in the United States – starting with

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http://dx.doi.org/10.1016/j.socscimed.2017.09.019
0277-9536/Published by Elsevier Ltd.

the No Child Left Behind (NCLB) Act of 2001 and followed by the Common Core State Standard (CCSS) Initiative and the Race-to-the-Top (RTTT) program in 2009 – have increased attention to standardized tests and the role of teachers in improving student performance (Darling-Hammond, 2013). Setting goals for student learning, education initiatives inevitably shape working conditions for teachers. However, impacts of education reform on teacher health has rarely been discussed. It is important to recognize teachers as workers, rather than simply as a component of the education system, so that unintended consequences of education initiatives for teachers be considered. With a large national data set and publicly available education reform data, this study explores associations between state education reform and teacher well-being measured by sleep duration.

1.1. Teacher stress and health: An understudied topic

The social-ecological framework for occupational health clearly indicates the link from social policies to working conditions and ultimately to worker health (Grzywacz and Fuqua, 2000; Landsbergis et al., 2014; Lipscomb et al., 2006). One important mechanism that links working condition to health is occupational stress. In the last several decades, occupational stress research has established psychosocial work environment (e.g., job demands, job control) as important factors influencing health (De Lange et al., 2003; Ganster and Rosen, 2013). Exposure to high job demands or lack of job control triggers a cascade of endocrinological reactions ("fight or flight"), which can harm various physiological functions over time from the immune system to metabolic and cardiovascular systems (McEwen, 1998).

While the job stress literature has flourished the last several decades, it does not inform us specifically about teacher stress and health. In epidemiologic studies that include multiple occupations, teachers are typically categorized with other professionals to form the reference group. In their seminal work on the demand-control model of job stress, Karasek and Theorell (1992) showed that teachers experience high demands but also high job control, similar to physicians and bank executives. In some occupation-specific studies, teachers are recruited specifically to serve as a low-risk comparison group (e.g., compared to flight attendants, Whelan et al., 2003). These practices indicate that teachers are seen as not particularly at risk. As a result, little epidemiologic knowledge on teacher health has been accumulated thus far.

A separate line of research has developed specifically to addresses teacher stress, mainly within the field of education research and frequently conducted or commissioned by teacher associations and labor unions. Entirely focused on "unpleasant, negative emotions […] resulting from some aspect of their work as a teacher" (Kyriacou, 2001) (p. 28), this small literature has paid little attention to teacher health beyond emotional well-being. In their review, Guglielmi and Tatrow (1998) concluded that teacher stress research "is characteristically of very poor quality and that substantial improvements need to be introduced before definitive statements can be made" (p. 81). A more recent review (Van Droogenbroeck and Spruyt, 2015) came to the same conclusion. The teacher stress literature has never been integrated with the mainstream occupational stress research, which could have helped strengthen the teacher stress research by employing epidemiologic approaches. Consequently, little is known about teacher health or its link to working conditions.

1.2. Education reform, teacher working conditions, and teacher stress

Working conditions for teachers are directly and indirectly influenced by education reforms. In response to NCLB and CCSS, and spurred by RTTT, a large federal grant competition designed to "trail-blaze effective reforms" (http://www2.ed.gov/programs/racetothetop/index.html), states have enacted a wide variety of initiatives related to student and teacher performance. These initiatives include regulations and legislation regarding high-stakes standardized testing, teacher evaluation on the basis of student achievement, and general accountability models that hold teachers, schools, and districts accountable for student performance. Opponents of these reforms claim that these accountability initiatives have added demands to teachers and disproportionately impact those who serve low-income and otherwise disadvantaged student populations (Darling-Hammond, 2013). If teachers are held accountable for poor performance of students from, for example, impoverished or violent neighborhoods, teachers are likely to experience low levels of job control, which is consistently associated with poor health (De Lange et al., 2003). Accountability policies are thus likely to be associated with poor health among teachers.

Other education policies are also likely to impact teacher health. Following the passage of NCLB and its increased focus on teacher qualification, many states now encourage or mandate professional development. After adopting CCSS, some states also placed requirements on classroom materials to align with the CCSS goals. Carter and Welner (2013) caution that these practices contribute to "the present challenging conditions of public education and the lack of respect for the teaching force," (p. 225–6). The lack of respect in and of itself is a stressor associated with poor health (Fujishiro and Heaney, 2009). While the opportunity for professional development may be desirable, it can increase job demands and scrutiny for teachers. The state monitoring of instructional materials may limit teacher job control. Because high demands and low control define high job strain (Karasek and Theorell, 1992), state policies regarding professional development and CCSS material requirements may be associated with poor health.

Although several studies have addressed education policies from a teacher stress perspective (Berryhill et al., 2009; Conley et al., 2005; Smith and Kovacs, 2011), they typically relied on teachers' report on how stressful education policies are (e.g., "For me, policies to increase student academic performance overall put more stress in my job," "… overall add a lot of burdens to my job," Berryhill et al., 2009) and associated the teacher perception with outcomes such as burnout and career dissatisfaction. This approach limits the analysis at the individual level—*perceptions* of policies and job attitudes—rather than directly examining education policies and their consequences. One exception is a study by Grissom et al. (2014): using a time-series design and a large national sample of teachers, they examined time trends before and after NCLB in teachers' reports on working conditions as well as job satisfaction, an important predictor of physical and mental health (Faragher et al., 2005). Their results were largely inconclusive, however, possibly because of the lack of state-level NCLB implementation data. There is a clear paucity of research on education reform and teacher health.

1.3. Sleep as an indicator of teacher health

In this study, we focus on sleep duration as an indicator of teacher health. Sleep is sensitive to the quality of work

environment. A recent review of prospective studies (Linton et al., 2015) concluded that components of job stress (e.g., high work demands, low job control) were prospectively associated with sleep disturbance. High work demands, lack of support, and inability to stop thinking about work are all associated with difficulty falling asleep and premature or frequent awakening (Åkerstedt et al., 2002; Querstret and Cropley, 2012), resulting in inadequate sleep. Moreover, inadequate sleep may influence the experience of job stress itself (Törnroos et al., 2017), thereby perpetuating the cycle of poor sleep and high stress. Sleep has also been associated with work performance, especially cognitive function (Fortier-Brochu et al., 2012; LeCheminant et al., 2015; Rosekind et al., 2010), an important issue for teacher effectiveness. Finally, inadequate sleep is associated with various chronic conditions such as obesity (Buxton and Marcelli, 2010; Spiegel et al., 2009), diabetes (Buxton and Marcelli, 2010), high cholesterol (Gangwisch et al., 2010), and hypertension (Buxton and Marcelli, 2010; Gangwisch et al., 2006). If certain education reforms are associated with inadequate sleep among teachers, then these reforms may impact not only teacher performance but also their long-term health.

1.4. The current study

To summarize, teacher stress and health have been understudied in the occupational stress research. In today's contentious environment surrounding teachers, it is important to consider unintended consequences of education policies for teacher well-being. This study examines the association between state-level education reform and sleep duration among teachers. We focus on selected state initiatives in response to NCLB and CCSS adoption. We also examine RTTT participation as a summary measure of the state's overall reform efforts, which may not be represented in the selected individual initiatives. Because states have different approaches and timelines to fulfill federal mandates, we can examine how these differences across states are associated with teacher sleep. As discussed earlier, we expect accountability policies, professional development requirements, and state oversight on instructional materials would be associated with shorter sleep; however, because very few studies have specifically addressed teacher health as a function of education policies, we consider this as an exploratory study. Our objective is to stimulate future research on potential health implications of education reform.

2. Methods

2.1. Data sources

Teachers' data were extracted from the Behavioral Risk Factor Surveillance System (BRFSS), an ongoing national phone interview survey conducted by CDC and administered by states. In 2013 and 2014, a total of 29 states chose to collect information about each participant's occupation. For this analysis, we selected those who were working at the time of BRFSS data collection and had the 2000 Standard Occupation Codes (SOC) for “elementary and middle school teacher (25–2020 or 2021)” (n = 6748) or “Secondary school teacher (25–2030 or 2031)” (n = 1770). Preschool and kindergarten teachers (n = 703) and teachers' assistants (n = 1371) in BRFSS were not included because their experience with state education reforms may differ from other teachers. We also decided not to include special education teachers (n = 349) because their small number made it infeasible to examine state-specific special education policies. Among the 8518 primary and secondary school teachers, those without a bachelor's degree (n = 667) were removed. As teaching certificate requires a bachelor's degree, they likely represent a distinct population of teachers (e.g., short-term or emergency hires, teachers in unique or specialized electives and hard-to-staff content areas) who may be less susceptible to the pressure of statewide education reform. Finally, we removed 15 respondents who did not report sleep duration. After applying these exclusion criteria, we had 7836 primary and secondary school teachers for analysis. Because BRFSS was not designed for occupational research, it did not collect any further occupational information such as job tenure, full-time or part-time, subject taught, and public or private school.

We obtained information on state education reform initiatives from the National Center for Education Statistics State Education Reform (NCES SER, http://nces.ed.gov/programs/statereform/), a program within the US Department of Education, which compiles and disseminates state-level education reform information. To ensure reform initiatives preceded teacher sleep data collected in the calendar year of 2013–2014, we used education reform information from the 2011–2012 school year.

2.2. Variables of interest

Sleep. BRFSS asked each participant, “On average, how many hours of sleep do you get in a 24-hour period?” The responses were recorded by the interviewer in whole numbers by rounding ≥30 min up to the next whole hour and dropping <30 min (e.g., “6 hour” represents self-reported sleep duration between 5 h 30 min and 6 h 29 min). In the 2015 joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society (Watson et al., 2015), 6 h of sleep or less was identified as “inappropriate to support optimal health in adults” (p. 1169) and 7–9 h appropriate; however, the review panel could not reach consensus regarding sleep duration between 6 and 7 h. Because of the BRFSS's rounding practice, we decided to use two cut-off points for inadequate sleep: “≤6 hour” (representing <6.5 h before rounding) and “≤5 hour” (representing <5.5 h). While the former includes the 6–7 h duration that consensus has not been reached, the latter clearly identifies inappropriate sleep duration for optimal health.

State education policies. We investigated three categories of post-NCLB state policies— professional development, test-based accountability for teachers and schools, and CCSS implementation—as potentially associated with sleep duration among teachers. Professional development requirements are likely to influence teacher workload. Accountability and CCSS implementation are high-profile state reforms that affected a large number of teachers and their work requirements. Specific initiatives we examined are presented in Table 1. In addition to these individual policies, we examined the RTTT award status (1 = awarded, 0 = not awarded/did not apply) to capture the state's overall orientation for education reform. To compete successfully for RTTT funds, states made assurances for (a) rigorous standards and aligned assessments; (b) data systems that allow for the measurement of student growth; (c) initiatives related to teacher and principal effectiveness and evaluation; and (d) consequences and interventions for the lowest-achieving school. Therefore, the RTTT award status can be considered a proxy for the extent to which each state had progressed toward post-NCLB and CCSS reform adoption.

Covariates. Some individual characteristics are associated with sleep and thus controlled for in our analysis. Age, sex, race,

Table 1
Number of states with each policy and estimated proportion of teachers under the policy in the BRFSS 29-state sample.

State policy[a] and Race to the Top participation[b]	Number of state with policy	% teachers under the policy	(SE for %)
Professional Development			
State requires districts to set aside time for professional development	10	30.8	(1.2)
State finances professional development for all districts	11	34.0	(1.1)
Accountability			
Teacher evaluation tied to student performance	9	39.5	(1.4)
State has a policy encouraging/allowing pay-for-performance (salaries or bonuses)	8	27.4	(1.1)
State sanctions low-performing schools and/or provides rewards to high-performing or improving schools	24	91.8	(0.4)
Common Core Implementation Support			
State requires district and school use of curricular materials	2	12.7	(0.9)
State approves/certifies lists of materials aligned with standards	10	34.7	(1.2)
State develops curricular and supplemental materials for voluntary use	19	58.5	(1.4)
State provides processes, protocols, and exemplars to district leaders and principals	25	84.8	(0.9)
Race-to-the-Top funds awarded	11	58.3	(1.5)

[a] National Center for Education Statistics, State Education Reform http://nces.ed.gov/programs/statereform/tables.asp).
[b] US. Department of Education Race to the Top Program (http://www2.ed.gov/programs/racetothetop/awards.html). SE=Standard error.

household income, marital status, and smoking status were all collected in BRFSS. Because BRFSS data were collected throughout the year, we created an indicator variable for data collected in July and August, summer months in which teachers typically have no school-related duties. Given that urban dwellers generally sleep less (Hale and Do, 2007), we identified the urbanicity of the county where each respondent resided. In addition, we obtained from NCES SER the percentage of schools in each state that achieved Adequate Yearly Progress (AYP) in 2011–12. AYP is based on school-level student performance on standardized testing, which is likely to influence the state's overall education policies and their implementation. We used data from all 50 states to calculate quartiles of the proportion of schools that achieved AYP, and applied those quartile cutpoints for the 29 states in our analysis.

2.3. Statistical analysis

Since all variables with missing data were categorical, we coded "missing" as an additional category and thereby kept all observations in the analysis. Although data were collected by states and thus participants were nested in states, preliminary analysis revealed that only a minuscule amount of variability (0.2%) in sleep duration was explained by resident state. For the sake of parsimony, we decided not to use the multi-level analysis. All analyses accounted for the BRFSS's complex sampling system, and appropriate weights were applied so that the standard error was estimated correctly. More specifically, we used the two-year combined sample weights and the DOMAIN statement in all analyses in SAS to identify the 7836 teachers as a subpopulation of interest within the entire BRFSS combined data set of 2013 and 2014 (n = 412,829). With the DOMAIN statement, the variance of each estimate for the subpopulation incorporates the variability of the subpopulation sample size and thus does not attenuate the variance. For descriptive statistics, we used PROC SURVEYFREQ to estimate the proportion of teachers who have each characteristic. For age, which is a continuous variable, we used PROC SURVEYMEANS.

We used logistic regression (PROC SURVEYLOGISTIC) to estimate the odds ratios (ORs) of reporting <6.5 h and <5.5 h of sleep associated with each of the state education initiative. In this exploratory study, the initiatives were examined one by one because we did not have particular *a priori* hypotheses for the combined effects of them. All regression models were adjusted for the covariates described above: age, age squared, sex, race, household income, marital status, smoking status, urbanicity (1 = living in a metropolitan area with a population of 250,000 or more, 0 = otherwise), data collection season (1 = July or August, 0 = other months), survey year, and the percent of schools in the resident state that achieved AYP in 2011 (in quartiles).

3. Results

Table 1 shows the number of states that have adopted each state education initiative and the proportion of teachers in our sample who are under the initiative. While a few were adopted by most states and therefore affected a large proportion of teachers, other initiatives had been adopted by only a few states. Table 2 displays the teacher characteristics. The average age was 44 years old; three-quarters were women, and 80% were white. These demographic characteristics are similar to the national composition of teachers (NCES, http://nces.ed.gov/programs/digest/d14/tables/dt14_209.10.asp?current=yes). More than a third of teachers (36%) choose not to report their marital status, but the proportion was similar to the BRFSS respondents in general (34%). In our sample, a vast majority (87%) lived in metropolitan areas, but not disproportionally to the entire population in the 29 states (86%). Nearly half (45%) of the teachers resided in states in which the proportion of schools that made AYP in 2011 was in the lowest quartile nationally. Overall, 28.3% of teachers reported <6.5 h of sleep and 4.7% reported <5.5 h of sleep.

Table 2 also shows the OR of reporting inadequate sleep associated with each demographic characteristic adjusted for all others in the table. Being black, having a household income of $15000-$24,999, and living in a metropolitan area were associated with a higher odds of reporting inadequate sleep. These associations did not change when policy variables were included in the models.

Table 3 presents the results from logistic regression for each education reform initiative. In the professional development category, state requirements to set aside time was not significantly associated with inadequate sleep. However, in states that provide financial support for professional development for all districts,

Table 2
Demographic characteristics of teachers in the 29 States, Behavioral Risk Factor Surveillance System 2013–14, and the odds ratios (OR) of reporting inadequate sleep duration associated with each characteristic adjusted for all others.

Characteristic	Distribution		<6.5 h of sleep		<5.5 h of sleep	
	Estimate	(SE)	OR	95%CI	OR	95%CI
Age, years, mean (SE)	44.2	(0.4)	0.94[1]	(0.85, 1.04)	1.08[a]	(0.91, 1.27)
Female	74.5	(1.3)	0.74	(0.57, 0.97)	1.03	(0.63, 1.68)
Race						
white	79.5	(1.4)	1.00		1.00	
black	8.5	(0.7)	2.46	(1.71, 3.55)	3.74	(2.11, 6.64)
Latino	6.5	(0.8)	1.55	(0.86, 2.80)	1.28	(0.51, 3.24)
Other	5.5	(1.1)	1.23	(0.62, 2.46)	2.01	(0.82, 4.96)
Household income						
< $15000	1.0	(0.4)	0.23	(0.06, 0.93)	0.71	(0.09, 5.87)
$15K-$24,999	1.5	(0.2)	1.49	(0.84, 2.63)	4.72	(2.04, 10.9)
$25K-$34,999	3.1	(0.5)	1.24	(0.73, 2.11)	1.96	(0.79, 4.90)
$35K-$49,999	11.4	(0.9)	1.03	(0.73, 1.46)	1.35	(0.81, 2.26)
$50K or more	77.4	(1.2)	1.00		1.00	
missing	5.7	(0.6)	0.87	(0.54, 1.39)	1.20	(0.56, 2.58)
Smoking status						
Current smoker	4.5	(0.6)	0.84	(0.51, 1.39)	1.64	(0.65, 4.17)
Former smoker	14.4	(0.8)	0.89	(0.66, 1.19)	1.53	(0.92, 2.54)
Never smoked	79.3	(1.0)	1.00		1.00	
missing	1.8	(0.3)	1.49	(0.78, 2.85)	1.23	(0.35, 4.34)
Marital status						
Married/have a partner	47.0	(1.4)	1.00		1.00	
Divorced/separated/widowed	7.1	(0.7)	1.07	(0.71, 1.63)	1.02	(0.48, 2.16)
Never married	10.4	(1.2)	0.82	(0.49, 1.38)	1.07	(0.50, 2.29)
missing	35.5	(1.1)	1.16	(0.75, 1.79)	1.34	(0.57, 3.16)
Lives in a metropolitan area[b]	87.1	(0.6)	1.37	(1.06, 1.76)	1.58	(1.06, 2.37)
% of schools in the resident state that achieved Adequate Yearly Progress[c]						
73% or higher (highest quartile)	18.5	(0.8)	1.00		1.00	
52–72%	20.8	(1.1)	1.20	(0.90, 1.60)	0.99	(0.62, 1.59)
38.5–51%	15.7	(0.9)	1.00	(0.71, 1.40)	0.85	(0.48, 1.51)
9–38% (lowest quartile)	45.0	(1.5)	0.92	(0.71, 1.19)	0.79	(0.50, 1.26)
Data collected in summer months (July, August)	21.8	(1.2)	0.81	(0.60, 1.08)	1.10	(0.66, 1.83)
Teach in secondary school (vs. elementary)	19.2	(1.0)	1.17	(0.89, 1.54)	1.08	(0.69, 1.68)
Reported <6.5 h of sleep	28.3	(1.2)	–		–	
Reported <5.5 h of sleep	4.7	(0.4)	–		–	

Notes. Unweighted n = 7836. SE = standard error. Data are reported as percent (standard error of percent) unless otherwise noted. Each OR is adjusted for all other demographic characteristics.
[a] Estimated for 10-year inclement in age.
[b] More than 250,000 population; USDA Rural-Urban Continuum Codes (http://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation.aspx).
[c] US Department of Education, National Center for Education Statistics (http://nces.ed.gov/programs/statereform/tab1_2.asp).

Table 3
Odds ratio (OR) of reporting <6.5 and <5.5 hours of sleep associated with state education policy.

State policy[a] and Race to the Top participation[b]	<6.5 h of sleep		<5.5 h of sleep	
	OR	(95%CI)	OR	(95%CI)
Professional Development				
State requires districts to set aside time for professional development	0.93	(0.72, 1.19)	0.87	(0.57, 1.34)
State finances professional development for all districts	1.25	(0.99, 1.57)	1.67	(1.10, 2.54)
Accountability				
Teacher evaluation tied to student performance	1.16	(0.91, 1.47)	1.11	(0.72, 1.69)
State has a policy encouraging/allowing pay-for-performance (salaries or bonuses)	1.19	(0.89, 1.60)	1.55	(0.94, 2.56)
State sanctions low-performing schools and/or provides rewards to high-performing or improving schools	1.43	(1.12, 1.81)	1.05	(0.67, 1.64)
Common Core Implementation Support				
State requires district and school use of curricular materials	1.17	(0.81, 1.70)	1.11	(0.57, 2.13)
State approves/certifies lists of materials aligned with standards	1.36	(1.07, 1.73)	1.84	(1.17, 2.88)
State develops curricular and supplemental materials for voluntary use	0.88	(0.71, 1.08)	0.85	(0.57, 1.28)
State provides processes, protocols, and exemplars to district leaders and principals	0.81	(0.61, 1.08)	0.98	(0.59, 1.63)
Race-to-the-Top fund awarded	1.41	(1.12, 1.78)	1.55	(1.04, 2.30)

Unweighted n = 7836. Each policy was evaluated separately. All models were adjusted for age, age-squared, sex, race, household income, smoking status, marital status, teaching in secondary school (vs. elementary), data collection season (summer or not), survey year, urbanicity, and proportion of schools within the state that made Adequate Yearly Progress in 2011.

[a] Source: National Center for Education Statistics, State Education Reform (http://nces.ed.gov/programs/statereform/tables.asp).

[b] US. Department of Education Race to the Top Program (http://www2.ed.gov/programs/racetothetop/awards.html).

odds of reporting <6.5 h of sleep was 25% higher than in states without such practice. Odds of reporting <5.5 h of sleep was 67% higher. As for initiatives related to accountability, the odds of reporting <6.5 h of sleep was 43% higher for teachers in states that sanction or reward schools according to student performance than those in states without such practice. The association of this policy with reporting <5.5 h of sleep was not significant. This may reflect low statistical power: as shown in Table 1, a vast majority of teachers (91.8%) were under this policy while only 4.7% reported <5.5 h of sleep. The ORs for the other two practices were greater than 1 but did not reach statistical significance. Among initiatives related to CCSS implementation, in states that approve or certify materials, teachers had significantly higher odds of reporting inadequate sleep (OR = 1.36, $p < 0.01$ for <6.5 h; OR = 1.84, $p < 0.001$ for <5.5 h). Providing materials for voluntary classroom use or guiding materials to district leaders tended to be associated with lower odds of reporting inadequate sleep, but neither reached statistical significance. Finally, being awarded the RTTT fund, an overall indicator of the state's reform-orientedness, was significantly associated with teachers' inadequate sleep. Compared to those in states that did not receive the award, teachers in awarded states were 41% more likely to report <6.5 h of sleep and 55% more likely to report <5.5 h of sleep.

4. Discussion

This study explored associations between state-level education reform and inadequate sleep among teachers, defined at two levels (<6.5 h, <5.5 h), using the 2013-14 BRFSS data, RTTT award status from the U.S. Department of Education, and 2011–2012 education reform data from NCES. Our analysis found that some state education initiatives regarding professional development, accountability, and CCSS implementation were associated with inadequate sleep. The two cutoff points for inadequate sleep showed similar results: while the non-significant associations were unchanged, the significant ones were generally stronger for <5.5 h of sleep than for <6.5 h. By analyzing actual policies, rather than teachers' perceptions of them, our findings strengthen previous studies using self-reported data on education reform and teacher stress (e.g., (Berryhill et al., 2009; Conley et al., 2005; Smith and Kovacs, 2011; von der Embse et al., 2016). Our findings make a stronger case for more detailed investigation of education reform and teacher health.

Of the nine specific policies we examined, some were associated with inadequate sleep, others were not. Of the two professional development policies, state financing was associated with higher odds of inadequate sleep. This may indicate that with the state funding, professional development becomes more substantial, which may increase work demands for teachers. State requirements to set aside time for professional development was not associated with inadequate sleep. This may indicate that districts and schools have different ways of implementing the requirement, and some may be less demanding of teachers (e.g., hiring substitute teachers to cover classes) than others (e.g., professional development built in outside the school year). Given the heightened attention to professional development for teachers (Yoon et al., 2007), our finding cautions that as professional development becomes a requirement, it is important to consider how it is implemented so as not to create unintended negative consequences for teachers.

Under the accountability category, policies linking teacher evaluation and pay to student performance tended to have higher ORs of inadequate sleep, but the associations did not reach statistical significance. This may reflect the heterogeneity of schools and districts in terms of resources and student performance. In resource-rich and high-performing schools and districts, teachers may not be overly concerned about such policies compared with those in disadvantaged schools. As Darling-Hammond (2013) argues, accountability policies may disproportionally affect teachers in resource-poor schools. For better understanding of accountability policies and their impacts on teachers, more detailed school and district contexts must be considered.

Among CCSS implementation initiatives, more prescriptive ones (i.e., requirements for material use, approvals for materials) were associated with higher likelihood of inadequate sleep, whereas

more supportive ones (i.e., offering materials for voluntary use, providing protocols and exemplars to school leaders) tended to have associations with lower likelihoods of inadequate sleep. Again, not all associations were statistically significant, but the general tendencies align with the findings in occupational stress research: low control, such as restrictions in instructional materials, is associated with higher stress; high support, such as options for instructional materials and clear leadership, is associated with lower stress.

Finally, teachers in states that received RTTT awards were more likely to report inadequate sleep. States competed successfully for RTTT award if they demonstrated strong reform readiness. Following RTTT award in 2009, these states implemented comprehensive, state-wide reform agendas. The implementation of RTTT reforms was arguably one of the largest systematic reform efforts ever undertaken in US schools (Office of Elementary and Secondary Education, 2015). Thus it is likely that in RTTT-awarded states, teachers work under heightened levels of accountability and expectations for teacher performance, represented not only by the individual policies we examined here but also many other rules and regulations. Our results suggest that those state-wide programs have impacted teacher sleep, providing evidence for the need for future research in synergistic effects of multiple policies.

Although the directions of the point estimates were consistent with the current knowledge of job stress, overall only few policies we examined had statistically significant associations with inadequate sleep. The lack of data in this study regarding district- and school-level implementation makes it difficult to identify potential impacts of these initiatives on teacher sleep. Education policy implementation varies considerably by districts and by schools (Rigby et al., 2016). Coburn (2016) articulates factors influencing policy implementation at the local level: social and organizational structure, cultural and normative expectations, and social and professional networks. These factors shape the way policies are implemented, but policies can also shape these factors through resource allocation (Spain, 2016) and social discourse (Rigby, 2016). Because teachers experience education reform as district- and school-level practices, addressing these dynamic and complex influences and the heterogeneity within states and districts will advance our understanding of education reform and its impacts on teacher health. Education policy implementation is a mature field of research; health researchers will benefit from collaborating with colleagues in this area.

The strengths of this study include its social-ecological perspective and multiple data sources. We took advantage of CDC's large data set containing over 7800 teachers in 29 states and publicly available education reform data from the U.S. Department of Education. BRFSS's coding practice for sleep duration (i.e., rounding minutes to the nearest hour) introduced ambiguity in clinical significance of sleep duration. Our use of two cut-off points was an effort to clarify the ambiguity. Because self-reported sleep duration is not the most reliable measure (Watson et al., 2015), better sleep measures including sleep quality will be desirable. While individual demographic characteristics were accounted for, we did not have information on details about the teaching context, such as job tenure, part- or full-time, public or private school, traditional or charter school, and grade or subject taught. Teachers are likely to experience education reforms differently by these characteristics, and therefore more precise investigations are necessary. A confounder we were not able to adjust for, yet potentially important for teachers' inadequate sleep, was school start time, which is also associated with certain school characteristics (e.g., suburban schools and large schools start early; see https://nces.ed.gov/surveys/sass/tables/sass1112_201381_s1n.asp). As discussed above, the lack of district and school-level information on policy implementation is an important limitation, even though we focused on state initiatives with the highest expectation of implementation fidelity (i.e., little room for district discretion). In this exploratory study, we examined each initiative separately, which may have obscured combined effects of multiple initiatives. When we included them in each category together in a logistic regression model, the results did not change our conclusion (results available upon request). Given the significant and strong effect of RTTT awards, future directions may include examining effects of multiple education initiatives with specific hypotheses derived based on relevant theories.

5. Conclusion

Hatzenbuehler et al. (2017) argue that social policies shape the social climate; and Fox et al. (2017) demonstrated that social climates in turn shape social policies that impact health. This study adds to the small body of literature on health impacts of social policies that are not originally designed for health or safety. Our exploration indicates that education policies are in fact prime candidates for such analysis: they specifically target students and schools, and the stakeholders are geographically and organizationally nested within a clearly defined structure. Moreover, various data collection systems have already been in place to capture not only student outcomes (e.g., the National Assessment of Educational Progress, a.k.a. “the Nation's Report Card”) but also school and district characteristics (e.g., the National Teacher and Principal Survey, http://nces.ed.gov/surveys/ntps/). Although data specifically capturing teacher health are still limited, there is ample information to investigate impacts of education reform on schools as workplaces and on teachers as workers. This perspective is a promising way to investigate how US education can be improved by ensuring the health and well-being of teachers.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control (CDC) and prevention or the National Institute for Occupational Safety and Health (NIOSH).

Acknowledgement

M. Kellemen was supported by an appointment to the Research Participation Program at CDC administered by the Oak Ridge Institute for Science and Education through an interagency agreement between CDC and the U.S. Department of Energy.

Appendix. The 29 states and education policies included in the analysis

	Professional Development		Accountability			Common Core Implementation Support				Race to the Top
State	State requires districts to set aside time for professional development	State finances professional development for all districts	Teacher evaluation tied to student performance	State has a policy encouraging/allowing pay-for-performance (salaries or bonuses)	State sanctions low-performing schools and/or provides rewards to high-performing or improving schools	State requires district and school use of curricular materials	State approves/certifies lists of materials aligned with standards	State develops curricular and supplemental materials for voluntary use	State provides processes, protocols, and exemplars to district leaders and principals	Awarded
California					x			x	x	
Colorado					x				x	x
Connecticut	x							x	x	
Florida		x	x	x	x		x	x	x	x
Georgia	x	x	x	x	x	x	x	x	x	x
Idaho					x				x	
Illinois					x				x	x
Iowa		x	x		x		x	x	x	
Louisiana	x			x	x		x		x	x
Maryland		x			x		x			x
Massachusetts		x			x		x		x	x
Michigan	x	x	x	x	x				x	
Minnesota		x		x						
Mississippi				x	x		x	x	x	
Montana	x	x						x	x	
Nebraska	x	x						x	x	
New Hampshire					x		x	x	x	
New Jersey					x	x		x		x
New Mexico					x			x	x	
New York	x		x		x				x	x
North Carolina			x		x		x			x
North Dakota	x	x			x			x	x	
Oregon					x			x	x	
Tennessee	x		x	x	x			x	x	x
Utah			x	x				x	x	
Vermont	x				x			x	x	
Washington					x		x	x	x	
Wisconsin		x			x			x	x	
Wyoming			x		x			x	x	

Source: National Center for Eucation Statistics, State Education Reform 2011-2012

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