

# Texting While Driving and Other Risky Motor Vehicle Behaviors Among US High School Students



**WHAT'S KNOWN ON THIS SUBJECT:** Distracted driving due to texting while driving (TWD) has emerged as an important teenage safety issue. Previous studies have shown that the self-reported prevalence of TWD among teenagers varies widely.



**WHAT THIS STUDY ADDS:** In 2011, 45% of US high school students aged  $\geq 16$  years reported TWD during the past 30 days. TWD was positively associated with other risky motor vehicle behaviors; this association strengthened as frequency of TWD increased.

## abstract

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**OBJECTIVE:** To assess the prevalence of texting/e-mailing while driving (TWD) and association of TWD with other risky motor vehicle (MV) behaviors among US high school students.

**METHODS:** Data were used from the Centers for Disease Control and Prevention's 2011 national Youth Risk Behavior Survey, which assessed TWD during the 30 days before the survey among 8505 students aged  $\geq 16$  years from a nationally representative sample of US high school students. TWD frequency was coded into dichotomous and polychotomous variables. Logistic regression assessed the relationship between TWD and other risky driving behaviors, controlling for age, race/ethnicity, and sex.

**RESULTS:** The prevalence of TWD on  $\geq 1$  days during the 30 days before the survey was 44.5% (95% confidence interval: 40.8%–48.2%). Students who engaged in TWD were more likely than their non-TWD counterparts to not always wear their seatbelt (prevalence ratio; 95% confidence interval: 1.16; 1.07–1.26), ride with a driver who had been drinking alcohol (1.74; 1.57–1.93), and drink alcohol and drive (5.33; 4.32–6.59). These other risky MV behaviors were most likely to occur among students who frequently engaged in TWD.

**CONCLUSIONS:** Nearly half of US high school students aged  $\geq 16$  years report TWD during the past 30 days; these students are more likely to engage in additional risky MV behaviors. This suggests there is a subgroup of students who may place themselves, their passengers, and others on the road at elevated risk for a crash-related injury or fatality by engaging in multiple risky MV behaviors. *Pediatrics* 2013;131:e1708–e1715

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### KEY WORDS

unintentional injury, adolescents, texting while driving, motor vehicle crashes

### ABBREVIATIONS

CDC—Centers for Disease Control and Prevention

MV—motor vehicle

TWD—texting while driving

YRBS—Youth Risk Behavior Survey

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Motor vehicle (MV) crashes are the leading cause of death among US adolescents aged 16 to 19.<sup>1</sup> Per mile driven, adolescents aged 16 to 19 years are nearly 3 times as likely to be involved in a fatal crash as drivers aged 20 years or older.<sup>2</sup> As inexperienced drivers, teenagers commonly make errors that contribute to their high crash rate, including driving too fast for conditions, inadequate visual scanning of the road (driver is paying attention to driving but fails to see a hazard), and driving while distracted.<sup>3–5</sup> Distracted driving occurs when a driver diverts attention away from the driving task and instead to “an object, person, task, or event not related to driving.”<sup>6</sup> As teenage cell phone ownership and texting have become ubiquitous in the United States,<sup>7,8</sup> distracted driving because of texting while driving (TWD) has emerged as an important teenage driver safety issue. Although the actual increase in crash risk imposed by TWD is not well understood, several studies conducted on driving simulators and closed-course tracks have linked the behavior to decreased braking reaction times and inability to maintain one’s lane among both teenagers and adults.<sup>9–13</sup> One driving simulator study found that newly licensed teenage drivers spent up to 400% more time not looking at the road when texting compared with when they were not texting.<sup>11</sup> Self-reported estimates of the prevalence of teenagers who engaged in TWD vary widely, in part because of differences in the population surveyed and how the behavior was measured.<sup>14–17</sup> For example, a 2006 survey of nearly 3000 Texas high school students reported that 24% answered yes to the question “Do you ‘text’ while driving?” Students from rural schools reported TWD at twice the rate of students from urban schools.<sup>14</sup> In a 2012 national survey of 1200 teenagers aged 15 to 19

years who had a cell phone and their driver’s license or learner’s permit, 43% reported TWD.<sup>15</sup> A 2009 survey of 230 North Carolina high school students with intermediate or full driver’s licenses reported that 71% of respondents had ever engaged in TWD; 29% reported either sending or reading a text message during their most recent trip.<sup>16</sup> Last, a 2012 national survey of 157 licensed teenagers aged <18 years reported that 57% had ever engaged in TWD.<sup>17</sup> To extend the literature, in 2011, the Centers for Disease Control and Prevention (CDC) included an item assessing frequency of TWD on the national Youth Risk Behavior Survey (YRBS) questionnaire. This study analyzed the 2011 national YRBS data to determine the prevalence of TWD among a large, nationally representative sample of high school students and to identify the association of TWD with other risky MV behaviors that contribute to morbidity and mortality from MV crashes.

## METHODS

The national YRBS has been implemented biennially since 1991 by CDC to monitor priority health risk behaviors among youth. The most recent national YRBS was conducted in spring 2011 and used a 3-stage cluster-sample design to obtain a nationally representative sample of 9th to 12th grade students. The target population consisted of all public and private high school students in grades 9 to 12 in the 50 states and the District of Columbia. Participation in the survey was anonymous and voluntary and local parental permission procedures were used. Students recorded their responses directly on a self-administered computer-scannable questionnaire with 97 items. The Institutional Review Board at CDC approved the national YRBS. Additional details of the sample design and survey methodology have been described previously.<sup>18,19</sup> For

this analysis, the sample was restricted to students who reported their age to be  $\geq 16$  years, the age at which teenagers in every jurisdiction except New Jersey and New York City could be licensed to drive.<sup>20</sup>

## Measures

The national YRBS assessed TWD by asking, “During the past 30 days, on how many days did you text or e-mail while driving a car or other vehicle?” Response options were “0 days,” “1 to 2 days,” “3 to 5 days,” “6 to 9 days,” “10 to 19 days,” “20 to 29 days,” and “all 30 days.” The responses “3 to 5 days” and “6 to 9 days” were combined because of sparse cell size to form 6 categories: “0 days,” “1 to 2 days,” “3 to 9 days,” “10 to 19 days,” “20 to 29 days,” and “30 days.” A dichotomous “any TWD” variable was also created with levels 0 days and  $\geq 1$  days.

The national YRBS also assessed irregular seatbelt use, riding in a car during the 30 days before the survey with a driver who had been drinking alcohol, and driving after drinking alcohol during the past 30 days. Irregular seatbelt use among passengers (ie, irregular seatbelt use) was assessed by asking, “How often do you wear a seatbelt when riding in a car driven by someone else?” with 5 response options ranging from never to always. Seatbelt use was dichotomized into the categories of regular (response: always) and irregular (responses: never, rarely, sometimes, and most of the time). Riding in a car with a driver who had been drinking alcohol was assessed with the question, “During the past 30 days, how many times did you ride in a car or other vehicle driven by someone who had been drinking alcohol?” and driving when they had been drinking alcohol was assessed with the question, “During the past 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?”

Responses to both of these questions were dichotomized into 1 or more times and 0 times.

Multivariable analyses were conducted controlling for age, race/ethnicity, and sex. Age was categorized into 3 groups: 16 years, 17 years, and 18 years or older. The YRBS uses 2 questions to assess race and ethnicity.<sup>19</sup> This analysis uses a 3-level race/ethnicity classification: white, non-Hispanic (referred to as white); black, non-Hispanic (referred to as black); and Hispanic or Latino (referred to as Hispanic); the numbers of students from other racial/ethnic groups were too small for meaningful analysis.

### Statistical Methods

All analyses were conducted in SUDAAN version 10.0.1 (Research Triangle Institute, Research Triangle Park, NC) to account for the complex sampling design of the national YRBS; all prevalence estimates reported herein reflect weighted estimates. Bivariate associations were tested by using *t* tests and  $\chi^2$  tests. Three logistic regression models were used to separately assess the association between TWD and irregular seatbelt use, TWD and riding with a driver who had been drinking alcohol, and TWD and driving when they had been drinking alcohol. The models controlled for age, race/ethnicity, and sex; all prevalence estimates reported herein are unadjusted and all prevalence ratios reported are adjusted for these demographic characteristics. The effects of interaction terms between each demographic variable and TWD were examined for statistical significance; because no significant interaction term was detected, none was included in the regression models. This analysis used the ADJRR option on PREDMARG in SUDAAN to obtain adjusted prevalence ratios and corresponding 95% confidence intervals.<sup>21</sup> All analyses were run for the dichotomous

TWD variable (0 days versus  $\geq 1$  days) and again for the polychotomous TWD variable; the latter analysis was conducted only among students who engaged in TWD on  $\geq 1$  day.

### RESULTS

The 2011 national YRBS had a school response rate of 81% and a student response rate of 87%, for an overall response rate of 71%. Of the 15 503 completed questionnaires, 78 failed quality control and were excluded from analysis, leaving a total of 15 425 usable questionnaires<sup>19</sup>; of those, 10 303 were aged  $\geq 16$  years (63.0%). Of this group, 8505 students (88.4%) responded to the TWD question. Nonresponse analysis revealed no significant differences by age, sex, or race/ethnicity between the TWD responders and TWD nonresponders. The analytic sample was 47.6% female, 60.9% white, 13.2% black, and 17.2% Hispanic. Forty-one percent of the analytic sample was 16 years old, 37.7% 17 years old, and 21.3% 18 years or older.

Prevalence of frequency of TWD and bivariate associations with demographic characteristics are summarized in Table 1. The prevalence of any TWD during the 30 days before the survey was 44.5% and the prevalence of daily TWD (all 30 days) was 11.5%. Thus, of students who engaged in any TWD, more than 1 in 4 engaged in TWD every day. Prevalence of any TWD increased with age, from 32.6% for 16-year-olds to 57.7% for students aged 18 years or older ( $P < .001$ ). The prevalence of any TWD also varied by race/ethnicity ( $P < .001$ ); prevalence was highest among white students (50.7%) and lowest among black students (30.1%). Male students also had higher prevalence of any TWD (46.4%) than female students (42.3%) ( $P = .01$ ).

Table 2 summarizes the bivariate and multivariable associations between any TWD and risky MV behaviors. Bivariate

analyses indicated students who engaged in any TWD had a higher prevalence of irregular seatbelt use as a passenger ( $P < .01$ ), riding with a driver who had been drinking alcohol ( $P < .0001$ ), and driving when they had been drinking alcohol ( $P < .0001$ ) than students who did not engage in TWD (0 days). Multivariable models showed that any TWD was associated with all risky MV behaviors (all  $P < .0001$ ) after controlling for age, sex, and race/ethnicity. TWD and driving when drinking alcohol were most strongly associated; students who engaged in any TWD were 5.33 (95% confidence interval: 4.32–6.59) times more likely to drive when they had been drinking alcohol than students who did not engage in TWD.

Prevalence of each risky MV behavior is graphed as a function of TWD frequency in Fig 1. Prevalence of each risky MV behavior increased as frequency of TWD increased for example, the prevalence of driving when drinking alcohol ranged from 3% among students who engaged in TWD on 0 days to 34% among students who engaged in TWD on all 30 days.

Among students who engaged in TWD on  $\geq 1$  day in the 30 days before the survey, multivariable analyses are summarized in Table 3. Students who engaged in TWD more often were more likely to irregularly wear a seatbelt, ride with a driver who had been drinking alcohol, and drive when they had been drinking alcohol. For example, students who engaged in TWD on 10 to 19 days, 20 to 29 days, or all 30 days were more likely than students who engaged in TWD on 1 to 2 days to ride with a driver who had been drinking alcohol and drive when drinking alcohol. Students who engaged in TWD on all 30 days were more than 40% more likely to not always wear their seatbelt as a passenger than students who engaged in TWD on 1 to 2 days.

**TABLE 1** Frequency of TWD<sup>a</sup> by Age, Sex, and Race/Ethnicity Among US High School Students Aged  $\geq 16$  y, National YRBS, 2011

Characteristic	Any TWD ( $\geq 1$ d)	1–2 d	3–9 d	10–19 d	20–29 d	All 30 d	P Value <sup>b</sup>
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	
Overall <i>n</i> = 8505	44.5 (40.8–48.2)	10.9 (10.0–11.7)	11.8 (10.1–13.6)	6.0 (5.2–7.0)	4.3 (3.7–5.0)	11.5 (10.1–13.1)	
Age, y							
16	32.6 (28.8–36.6)	10.2 (8.9–11.7)	8.8 (7.3–10.6)	3.8 (2.9–5.0)	2.4 (1.8–3.2)	7.4 (5.9–9.3)	<.001
17	50.0 (44.9–55.1)	11.7 (10.4–13.1)	13.6 (11.2–16.3)	7.3 (6.0–8.9)	5.1 (4.1–6.4)	12.3 (10.5–14.5)	
$\geq 18$	57.7 (53.6–61.7)	10.6 (8.9–12.5)	14.3 (12.5–16.4)	8.1 (6.3–10.4)	6.6 (5.2–8.3)	18.1 (15.4–21.2)	
Sex							
Female	42.3 (38.0–46.8)	11.5 (10.5–12.6)	11.1 (9.1–13.5)	5.4 (4.6–6.5)	4.0 (3.2–5.0)	10.3 (8.5–12.3)	<.001
Male	46.4 (42.8–50.0)	10.2 (9.2–11.4)	12.4 (10.6–14.5)	6.5 (5.5–7.8)	4.6 (3.8–5.4)	12.6 (11.2–14.2)	
Race/ethnicity							
White <sup>c</sup>	50.7 (45.8–55.6)	11.4 (10.1–12.9)	13.4 (11.1–16.1)	7.5 (6.3–8.8)	5.4 (4.6–6.4)	13.0 (11.2–15.0)	<.001
Black <sup>c</sup>	30.1 (25.1–35.6)	9.2 (7.0–12.0)	7.4 (5.4–10.0)	2.6 (1.8–3.7)	2.4 (1.4–4.1)	8.6 (6.9–10.6)	
Hispanic	38.8 (35.8–41.9)	11.5 (10.0–13.1)	10.6 (9.2–12.2)	4.1 (3.3–5.1)	2.7 (2.1–3.4)	9.9 (8.3–11.8)	

CI, confidence interval.

<sup>a</sup> During the 30 d before the survey.<sup>b</sup>  $\chi^2$  test, frequency of TWD by demographic distribution.<sup>c</sup> Non-Hispanic.**TABLE 2** Prevalence and Adjusted Prevalence Ratios of Risky MV Behaviors by TWD Status Among US High School Students Aged  $\geq 16$  y, National YRBS, 2011

Risky MV Behavior	Engaged in TWD on $\geq 1$ d <sup>a</sup>		Engaged in TWD on 0 d <sup>a</sup>		Adjusted Prevalence Ratio (95% CI) <sup>b</sup>
	%	95% CI	%	95% CI	
	Irregular seatbelt use as a passenger <sup>c</sup>	45.9	42.0–49.9	41.2	
Rode with driver who had been drinking alcohol <sup>d</sup>	32.9	30.6–35.2	19.0	17.4–20.7	1.74 (1.57–1.93)
Drove when they had been drinking alcohol <sup>d</sup>	19.3	17.7–21.1	3.3	2.7–4.1	5.33 (4.32–6.59)

CI, confidence interval.

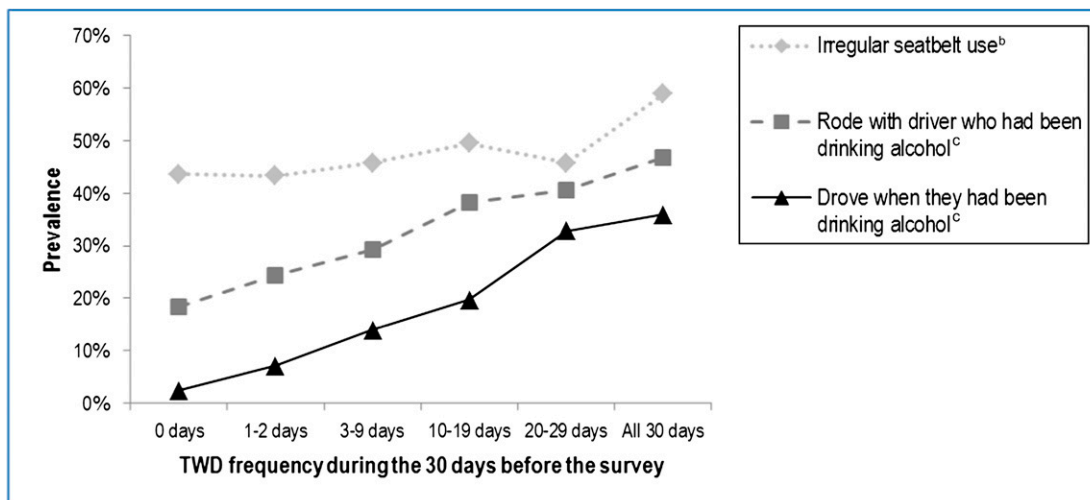
<sup>a</sup> During the 30 d before the survey.<sup>b</sup> Adjusted for age, sex, and race/ethnicity.<sup>c</sup> Most of the time, sometimes, rarely, or never wore their seatbelt when riding in a car driven by someone else.<sup>d</sup> One or more times during the 30 d before the survey.

## DISCUSSION

In 2011, nearly half of all high school students of driving age ( $\geq 16$  years) engaged in TWD during the 30 days before the survey. Students who engaged in TWD were also more likely than their non-TWD counterparts to not always wear their seatbelt, drink alcohol and drive, and ride with a driver who had been drinking alcohol; these relationships strengthened as the frequency of TWD increased. The high prevalence of TWD among the youngest, least experienced drivers is of particular public health concern for several reasons. First, teenagers have the highest rate of fatal crash involvement and among the lowest rates of seatbelt use of any age group.<sup>20,22</sup>

Although, to our knowledge, no on-road studies have measured the actual increase in risk of crash imposed by TWD among teenage drivers, the 1 published in-vehicle camera study of TWD among adult commercial drivers reported that the behavior was associated with a 23-fold increase in crashes or maneuvers that greatly increased the risk of a crash.<sup>23</sup> Further, the limited distracted driving research to date suggests that (1) teenagers engage in TWD at least as often as adult drivers<sup>24,25</sup>; (2) teenagers are less willing to disengage from a distracting behavior even as more road hazards are presented<sup>26</sup>; and (3) teenagers are less adept at handling driving hazards than more experienced drivers.<sup>26</sup>

Findings from this study indicate there is a subgroup of high school students that engages in multiple risky MV behaviors, including frequent TWD. Separate research suggests that, in general, teenagers recognize that behaviors such as TWD, nonuse of seatbelts, and drinking and driving are unsafe.<sup>16,27,28</sup> However, teenagers who engage in these behaviors may tend to view them as being less of a safety risk than teenagers who do not engage in them,<sup>28</sup> possibly because those who perceive greater emotional and social rewards associated with the behaviors are more likely to also perceive the benefits of these rewards outweigh the risks involved.<sup>29–32</sup> Teenagers may also believe that injury or misfortune results only from regular risk behavior participation and that, conversely, occasional participation will not result in harm.<sup>33</sup> These findings help explain why educational approaches alone are largely ineffective in reducing adolescent risk behaviors and point to the importance of fully implementing strategies proven to reduce crash risk among teenage drivers, such as graduated driver's licensing systems and minimum legal drinking age laws.<sup>30,34</sup> In recent years, many states have enacted laws to limit TWD or all cell phone use while driving among



**FIGURE 1**

Adjusted prevalence of risky MV behaviors by frequency of TWD<sup>a</sup> among US high school students aged  $\geq 16$  years. <sup>a</sup> TWD during the 30 days before the survey. <sup>b</sup> Most of the time, sometimes, rarely, or never wore their seatbelt when riding in a car driven by someone else. <sup>c</sup> One or more times during the 30 days before the survey.

**TABLE 3** Adjusted Prevalence Ratios of Risky MV Behaviors by Frequency of TWD<sup>a</sup> Among US High School Students Aged  $\geq 16$  y Who Engaged in TWD on  $\geq 1$  d, National YRBS, 2011

Risky MV Behavior	Adjusted Prevalence Ratio (95% CI) <sup>b,c</sup>			
	Frequency of TWD During the 30 d Before the Survey			
	3–9 d	10–19 d	20–29 d	30 d
Irregular seatbelt use as a passenger <sup>d</sup>	1.06 (0.92–1.23)	1.23 (1.07–1.41)	1.17 (0.95–1.45)	1.42 (1.29–1.57)
Rode with driver who had been drinking alcohol <sup>e</sup>	1.25 (0.96–1.61)	1.74 (1.38–2.21)	1.92 (1.38–2.65)	2.12 (1.71–2.63)
Drove when they had been drinking alcohol <sup>e</sup>	2.00 (1.49–2.70)	3.10 (2.17–4.43)	5.49 (3.94–7.63)	5.80 (4.43–7.59)

CI, confidence interval.

<sup>a</sup> During the 30 d before the survey.

<sup>b</sup> Adjusted for age, sex, and race/ethnicity.

<sup>c</sup> Referent group is students who engaged in TWD 1–2 d during the 30 d before the survey.

<sup>d</sup> Most of the time, sometimes, rarely, or never wore their seatbelt when riding in a car driven by someone else.

<sup>e</sup> One or more times during the 30 d before the survey.

teenagers and the general driving public. As of January 2013, 33 states and the District of Columbia had laws prohibiting newly licensed teenagers from any cell phone use while driving, and an additional 5 states ban TWD for novice drivers.<sup>35</sup> Few evaluations of these laws have been conducted to date, and there is currently no evidence that the laws reduce crashes among teenage drivers.<sup>35</sup> An evaluation of the 2006 law prohibiting cell phone use while driving for teenagers in North Carolina found that two-thirds of teenagers were aware of the law, but cell phone

use remained essentially stable during the pre- and post-law periods (11.0% vs 11.8%). Fewer than a quarter of teenagers interviewed believed that the law was being actively enforced.<sup>36</sup> A follow-up study conducted 2 years later indicated a lack of long-term effect of the law on cell phone use among teenage drivers.<sup>37</sup> Indeed, these laws are difficult to enforce because of the intermittent nature of TWD or other cell phone use and the difficulty in observing the behavior. Also, in states that prohibit TWD or cell phone use only among teenage drivers, identifying the

teenage drivers to whom the law applies poses additional difficulty.

Technology may provide additional approaches to addressing TWD and other risky MV behaviors, although support for their use is not universal. Previous studies of in-vehicle devices that block cell phone access or provide feedback on teenage driver performance have encountered difficulties, including incompatibility with smartphones and considerable resistance on the part of parents to install these devices.<sup>38,39</sup> One study found that parents were reluctant to install the device because their teenage driver was opposed, or because they felt “the system might impinge on the trust between parents and their children.”<sup>39</sup> Another study reported that 32% to 51% of parents would consider using in-vehicle electronic devices to inform them and/or their teenager if the teenager engages in risky MV behaviors such as nonuse of seatbelts, speeding, or hard braking.<sup>5</sup> Although some questions remain as to the acceptability and efficacy of these in-vehicle devices in improving teenage driver safety, the devices are commercially available.

Parental supervision may be the most effective strategy for preventing teenagers from TWD.<sup>40</sup> Parents are the primary enforcers of driving limits set for their newly licensed teenagers, whether the limits are imposed by law or by the parents themselves. Accumulating evidence suggests programs to assist parents in setting and monitoring “house driving rules” for their newly licensed teenagers can reduce risky MV behaviors and crashes.<sup>41–43</sup>

Last, pediatricians have an important role in improving teenage driver safety.<sup>44</sup> The American Academy of Pediatrics encourages pediatricians to promote teenage driver safety by providing anticipatory guidance to patients and their parents and advocating for teenage driver safety in their community and with their legislative bodies.<sup>44,45</sup> With regard to TWD, pediatricians are advised to encourage parents of teenagers to prohibit all cell phone use while driving and to set an example by following the same rule when they are driving.<sup>46</sup>

The findings of this study are subject to at least 6 limitations. First, because a separate response option to the TWD question was not provided for students who do not drive or do not have a cell phone, it is not possible to differentiate students who refrained from TWD from those who do not drive or do not own a cell phone among those respondents who selected “0 times.” Cell phone

ownership among teenagers is estimated to be >75%,<sup>8</sup> and the proportion of teenagers who have begun the licensing process (ie, teenagers who have a learner’s permit, restricted license, or full license) is estimated to range from 67% for 16-year-olds to 78% for 18-year-olds.<sup>47</sup> Using these figures, a rough sensitivity analysis suggests that the reported TWD prevalence could be as high as 61% among teenagers aged 16 to 18 who have begun the licensing process or 91% among teenagers aged 16 to 18 who hold either a restricted or full license. Therefore, the reported prevalence of TWD of 44.5% likely underestimates the prevalence of the behavior among student drivers. Second, the TWD question does not distinguish between sending, receiving, or reading texts, which may be perceived as having different levels of risk and could therefore influence the students’ response. For example, students may not consider that reading a text while driving is the same as initiating a text while driving and may not be inclined to report it.<sup>48</sup> Third, although we found that risky MV behaviors were associated, we cannot conclude that students were simultaneously engaging in multiple risky MV behaviors. Fourth, the question “rode with a driver who had been drinking alcohol” does not distinguish between parent drivers and peer drivers. Students may perceive they had no choice

whether to ride with a parent who had been drinking alcohol, thus this prevalence might overreport riding with other adolescent drivers who had been drinking alcohol. Fifth, these data apply only to youth who attend school and are not representative of all people in this age group. In 2009, ~4% of people in the United States aged 16 to 17 years were not enrolled in a high school program and had not completed high school.<sup>49</sup> Finally, these data are self-reported. Although the extent of underreporting or overreporting of TWD on this survey cannot be determined, YRBS questions assessing other risk behaviors have been shown to have good test-retest reliability.<sup>50</sup>

## CONCLUSIONS

This study found nearly half of US high school students aged  $\geq 16$  years engage in TWD. To our knowledge, this is the first national study to explore the relation between TWD and other known risky MV behaviors among high school students. This study establishes a connection between TWD and other risky MV behaviors; the strength of this connection increases with increasing TWD frequency. Strategies to reduce TWD and other risky MV behaviors may include state laws and technological advances, although parental supervision of their teenage drivers may be the most effective prevention strategy.

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