Impact of States' Nurse Work Hour Regulations on Overtime Practices and Work Hours among Registered Nurses

Sung-Hewi Bae and Jangho Yoon

Objectives. To examine the degree to which states' work hour regulations for nurses—policies regarding mandatory overtime and consecutive work hours—decrease mandatory overtime practice and hours of work among registered nurses.

Methods. We analyzed a nationally representative sample of registered nurses from the National Sample Survey of Registered Nurses for years 2004 and 2008. We obtained difference-in-differences estimates of the effect of the nurse work hour policies on the likelihood of working mandatory overtime, working more than 40 hours per week, and working more than 60 hours per week for all staff nurses working in hospitals and nursing homes.

Principal Findings. The mandatory overtime and consecutive work hour regulations were significantly associated with 3.9 percentage-point decreases in the likelihood of working overtime mandatorily and 11.5 percentage-point decreases in the likelihood of working more than 40 hours per week, respectively.

Conclusions. State mandatory overtime and consecutive work hour policies are effective in reducing nurse work hours. The consecutive work hour policy appears to be a better regulatory tool for reducing long work hours for nurses.

Key Words. State labor policy for nurses, mandatory overtime, consecutive work hour, quasi-experiment, difference-in-differences

Limits on work hours have long been found in high-risk occupational settings such as the aviation, trucking, and marine industries (Peets and Ayas 2012), where long work hours can adversely affect safety and performance as well as job satisfaction and quality of life. Thus, regulations limiting pilot flight time were first instituted in the 1940s (Federal Aviation Administration 2010), and federal hours of service rules have limited the length of time a driver may spend operating a commercial motor vehicle since 1938. The latter were found to improve safety and hence the functional efficiency of truck drivers on duty (Jones et al. 1941; Federal Motor Carrier Safety Administration 2011).

Adoption of work hour regulations has been slower in the health care sector (Peets and Ayas 2012), although significant attention has been paid to extreme work hours among physicians (Moonesinghe et al. 2011; Cohen, Czeisler, and Landrigan 2013). A review of the current literature indicates that despite potential pitfalls of discontinuity in care, regulated work hours for resident physicians improve occupational and patient safety (Peets and Ayas 2012).

At present, given the potential benefits of limiting work hours in general, some states have begun to regulate work hours for nurses as well. By 2012, 15 states had introduced restrictions on the use of mandatory overtime and shift lengths for nurses (American Nurses Association 2012a). Nurses do often work a substantial number of hours. In 2008, 54 percent of registered nurses (RNs) in the United States (i.e., more than half) worked more than 39 hours per week or at least 2,000 hours per year in their principal nursing positions (Department of Health and Human Services 2010). The RN work year is substantially longer than the national average by 200 work hours (Fleck 2009). When nurses with more than one position of employment are taken into account, total nurse work hours may be greater than the estimate above. Furthermore, because nurses frequently work under a 12-hour shift schedule (American Nurses Association 2009), they not only work extended hours but also return to work often without sufficient time for rest.

Nurse work hour policies have important implications for nurse working conditions and patient outcomes (Institute of Medicine 2003). Nurses working long hours often experience fatigue, poor sleep quality, impaired vigilance, and lack of alertness (Geiger-Brown, Trinkoff, and Rogers 2011; Trinkoff et al. 2011). As a result, working extended hours increases the chance of musculoskeletal injuries, needlesticks, and near motor vehicle crashes due to drowsy driving among nurses (Ilhan et al. 2006; Trinkoff et al. 2006, 2007; Scott et al. 2007). Working overtime is also positively associated with adverse patient outcomes such as catheter-associated urinary tract infections, decubitus ulcers, and medical errors (Rogers et al. 2004; Stone et al. 2007), as well as patient mortality and patient dissatisfaction even after controlling for staffing levels and hospital characteristics (Trinkoff et al. 2011; Stimpfel, Sloane, and Aiken

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2012). In particular, nurses working more than 40 hours per week commit medication errors more frequently than do those working less, and they are more subject to falls with injuries and nosocomial infections (Olds and Clarke 2010). Although other studies (e.g., Berney and Needleman 2006; Tanaka et al. 2010) have reported that working overtime may be related to better patient outcomes, there is a consensus regarding the overall adverse impact of long work hours and overtime on patient outcomes (Institute of Medicine 2003).

Two regulatory tools have been employed by states to prevent nurses from working overtime. The first comprises state laws that allow nurses to refuse *mandatory overtime* requests by their employers except in unforeseeable emergency situations (*mandatory overtime policy*). Proponents of bans on mandatory overtime have shown that such a regulation can improve quality of patient care as well as nurses' work conditions (Washington State Department of Labor and Industries 2002), which in turn may increase nurses' job satisfaction and retention. The second tool consists of state regulations that restrict nurses from working *consecutive hours* over a certain threshold. Most of the time nurses are restricted to working 12 hours within a 24-hour period (*consecutive work hour policy*) (Bae, Brewer, and Kovner 2012). Restrictions on consecutive hours of work for nurses often include breaks between shifts such as a 10-hour rest period (American Nurses Association 2012b). The American Nurses Association (2012a) supports such state laws and has pursued federal legislation for the same purpose.

State work hour policies for nurses currently affect approximately 1.3 million RNs, half of all the 2.7 million RNs in the United States (Census Bureau, U. S. 2010). However, few studies have tested the impact of these state laws on mandatory overtime and work hour practices among nurses, and the findings are mixed. Bae and Brewer (2010) analyzed data from the 2004 National Sample Survey of Registered Nurses (NSSRN) and found no significant association between nurse work hour regulations and hours of mandatory overtime. In contrast, using newly licensed RN data collected in 2006, Bae, Brewer, and Kovner (2012) found a significant association between regulations and decreases in nurse mandatory overtime. Despite their contributions to the literature, these two studies are limited because they draw inferences from a cross-sectional association, and therefore they cannot claim any causal inference about a policy effect. In addition, possible bias from omitted variables may have contaminated the estimated policy effect.

The main purpose of this study is to evaluate whether, and to what extent, nurse work hour policies recently implemented by several states

—mandatory overtime and consecutive work hour policies—are having an effect on overtime work practice and hours worked by RNs. Using a quasi-experimental study design, we obtained difference-in-differences estimates of work hour policy effects, controlling for potential confounders both observable and unobservable at individual and work-setting levels.

We also investigate state regulations' unintended consequences, including voluntary overtime, on-call hours, and having a second position of employment. State regulations on nurse work hours do not prohibit other types of overtime work practices such as voluntary overtime or on-call hours. Therefore, health care facilities may be incentivized to use nurses on a voluntary overtime and/or on-call hour basis to manage variations in patient volume, if mandatory overtime and consecutive work-hour policies are enforced by states (Bae, Brewer, and Kovner 2012). It is also possible that nurses themselves pursue voluntarily overtime or on-call hours for their own financial reasons. Furthermore, nurses in a state with such regulations could work in a second position to obtain extra income, even when health care facilities do not allow their nurses to work extra hours beyond a mandated threshold.

DATA AND METHODS

Data Sources and Study Population

We analyzed data from NSSRN, which were administered to actively licensed, nationally representative samples of RNs in 2004 ($N = 35,724$) and 2008 ($N = 33,549$) (Department of Health and Human Services 2006, 2010). The NSSRN has been conducted approximately every 4 years since 1977, and the 2008 NSSRN provides the latest data available. The 2004 and 2008 NSSRNs provide information on nurse work hours and overtime practice, as well as personal sociodemographics such as educational background, employment, age, gender, race/ethnicity, and family status.

We focused on data representing the RNs' principal positions because detailed information such as overtime work hours was collected only for their principal positions. We also focused on staff nurses working in hospitals and nursing homes because those nurses are most likely involved in patient direct care and quality of care. As a result, our sample includes full-time employees who worked more than 39 weeks per year and at least 36 hours per week. Working 86 hours per week is equivalent to working 12 shifts working plus 2 hours overtime per week, which is extremely unusual. Therefore, we

excluded those who worked 86 hours or more per week as likely outliers. The final analytic file included 14,622 RNs: 6,807 from 2004 and 7,815 from 2008, respectively.

Measures

State Mandatory Overtime and Consecutive Work Hour Policies. The mandatory overtime policy variable equals 1 if a state prohibited nurse mandatory overtime between 2004 and 2008 (see Table S1). Four states—West Virginia, Connecticut, Illinois, and Missouri—fall into this category. All other states and Washington, DC serve as the reference category, including four states—Maryland, Minnesota, New Jersey, and Washington—that banned nurse mandatory overtime in both 2004 and 2008. The consecutive work hour policy variable takes the value of 1 for three states that implemented the work hour regulation between 2004 and 2008: Rhode Island, New Hampshire, and Minnesota. These states adopted the same restriction, requiring no more than 12 hours within a 24-hour period. All other states and Washington, DC—including California, Maine, Oregon, and Texas, which all had the regulation by 2004—serve as the reference group. Table 1 presents the variables used in this study with their definitions and summary statistics separately for the 2004 and 2008 NSSRN samples.

Outcomes. The NSSRN data provide regular and overtime work hours for RNs in their principal nursing positions during the last full work week and during the typical week in both 2004 and 2008. Nurses were queried about mandatory/unscheduled overtime hours. To measure mandatory overtime, we created a dichotomous outcome variable that indicates whether a nurse worked overtime mandatorily.

States' consecutive work hour policies prohibit nurses from working more than 12 hours consecutively within a 24-hour period, and thereby could reduce total hours worked. To examine the effect of the work hour policies, we created the weekly work hour indicator for whether an RN worked more than 40 hours per week. The Institute of Medicine (2003) recommends that weekly nurse work hours be no more than 60. Therefore, outcomes also include a work hour indicator of whether a RN worked more than 60 hours per week.

To investigate unintended consequences, we created dichotomous outcome variables for whether a nurse worked overtime voluntarily, worked on-call hours, or had a second position.

Table 1: Variables, Definitions, and Sample Summary Statistics

<i>Variables</i>	<i>Definition</i>	<i>Year 2004 (n = 6,807)</i> <i>Mean (SD)</i>	<i>Year 2008 (n = 7,815)</i> <i>Mean (SD)</i>
Dependent variables			
Worked overtime mandatorily	= 1 if worked mandatory overtime and 0 otherwise	0.155 (0.362)	0.093 (0.290)
Worked >40 hours	= 1 if worked more than 40 hours per week and 0 otherwise	0.429 (0.495)	0.314 (0.464)
Worked >60 hours	= 1 if worked more than 60 hours per week and 0 otherwise	0.088 (0.284)	0.038 (0.191)
Worked overtime voluntarily	= 1 if worked overtime voluntarily and 0 otherwise	0.264 (0.441)	0.320 (0.466)
Worked on-call	= 1 if worked on-call hours and 0 otherwise	0.197 (0.398)	0.183 (0.387)
Had second job	= 1 if had a second position	0.176 (0.381)	0.140 (0.347)
Main independent variables			
Mandatory overtime	= 1 if a state implemented a mandatory overtime state regulation between 2004 and 2008 (WV, CT, IL, MS), and 0 otherwise	0.078 (0.268)	0.076 (0.265)
Consecutive work hour	= 1 if a state banned nurses from working more than 12 consecutive hours between 2004 and 2008 (RI, NH, MN), and 0 otherwise	0.045 (0.207)	0.043 (0.202)
Mandatory overtime $\times$ Year 2008	Interaction term of the mandatory overtime variable and the year 2008 indicator	0 (0)	0.076 (0.265)
Consecutive work hour $\times$ Year 2008	Interaction term of the consecutive work hour variable and the year 2008 indicator	0 (0)	0.043 (0.202)
Covariates			
Work settings			
Nonfederal nonpsychiatric hospitals (reference)	= 1 if nonfederal, short-term and long-term hospitals, except psychiatric, and 0 otherwise	0.859 (0.348)	0.889 (0.315)
Other hospitals	= 1 if other hospital types (nonfederal psychiatric, federal government, other type) and 0 otherwise	0.113 (0.317)	0.084 (0.278)
Nursing home	= 1 if nursing home and 0 otherwise	0.028 (0.164)	0.027 (0.161)
Union membership (reference: nonunion)	Union membership	0.225 (0.417)	0.201 (0.401)

continued

Table 1. Continued

<i>Variables</i>	<i>Definition</i>	<i>Year 2004 (n = 6,807)</i> <i>Mean (SD)</i>	<i>Year 2008 (n = 7,815)</i> <i>Mean (SD)</i>
Nurse demographics			
Age	Age (in years)	41.8 (10.7)	42.1 (11.6)
Female (reference: male)	= 1 if female	0.915 (0.278)	0.896 (0.305)
Race/ethnicity (reference: non-Hispanic white)	= 1 if other race/ethnicity and 0 if Non-Hispanic white	0.143 (0.350)	0.212 (0.409)
Bachelor's degree or above (reference: associate or below)	= 1 if bachelor's degree or above and 0 otherwise	0.413 (0.492)	0.440 (0.496)
Married (reference: unmarried)	= 1 if married and 0 otherwise	0.649 (0.478)	0.663 (0.472)
Child in family (reference: no child living at home)	= 1 if having a child living at home and 0 otherwise	0.448 (0.497)	0.413 (0.492)
Having second position (reference: not having second position)	= 1 if having second position and 0 otherwise	0.176 (0.381)	0.140 (0.347)

Covariates. We controlled for factors likely to be associated with nurse mandatory overtime and work hours. Covariates included work setting (nonfederal nonpsychiatric, other types of hospital, nursing home); union membership; nurse demographics (age, gender, race/ethnicity, education, marital status, having a child); and having a second position (either nursing or nonnursing job).

Analytic Approach

To isolate the effect of mandatory overtime and consecutive work hour policies, we utilized the within-state change in the policies between 2004 and 2008. We employed a difference-in-differences approach in which changes in an outcome in states that had the nurse overtime or work hour policy in 2008, not in 2004, were compared with changes in the outcomes in all other states that did not experience any policy changes. We used the following equation to investigate whether having mandatory overtime policy would affect the likelihood of working mandatory overtime:

$$Pr(Y_{igt} = 1) = F(M_g \times Y08_t, M_g, Y08_t, X_{igt}, \varepsilon_{igt}) \quad (1)$$

where the subscripts i , g , and t index nurse, state group (state with or without the mandatory overtime policy), and year (2004 or 2008), respectively. Y is a dichotomous indicator of working overtime mandatorily. $F(\cdot)$ represents a cumulative logit distribution function.

M indicates the policy group of states that implemented the mandatory overtime policy between 2004 and 2008. $Y08$, the binary postpolicy indicator, takes the value of 1 if an observation is for 2008. It captures all unobserved factors that did not vary across states, such as the promotion of nationwide awareness of overtime work and job-related injuries, which cannot be observed empirically. The interaction term $M \times Y08$, the main policy variable of interest, equals 1 if a nurse worked in a policy state in 2008 and 0 otherwise. Therefore, as in a usual quasi-experimental study, its coefficient represents a difference-in-differences estimate and captures the effect of the mandatory overtime policy.

For the difference-in-differences estimate to be accurate, characteristics of nurses in states with the policy changes should be comparable to those in states without the policy changes. Table S2 presents characteristics of nurses working in states with and without the policy changes. To address any potential concerns about incomparability, we controlled for, in X , observable differences in person characteristics between states with and without the policy changes, discussed above.

Similarly, with the following equation, we examined the effect of consecutive work hour policy:

$$Pr(Y_{igt} = 1) = F(C_g \times Y08_t, C_g, Y08_t, X_{igt}, \varepsilon_{igt}) \quad (2)$$

where Y is either working more than 40 hours per week or working more than 60 hours per week. C is an indicator of states that had the consecutive work hour policy in 2008 but not in 2004. As in equation (1), the coefficient on the interaction term $C \times Y08$ captures a difference-in-differences estimate of the effect of the consecutive work hour policy.

Mandatory overtime policy can affect not only the likelihood of working mandatory overtime but also the length of hours worked. As such, consecutive work hour policy may indirectly affect mandatory work hours if employers ask nurses to work mandatory overtime to compensate for reduced work hours. Therefore, we extended our empirical model to include both policies in a single equation, as follows:

$$Pr(Y_{igt} = 1) = F(M_g \times Y08_t, C_g \times Y08_t, M_g, C_g, Y08_t, X_{ist}, \varepsilon_{ist}) \quad (3)$$

where Y includes the outcomes in equations (1) and (2).

In addition, we extended the equations (1)–(3) to improve the precision of our difference-in-differences estimates. We replaced the policy group indicator with state dummy indicators. For example,

$$Pr(Y_{ist} = 1) = F(M_s \times Y08_t, S_s, Y08_t, X_{ist}, \varepsilon_{ist}) \quad (4)$$

where the subscripts i , s , and t index nurse, state, and year. In equation (1), the group indicator M can be viewed as a “group fixed-effect” that captures all permanent group differences. In a regression context, equation (1) allows for different intercepts for the policy and reference state groups. In equation (4), S is a vector of binary state indicators, that is, “state fixed-effects.” Therefore, we estimate equation (4) to control for unobserved state heterogeneity by including intercepts separately for each state. In this way, we removed any bias in our difference-in-differences estimates due to all unobserved state characteristics that did not change during the study period and that might have affected the outcomes. For example, state fixed-effects would capture the general hospital/nursing home working environment, as well as other state-specific regulations implemented in both 2004 and 2008, that might affect the outcomes (e.g., mandatory minimum nurse-patient ratios implemented in California since January 1, 2004; see Kasprak 2004).

Statistical Analysis

In all models, we calculated logit estimators. Therefore, the coefficients on the main policy variables show only the direction of the effects of state policies. To measure the magnitude of the effects, we obtained marginal effects, computed as the average change in predicted probabilities (Norton, Wang, and Ai 2004). Standard errors were based on 300 bootstrap repetitions.

Because data for this study were originally collected using a complex survey design, we calculated population-weighted estimators so that our findings could have population inference. To obtain correct statistical inferences, standard errors were adjusted for clustering on states. All analyses were performed in STATA, version 12.1 (Stata Corp., College Station, TX, USA).

RESULTS

Work Hour Policies

Coefficient estimates from the logit models are reported in Table 2. The coefficients on the interaction variables for mandatory overtime policy (Mandatory overtime $\times$ Year 2008) and consecutive work hour policy (Consecutive work hour $\times$ Year 2008) are of primary interest and represent difference-in-differences estimates. Results from the group fixed-effects model (i.e., the usual difference-in-differences model) and the state fixed-effects models (i.e., the difference-in-differences models with state indicators) are consistent and comparable in magnitude to each other.

Mandatory overtime policy is negatively and significantly associated with working overtime mandatorily, implying that the presence of mandatory overtime policy may decrease the likelihood of working overtime mandatorily. The coefficient for consecutive work hour policy is negative and statistically significant for working more than 40 hours per week, but not significant for working more than 60 hours.

In terms of the covariates, the year dummy variable (year 2008) is negatively related to the probability of working mandatory overtime, working more than 40 hours, and working more than 60 hours per week. Compared with nurses working in nonfederal nonpsychiatric hospitals, nurses working in other types of hospitals were more likely to work more than 40 hours per week and nurses working in nursing homes were more likely to work overtime mandatorily. Older nurses were more likely to work mandatory overtime, and worked more than 40 hours per week. Female nurses were less likely than

Table 2: Effect of Mandatory Overtime and Consecutive Work Hour Policies: Coefficients ($n = 14,055$)

Variables	Hours Worked					
	Worked More Than 40 Hours			Worked More Than 60 Hours		
	Group Fixed-Effects	State Fixed-Effects		Group Fixed-Effects	State Fixed-Effects	
Main independent variables						
Mandatory overtime $\times$ Year 2008	-0.439* (0.214)	-0.434* (0.214)		-	-	
Consecutive work hour $\times$ Year 2008	-	-		-0.574*** (0.042)	-0.551*** (0.039)	0.106 (0.262)
Covariates						
Mandatory overtime	0.049 (0.129)	-		-	-	-
Consecutive work hour	-	-		0.264*** (0.061)	-	-
Year 2008	-0.478*** (0.101)	-0.490*** (0.102)		-0.468*** (0.035)	-0.482*** (0.034)	-0.910*** (0.095)
Work settings (reference: nonfederal nonpsychiatric hospitals)						
Other hospitals	0.051 (0.091)	0.001 (0.106)		0.159** (0.059)	0.133* (0.060)	-0.135 (0.133)
Nursing home	0.330* (0.163)	0.375* (0.166)		0.247* (0.110)	0.237 (0.129)	-0.143 (0.396)
Union membership (reference: nonunion membership)	-0.025 (0.116)	0.066 (0.149)		-0.160* (0.072)	-0.067 (0.070)	0.046 (0.117)
Nurse demographics						
Age	0.008* (0.003)	0.009** (0.003)		0.006* (0.003)	0.006* (0.003)	0.006 (0.004)
Female (reference: male)	-0.179 (0.143)	-0.155 (0.140)		-0.353*** (0.108)	-0.356*** (0.104)	0.116 (0.106)
Race/ethnicity (reference: non-Hispanic White)	-0.033 (0.098)	-0.070 (0.118)		0.201*** (0.046)	0.198** (0.072)	0.612*** (0.060)
Bachelor's degree or above (reference: associate or below)	-0.154* (0.070)	-0.146* (0.070)		-0.082 (0.063)	-0.077 (0.063)	-0.088 (0.095)
Married (reference: not married)	-0.038 (0.071)	-0.054 (0.072)		0.017 (0.065)	0.005 (0.067)	0.151 (0.097)
Children family member (reference: no children living at home)	0.022 (0.072)	0.031 (0.073)		-0.046 (0.060)	-0.051 (0.061)	-0.215* (0.097)
Having second position (reference: not having second position)	-0.200 (0.108)	-0.190 (0.107)		0.177*** (0.045)	0.186*** (0.045)	0.243* (0.122)

Note. All models include state fixed-effects. Estimates are survey-weighted. Standard errors are reported in parentheses and are adjusted for clustering at the state level.

*Significant at the 95% level; **Significant at the 99% level; ***Significant at the 99.9% level.

male nurses to work more than 40 hours per week. Compared with non-Hispanic white nurses, other race/ethnic nurses were more likely to work more than 40 hours and to work more than 60 hours per week. Nurses with bachelor's degrees were less likely to work overtime mandatorily than were nurses with associate's degrees or less. When nurses had children at home, they were less likely to work more than 60 hours per week. Those who had a second position were less likely to work overtime mandatorily and more likely to work more than 40 hours per week in their principal nursing positions than nurses who did not have a second position.

Magnitudes of the Effects of State Nurse Work Hour Policies

Table 3 presents marginal effects of the state nurse work hour policies. These marginal effects represent the degree to which state nurse work hour policies on average are associated with the likelihood of working mandatory overtime, working more than 40 hours per week, and working more than 60 hours per week.

Panel A presents results from the models with the state policies in separate equations, that is, equations (1) and (2). Mandatory overtime policy is significantly associated with 3.9 percentage-point decreases in the likelihood of working overtime mandatorily when state fixed-effects are included. Given that approximately 9.3 percent of RNs worked mandatory overtime in 2008, the estimated relationship appears large in magnitude. Consecutive work hour policy is associated with 11.5 percentage-point decreases in the likelihood of working more than 40 hours per week when state heterogeneity is controlled for.

Panel B presents results from the model with both state policies in the same empirical equation, that is, equation (3). The effect on working mandatory overtime and working more than 40 hours is almost identical to those in Panel A. The group fixed-effects model shows that the presence of mandatory overtime policy is significantly associated with 4.6 percentage-point increases in the likelihood of working more than 60 hours per week. However, the positive marginal effect becomes insignificant in the more rigorous state fixed-effects model.

Table 4 presents results for the unintended consequences of the state policies. None of the marginal effects are statistically significant.

Additional Analyses

We performed several additional analyses to assess the robustness of our main findings and draw more useful policy implications (see Table 5).

Table 3: Marginal Effect of Mandatory Overtime and Consecutive Work Hour Policies

	Hours Worked					
	Worked Overtime Mandatorily			Worked More Than 40 Hours		
	Group	State	Fixed-Effects	Group	State	Fixed-Effects
Panel A: Mandatory overtime and consecutive work hour policies in separate equations						
Mandatory overtime policy	-0.036 (0.023)	n/a	-0.039* (0.019)	n/a	n/a	n/a
Consecutive work hour policy	n/a	n/a	n/a	-0.128** (0.047)	-0.115** (0.040)	-0.009 (0.032)
Panel B: Mandatory overtime and consecutive work hour policies in the same equation						
Mandatory overtime policy	-0.037 (0.020)	-0.038* (0.019)	-0.038* (0.019)	0.016 (0.033)	0.030 (0.032)	0.046* (0.018)
Consecutive work hour policy	-0.032 (0.035)	-0.027 (0.032)	-0.027 (0.032)	-0.126** (0.047)	-0.113** (0.041)	-0.005 (0.032)

Note. All models control for the full covariates. Only marginal effects on the overtime and work hour policy are reported to preserve the space. Full results are available upon request. All models are survey-weighted. Bootstrapped standard errors are reported in parentheses and are adjusted for clustering at the state level.

*Significant at the 9.5% level; **significant at the 99% level.

Table 4: Unintended Consequences: Marginal Effect of Mandatory Overtime and Consecutive Work Hour Policies

	Worked Overtime Voluntarily		Worked Paid On-Call Hours		Had a Second Position	
	Group Fixed-Effects	State Fixed-Effects	Group Fixed-Effects	State Fixed-Effects	Group Fixed-Effects	State Fixed-Effects
Mandatory overtime policy	0.048 (0.033)	0.053 (0.036)	0.013 (0.027)	0.029 (0.031)	0.005 (0.024)	0.002 (0.027)
Consecutive work hour policy	-0.027 (0.049)	-0.033 (0.043)	-0.014 (0.034)	-0.018 (0.039)	0.051 (0.033)	0.052 (0.048)

Note. All models control for the full covariates. Only marginal effects on the overtime and work hour policy are reported to preserve the space. Full results and coefficients are available upon request. All models are survey-weighted. Bootstrapped standard errors are reported in parentheses and are adjusted for clustering at the state level.

Table 5: Additional Analyses: Marginal Effects of Mandatory Overtime and Consecutive Work Hour Policies from State Fixed-Effects Models

	Hours Worked			Unintended Consequences		
	Worked Overtime Mandatorily	Worked More Than 40 Hours	Worked More Than 60 Hours	Worked Overtime Voluntarily	Worked Paid On-Call Hours	Had a Second Position
Main findings (from Tables 3 and 4)						
Mandatory overtime	-0.038* (0.019)	0.030 (0.032)	0.057 (0.033)	0.053 (0.036)	0.029 (0.031)	0.002 (0.027)
Consecutive work hour	-0.027 (0.032)	-0.113** (0.041)	0.011 (0.032)	-0.033 (0.043)	-0.018 (0.039)	0.052 (0.048)
(1) Include state linear time trends						
Mandatory overtime	-0.118* (0.059)	-0.208 (0.107)	0.026 (0.027)	-0.133 (0.165)	0.063 (0.155)	-0.028 (0.173)
Consecutive work hour	0.132 (0.216)	-0.234** (0.088)	0.006 (0.026)	-0.174 (0.111)	-0.017 (0.207)	-0.075 (0.126)
(2) Drop seven states with staffing regulations (CA, IL, FL, NJ, OR, RI, VT)						
Mandatory overtime	-0.057** (0.019)	-0.018 (0.044)	0.018 (0.043)	0.086 (0.047)	-0.033 (0.032)	-0.022 (0.031)
Consecutive work hour	-0.005 (0.038)	-0.113** (0.048)	0.014 (0.028)	-0.040 (0.048)	-0.054 (0.036)	0.063 (0.057)
(3) Include state unemployment rates						
Mandatory overtime	-0.039* (0.017)	0.020 (0.034)	0.058 (0.032)	0.058 (0.037)	0.015 (0.032)	0.003 (0.028)
Consecutive work hour	-0.024 (0.034)	-0.108** (0.043)	0.008 (0.029)	-0.022 (0.043)	-0.009 (0.040)	0.067 (0.048)
(4) Drop states that implemented mandatory overtime by 2004 (MA, MN, NJ, WA)						
Mandatory overtime	-0.042* (0.019)	0.016 (0.034)	0.057 (0.035)	0.057 (0.037)	0.016 (0.029)	0.001 (0.027)
Consecutive work hour	-0.052 (0.029)	-0.107* (0.048)	0.011 (0.032)	-0.009 (0.049)	0.059 (0.059)	-0.001 (0.040)
(5) Drop states that implemented consecutive work hour by 2004 (CA, ME, OR, TX)						
Mandatory overtime	-0.037* (0.018)	0.020 (0.034)	0.056 (0.035)	0.055 (0.039)	0.012 (0.029)	0.005 (0.028)
Consecutive work hour	-0.014 (0.032)	-0.110** (0.040)	0.010 (0.029)	-0.033 (0.040)	-0.015 (0.038)	0.062 (0.046)
(6) Early implementers versus follower states						
Mandatory overtime	-0.006 (0.032)	0.049 (0.050)	0.064 (0.042)	0.023 (0.050)	-0.009 (0.039)	0.003 (0.032)
Consecutive work hour	0.029 (0.059)	-0.096 (0.065)	0.037 (0.049)	-0.064 (0.060)	-0.065 (0.048)	0.092 (0.076)

Note. Mandatory overtime and consecutive work hour policies are included in the same equation. All models control for the full covariates. Only marginal effects on the overtime and work hour policy are reported to preserve the space. Full results and coefficients are available upon request from the authors. All models are survey-weighted. Bootstrapped standard errors are reported in parentheses and are adjusted for clustering at the state level. Results are robust when the policies are specified in separate equations and are available upon request. Also, results from the group fixed-effects models lead to the same conclusions and are available upon request.

*Significant at the 95% level; **significant at the 99% level.

A fundamental assumption in our difference-in-differences analysis was that other state policies (e.g., nurse-patient ratios) and changes in macro environments (e.g., economic downturn) have no independent effect on the policy and references states. We assessed the legitimacy of this assumption as follows.

We tested whether the presence of a nurse staffing law might alter the main findings. Currently California is the only state with mandated minimum nurse-patient ratios. Other states have enacted similar policies, such as public disclosure or reporting of nurse-patient ratios (Illinois, New Jersey, New York, Rhode Island, and Vermont) or have established committees responsible for staffing plans (Nevada, Texas, Ohio, Connecticut, Illinois, Washington, and Oregon) (Tevington 2011). Although the overall effectiveness of nurse staffing laws remains unproven (Tevington 2011), Aiken et al. (2010) and Douglas (2010) have reported that increased nurse staffing alleviates nurse workloads and decreases nurse turnover. This implies that our findings may suffer from bias if nurse staffing policies are associated with the nurse overtime and work hour policies, as this could have biased our findings.

An effective analytic approach to bias from omitted variables such as nurse-patient ratios is to specify state fixed-effects and eliminate sources of bias from state heterogeneity, as has been done in this study. Our difference-in-differences estimates should remain consistent given that state nurse staffing regulations did not change during our study period or alter mandatory overtime or consecutive work hour practices. We therefore included in the main equations state-specific linear time trends (i.e., interactions of binary state indicators and a linear time trend variable). Although this extension might overspecify the models, state linear time trends can effectively control for unmeasured macro-level changes over time unique to each state. As reported in row (1) of Table 5, the results from the state-specific linear time trend models had the same implications as our main findings.

We alternatively gauged any influence of states with nurse staffing regulations by excluding seven states that passed at least one of the staffing laws by 2008: California (1999), Illinois (2003, 2007), Florida (2006), New Jersey (2005), Oregon (2005), Rhode Island (2005), and Vermont (2006). As shown in row (2), marginal effects from this additional analysis were highly similar to the main findings.

We also tested whether the year dummy variable and state fixed-effects specified in our main equations were insufficient for capturing changes in economic situations in each state. We augmented the main analytic file with annual averages of state unemployment rates from the United States Bureau

of Labor Statistics (2013) and ran the main equations again. The marginal effects reported in row (3) are in line with the main findings.

By 2004, the mandatory overtime policy had already been implemented in Maryland, Minnesota, New Jersey, and Washington, and the consecutive work hour policy in California, Maine, Oregon, and Texas. These states are included as reference states in our main models in that they did not experience changes in the nurse work hour policies between 2004 and 2008. A difference-in-differences approach by nature estimates the extent to which a policy would have led to a change in an outcome if the policy were implemented in a non-policy reference group. To assess whether the main findings were in line with the spirit of a difference-in-differences approach, we excluded the eight states from the main models. Rows (4) and (5) confirm that our main findings are robust to the exclusion of states with nurse overtime and work hour policies by 2004.

In addition, we examined whether the effectiveness of the mandatory overtime and consecutive work hour policies might change over time. This extension was run only on the states with the mandatory overtime or consecutive work hour policies in 2004 or 2008. We thereby obtained difference-in-differences estimates for early implementers—defined as states that implemented the policies by 2004—as compared with follower states that implemented the policies between 2004 and 2008. As reported in row (6), we did not find significant differences between early and later implementers, which implies that the mandatory overtime and consecutive work hour policies may become effective quickly after their enactment.

DISCUSSION

Our findings show that the state policy of banning nurse mandatory overtime leads to a decrease in working mandatory overtime and that the consecutive work hour policy yields a reduction in the likelihood of working more than 40 hours per week. This suggests that these policies can be successful and prevent nurses from working extended hours. In particular, the consecutive work hour policy appears to be a more effective way to control nurse work hours in that its effect is approximately three times larger than the effect of the mandatory overtime policy.

Our findings are consistent with those of Bae, Brewer, and Kovner (2012), who analyzed a sample of newly licensed RNs, in that mandatory overtime policy reduces a nurse's likelihood of working mandatory overtime and

consecutive work hour policy decreases work hours among nurses. However, contrary to Bae, Brewer, and Kovner (2012), who found that the mandatory overtime policy led to a decrease in working long hours, we do not find that a state mandatory overtime policy leads to a reduction in weekly working hours. This discrepancy may stem from the data used and the study designs employed. In comparison with the Bae, Brewer, and Kovner (2012) study, this study analyzes more up-to-date data (2006 vs. 2004 and 2008) and importantly utilizes a quasi-experimental study design to control for unobserved state heterogeneity, which is more appealing for causal inference. Together, the two studies may imply that states without a nurse work hour limit can benefit more from a consecutive work hour regulation if their intention is to reduce the length of work time among nurses.

The Institute of Medicine (2003) recommends that voluntary overtime should be limited and that nurses should not work more than 12 hours in a 24-hour period and no more than 60 hours in a 7-day period. Although the state regulations do not include any *voluntary* overtime restrictions for nurses, our results imply that adopting a consecutive work hour law can control nurse work hours effectively even without limiting voluntary overtime among nurses.

Our findings should be interpreted with some caution. Because of data limitations, we were not able to include other variables that might affect nurses' mandatory overtime practice and work hours, such as nursing workload and nurses' organization commitment (Bae, Brewer, and Kovner 2012). For example, nurses with greater levels of organizational commitment work voluntary overtime more frequently, but work mandatory overtime less often (Bae, Brewer, and Kovner 2012). We did include work-setting variables to reduce this source of omitted-variable bias, although work-setting difference is not likely to capture all variability in workload and organization commitment among nurses. Further, as long as the state-level nurse work hour policies are not strongly associated with the omitted variables, potential bias in our difference-in-differences estimates should be minimized. It would be informative to investigate whether, as compared with the independent effects of mandatory overtime and consecutive work-hour regulations, having both policies would have different implications on nurse work practices. Unfortunately, an examination of such question was not feasible. Minnesota represents the state that had both policies in 2008. However, it is one of the states that was already implementing the mandatory overtime policy in 2004, and therefore was not able to provide a policy change between 2004 and 2008 that is necessary to isolate the effect of having both policies. Given that states continue their efforts

to promote nurse work conditions, an in-depth analysis that focuses on the influence of jointly implementing different regulations is warranted.

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REFERENCES

- Aiken, L. H., D. M. Sloane, J. P. Cimiotti, S. P. Clarke, L. Flynn, J. A. Seago, J. Spetz, and H. L. Smith. 2010. "Implications of the California Nurse Staffing Mandate for Other States." *Health Services Research* 45 (4): 904–21.
- American Nurses Association. 2009. "Safe Staffing Saves Lives" [accessed on June 30, 2011]. Available at <http://www.safestaffingsaveslives.org/WhatIsANADoing/PollResults.aspx>
- American Nurses Association. 2012a. "Mandatory Overtime" [accessed on June 6, 2012]. Available at <http://nursingworld.org/MainMenuCategories/Policy-Advocacy/State/Legislative-Agenda-Reports/MandatoryOvertime>
- American Nurses Association. 2012b. "Mandatory Overtime: Summary of State Approaches" [accessed on June 6, 2012]. Available at <http://nursingworld.org/MainMenuCategories/Policy-Advocacy/State/Legislative-Agenda-Reports/MandatoryOvertime/Mandatory-Overtime-Summary-of-State-Approaches.html>
- Bae, S. H., and C. Brewer. 2010. "Mandatory Overtime Regulations and Nurse Overtime." *Policy, Politics, & Nursing Practice* 11 (2): 99–107. doi:10.1177/1527154410382300.
- Bae, S. H., C. Brewer, and C. Kovner. 2012. "State Mandatory Overtime Regulations and Newly Licensed Nurses' Mandatory and Voluntary Overtime and Total Work Hours." *Nursing Outlook* 60 (2): 60–71.
- Berney, B., and J. Needleman. 2006. "Impact of Nursing Overtime on Nurse-Sensitive Patient Outcomes in New York Hospitals, 1995-2000." *Policy, Politics, & Nursing Practice* 7 (2): 87–100.
- Bureau of Labor Statistics. 2013. "Local Area Unemployment Statistics" [accessed on September 10, 2013]. Available at <http://www.bls.gov/lau/tables.htm>
- Census Bureau, U. S. 2010. "United States Census 2010 Interactive Population Map" [accessed on June 13, 2012]. Available at <http://2010.census.gov/2010census/popmap/>
- Cohen, I. G., C. A. Czeisler, and C. P. Landrigan. 2013. "Making Residency Work Hour Rules Work." *Journal of Law Medicine & Ethics* 41 (1): 310–4.

- Department of Health and Human Services. 2006. "The Registered Nurse Population: Findings from the March 2004 National Sample Survey of Registered Nurses" [accessed on June 6, 2012]. Available at <http://bhpr.hrsa.gov/healthworkforce/rnsurveys/rnsurvey2004.pdf>
- Department of Health and Human Services. 2010. "The Registered Nurse Population: Findings from the 2008 National Sample Survey of Registered Nurses" [accessed on May 3, 2011]. Available at <http://bhpr.hrsa.gov/healthworkforce/rnsurveys/rnsurveyinitial2008.pdf>
- Douglas, K.. 2010. "Ratios—If It Were Only That Easy." *Nursing Economic\$* 28 (2): 119–25.
- Federal Aviation Administration. 2010. "Fact Sheet — Pilot Flight Time, Rest, and Fatigue" [accessed on September 17, 2013]. Available at http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6762
- Federal Motor Carrier Safety Administration. 2011. "Hours of Service and Driver Fatigue: Driver Characteristics Research" [accessed on September 17, 2013]. Available at <http://www.fmcsa.dot.gov/facts-research/research-technology/report/HOS-Driver-Fatigue.pdf>
- Fleck, S. E. 2009. "International Comparisons of Hours Worked: An Assessment of the Statistics." *Monthly Labor Review* 132 (5): 3–31.
- Geiger-Brown, J., A. Trinkoff, and V. E. Rogers. 2011. "The Impact of Work Schedules, Home, and Work Demands on Self-Reported Sleep in Registered Nurses." *Journal of Occupational Environment Medicine* 53 (3): 303–7. doi:10.1097/JOM.0b013e31820c3f87.
- Ilhan, M. N., E. Durukan, E. Aras, S. Turkuoglu, and R. Aygun. 2006. "Long Working Hours Increase the Risk of Sharp and Needlestick Injury in Nurses: The Need for New Policy Implication." *Journal of Advanced Nursing* 56 (5): 563–8.
- Institute of Medicine. 2003. *Keeping Patients Safe: Transforming the Work Environment of Nurses*. Washington, DC: National Academies Press.
- Jones, B. F., R. H. Flinn, E. C. Hammond, and W. H. Wulfect. 1941. *Fatigue and Hours of Service of Interstate Truck Drivers*. Public Health Bulletin No. 265. Washington, DC: U.S. Government Printing Office.
- Kasprak, J. 2004. "California RN Staffing Ratio Law" [accessed on September 10, 2013]. Available at <http://www.cga.ct.gov/2004/rpt/2004-R-0212.htm>
- Moonesinghe, S. R., J. Lowery, N. Shahi, A. Millen, and J. D. Beard. 2011. "Impact of Reduction in Working Hours for Doctors in Training on Postgraduate Medical Education and Patients' Outcomes: Systematic Review." *British Medical Journal* 342: d1580.
- Norton, E. C., H. Wang, and C. Ai. 2004. "Computing Interaction Effects and Standard Errors in Logit and Probit Models." *Stata Journal* 4 (2): 154–67.
- Olds, D. M., and S. P. Clarke. 2010. "The Effect of Work Hours on Adverse Events and Errors in Health Care." *Journal of Safety Research* 41 (2): 153–62. doi:10.1016/j.jsr.2010.02.002.
- Peets, A., and N. T. Ayas. 2012. "Restricting Resident Work Hours: The Good, the Bad, and the Ugly." *Critical Care Medicine* 40 (3): 960–6.

- Rogers, A. E., W. T. Hwang, L. D. Scott, L. H. Aiken, and D. F. Dinges. 2004. "The Working Hours of Hospital Staff Nurses and Patient Safety." *Health Affairs* 23 (4): 202–12. doi:10.1377/hlthaff.23.4.202.
- Scott, L. D., W. T. Hwang, A. E. Rogers, T. Nysse, G. E. Dean, and D. F. Dinges. 2007. "The Relationship between Nurse Work Schedules, Sleep Duration, and Drowsy Driving." *Sleep* 30 (12): 1801–7.
- Stimpfel, A. W., D. M. Sloane, and L. H. Aiken. 2012. "The Longer the Shifts for Hospital Nurses, the Higher the Levels of Burnout and Patient Dissatisfaction." *Health Affairs* 31 (11): 2501–9.
- Stone, P. W., C. Mooney-Kane, E. L. Larson, T. Horan, L. G. Glance, J. Zwanziger, and A. W. Dick. 2007. "Nurse Working Conditions and Patient Safety Outcomes." *Medical Care* 45 (6): 571–8.
- Tanaka, K., M. Takahashi, H. Hiro, M. Kakinuma, M. Tanaka, N. Kamata, and H. Miyaoka. 2010. "Differences in Medical Error Risk among Nurses Working Two- and Three-Shift Systems at Teaching Hospitals: A Six-Month Prospective Study." *Industrial Health* 48 (3): 357–64.
- Tevington, P. 2011. "Mandatory Nurse-Patient Ratios." *MEDSURG Nursing* 20 (5): 265–8.
- Trinkoff, A. M., R. Le, J. Geiger-Brown, J. Lipscomb, and G. Lang. 2006. "Longitudinal Relationship of Work Hours, Mandatory Overtime, and On-Call to Musculoskeletal Problems in Nurses." *American Journal of Industrial Medicine* 49 (11): 964–71. doi:10.1002/ajim.20330.
- Trinkoff, A. M., R. Le, J. Geiger-Brown, and J. Lipscomb. 2007. "Work Schedule, Needle Use, and Needlestick Injuries among Registered Nurses." *Infection Control & Hospital Epidemiology* 28 (2): 156–64. doi:10.1086/510785.
- Trinkoff, A. M., M. Johantgen, C. L. Storr, A. P. Gurses, Y. Liang, and K. Han. 2011. "Nurses' Work Schedule Characteristics, Nurse Staffing, and Patient Mortality." *Nursing Research* 60 (1): 1–8. doi:10.1097/NNR.0b013e3181fff15d.
- Washington State Department of Labor and Industries. 2002. "Law Restricting Mandatory Overtime for Nurses" [accessed on June 22, 2010]. Available at <http://www.lni.wa.gov/WorkplaceRights/files/policies/esa11.pdf>

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Table S1. Summary of State Nurse Work Hour Regulations.

Table S2. Sample Characteristics by Presence of State Policies.