The Prevalence and correlates of texting while driving among a Population-Based Sample of Ontario Students

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ABSTRACT

Objective: Texting while driving (TWD) has a deleterious impact on driving performance, and may pose a significant challenge to traffic safety. This challenge may be particularly relevant for young and inexperienced drivers. This study examined the prevalence and risk factors of writing text messages or emails while driving during the past twelve months.

Method: This study analyzed a subpopulation of 1,133 licensed students 16 years of age or older from the 2013 Ontario Student Drug Use Survey (OSDUHS), a population-based survey of students in Ontario, Canada.

Results: Our results indicate that 36% of licensed drivers reported writing a text message while driving during the past 12 months; of those who did, 56% reported doing so four or more times. Graduated licensing was the strongest factor predicting TWD. Compared to students with the more restrictive G1 license, students with a G2 or full license were 9.4 times more likely to report TWD after controlling for the effect of all other factors. Older students, white students, and students attending school in urban centers were more likely to report TWD, while the amount of time spent on social media sites, being a passenger with a driver using substances, and past year collisions were also significantly associated with TWD. Gender differences and participation in driver education training were not associated with TWD.

Conclusions: This research demonstrates that TWD is an extremely common behavior among licensed student drivers in Ontario, particularly among those who have passed the first stage of graduated licensing. TWD is associated with other risky driving behaviors and outcomes, and the findings from this study underscore the need to better understand the harms associated with this behavior.

Keywords: texting while driving; adolescents; graduated licensing; traffic safety

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INTRODUCTION

Motor vehicle collisions are the leading cause of death and serious injuries among older adolescents and young adults (Redelmeier & Tibshirani, 1997; Toroyan & Peden, 2007). Collision rates among younger drivers are high, and then decrease with age and driving experience (Mann et al., 2010; Mayhew, 2007; Williams & Shabanova, 2003). Many factors contribute to this elevated collision risk, including inexperience with the driving task, higher levels of risk-taking, and enhanced effects of alcohol, cannabis and other drugs in comparison to older drivers (Adlaf, Mann, & Paglia, 2003; Asbridge et al., 2014; Mann et al., 2001). In recent years, distraction has emerged as a significant traffic safety challenge and one that may be particularly relevant to young drivers (Caird, Johnston, Willness, Asbridge, & Steel, 2014).

Driving is a complex cognitive and psychomotor task, and increased task complexity can degrade task performance (Caird et al., 2014). The advent of mobile telephones and similar technologies created concerns about their impact on driver behavior, and preliminary studies with simulators suggested that use of a cellular telephone while driving had a deleterious effect on driver performance (Brookhuis, de Vries, & De Waard, 1991; McKnight & McKnight, 1993). Redelmeier and Tibshirani (1997) first demonstrated, in a case-crossover study, that cellular telephone use was associated with a significant increase in collision risk. Subsequent research has replicated and expanded that observation (Caird et al., 2014).

Texting involves receiving and sending text messages over mobile telephones. Beyond a cognitive distraction, texting also represents a visual and manual distraction because the driver's gaze is averted to read the text on the screen and one or both hands are involved in the typing of text messages (Centers for Disease Control and Prevention, 2017). Caird et al. (2014) conducted a meta-analysis of 28 experimental studies that assessed the effects of text messaging on simulated or on-road driving. They concluded that typing and reading text messages had adverse effects on eye movements, stimulus detection, reaction time, lane positioning, speed, headway, and collisions. While reading text messages alone was associated with fewer adverse effects on driving, typing alone had similar effects to typing and reading, and both negatively impacted driving performance. Available studies suggest that texting may increase collision risk dramatically, especially among novice drivers (Klauer et al., 2014).

Research on the prevalence of texting while driving among young drivers has begun to appear, although estimates vary drastically. In a sample of American teenage drivers in grade 11, Elhani, Li, and Simons-Morton (2015) observed that 40.3% reported texting while driving (TWD) in the past 30 days. Cook and Jones (2014) reported that 74.3% of a sample of American college students reported TWD at least a few times per month, and they also observed that those reporting this behavior were significantly more likely to report traffic citations and collision involvement. Results from a national survey of American high school students indicated that 44.5% of drivers reported TWD on one or more occasions in the 30 days prior to participating in the survey, and that TWD was also significantly associated with other driving-related risk behaviors, such as not always wearing a seatbelt, riding with a driver who had been drinking and driving after drinking (Olsen, Shults, & Eaton, 2013). In a Canadian study based on community outreach data, young people aged 16 to 19 responding to an online safety survey were asked to indicate how often they engage in TWD. In the 2012-2013 edition of the survey, 27% of young people

reported TWD "sometimes" to "almost always"; in the 2014-2015 edition of the survey that number had dropped to 11% (Tucker, Pek, Morrish, & Ruf, 2015). This decrease must be interpreted with caution, as the nature of the sample precludes inferences to the general population. Differences in prevalence estimates for TWD may be the result of differences across jurisdictions, in timeframe (e.g., past 30 days or past 12 months), or how specific samples were recruited.

In view of the dangers associated with TWD among young people, more research on the prevalence of the behavior and influencing factors is needed. To address some of the potential limitations of the previous research, the current study examined TWD among a large and representative population-based sample of licensed adolescent drivers in grades 10-12 in Ontario, Canada. The relationships of socio-demographic variables, license type and training, and risky motor vehicle behaviors to TWD were examined.

MATERIALS AND METHODS

Data

Data were derived from the 2013 Ontario Student Drug Use and Health Survey (OSDUHS), a province-wide survey of students in grades 7 to 12 attending publicly funded schools. This biennial cross-sectional survey is based on a stratified two-stage (school, class) cluster design that primarily monitors substance use, mental and physical health, gambling, and delinquent behavior. Participation among selected schools and selected classes was 61% and 87%, respectively. Overall, 63% of students in participating classes completed in-class questionnaires. The participation rate is considered above average for a student survey that requires active consent from a parent or guardian (Courser, Shamblen, Lavrakas, Collins, & Ditterline, 2009). Lack of student participation was due to absenteeism (11%) and parental refusal or unreturned consent forms (26%) (Boak, Hamilton, Adlaf, & Mann, 2014). Post hoc analyses revealed no significant between-class differences among classes with high (above 70%) and low (below 70%) response rates relating to substance abuse, delinquency, mental health problems, or demographic characteristics suggesting that a non-response bias is unlikely. Post stratification weights were calculated for the sex-by-grade distributions within each regional stratum separately to ensure that the respondents in each region were proportionate to the population structure. Students were surveyed between October 2012 and June 2013.

The survey question on TWD was asked of a random half-sample of students in grades 10 to 12. Analyses presented here were based on data from 1,133 student respondents, ages 16 years and older, who were licensed to drive in Ontario. Analyses were restricted to those ages 16 years and older because that is the minimum age at which individuals can be licensed to drive in Ontario. The study design and methods are described in greater detail elsewhere (Boak et al., 2014). The 2013 OSDUHS received ethics approval from the Research Ethics Boards of the Centre for Addiction and Mental Health, and York University.

Measures and Variables

Measures were derived from items contained in the student survey, and the full survey instrument is included as an Appendix in the online supplement. TWD responses were recoded to create an ordinal measure with values ranging from zero to two to reflect the number of instances of TWD (0=never; 1=one to three times; 2=four or more times). This variable formed the dependent variable of the current study.

Several independent variables were derived. Age was classified as a continuous measure ranging from 16-20 years of age, sex was classified as a dichotomous measure (female=0, male=1), and due to small sample sizes for some racial groups, ethnicity was categorized as a dichotomous variable (0=non-white, 1=white). Students going to school in a town with less than 10,000 residents were considered to be rural (0=urban, 1=rural). The number of hours per day spent on social media sites was defined as a three category ordinal measure: less than 1 hour a day, 1-2 hours a day, and 3 or more hours per day. A dichotomous measure was constructed to reflect Ontario's graduated licensing structure: having a G1 license versus having a G2 or G license. Driver's Education Training was measured with a dichotomous variable that reflects having taken (or are currently taking) a driver's education course versus no driver's education.

Three measures of risky motor vehicle behaviors in the past year were examined. *Irregular seat belt use* was a dichotomous measure reflecting always using a seatbelt versus less than always. *Driven after alcohol or marijuana use* was a dichotomous measure reflecting engaging in either behavior once or more often versus not engaging in either behavior. The dichotomous measure *rode in vehicle with a driver who had been using alcohol or drugs* contrasted engaging in either behavior once or more often versus not engaging in either behavior. The measure of collision involvement was a dichotomous measure contrasting any involvement in the past 12 months as a driver in a collision that involved any kind of injury or vehicle damage, versus no involvement.

Statistical Analysis

Design-based survey commands within Stata 13.1, which included adjustments for the complex survey sample design and allowed for unbiased variances and point estimates, were used for all analyses (StataCorp, 2013). Analyses also included sample weights to adjust for any unequal probability of selection (Boak et al., 2014). Descriptive statistics were used to summarize the frequency of TWD across demographic subgroups, license type, social media use, and risky motor vehicle behaviors. Multivariate ordinal logit regression models were used to investigate the association between TWD and covariates. All models satisfied the assumption of parallel lines, and additional diagnostic tests revealed that multicollinearity was not a problem. Missing data were dealt with through listwise deletion prior to the analysis stage, which ensured that all models were nested within the same sample (n=1,133).

RESULTS

Descriptive findings on demographic characteristics and risk behaviors of drivers by frequency of TWD are presented in Table 1. The sample was 56.4% male with a mean age of 17.0 years; 55.1% of students had a G1 license that permitted them to drive if accompanied by a fully licensed driver; 42.5% had a G2 license that permitted them to drive unaccompanied by another driver but with restrictions on the number of passengers under 19 years of age; and 2.4% of students had a full (G) license to drive with no restrictions. Overall, 35.7% (95% CI: 31.8%-39.8%) of licensed students reported TWD at least once in the past year; 15.6% reported TWD on one to three occasions and 20.1% reported doing so on four or more occasions.

Results of bivariate analyses indicate that TWD was more prevalent among students who were older than 16 years of age. Prevalence of TWD increased significantly among students who frequently used social media

websites. Students who had a G2 or full license were much more likely to text while driving: 91.5% of those who reported TWD at least 4 times during the past year had either a G2 or a full license. The incidence of TWD was also higher for students who had ridden with someone who had been drinking alcohol or using drugs as 42.5% of those who reported TWD at least 4 times during the past year also reported riding with a driver who had been using substances. The prevalence of past year collision involvement was greater among those who reported TWD versus those who did not.

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Table 1 about Here

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The results of multivariate ordinal logistic regression predicting the frequency of TWD during the past 12 months for licensed drivers in Ontario are outlined in Table 2. After controlling for the effects of all other factors, older students (AOR=1.47; 95% CI: 1.06-2.04) and white students (AOR=1.96; 95% CI: 1.14-3.35) were more likely to report TWD. Students living in towns with a population less than 10,000 were less likely to report TWD (AOR=.48; 95% CI: .28-.82), while no sex differences were found in any statistical analysis. The amount of time spent on social media sites was associated with the frequency of TWD: licensed students who reported spending between 1-2 hours per day on social media (AOR=2.46; 95% CI: 1.55-1.92) and 3 or more hours on social media per day (AOR=2.29; 95% CI: 1.25-4.21) reported significantly higher levels of TWD than those who spent less than one hour per day or did not use at all. The difference between 1-2 hours and 3 or more hours of social media use per day was not statistically significant.

The current research also examined whether participation in driver education training and the type of license affected the odds of TWD. No significant effect was found for the former, suggesting that driver's education was not associated with TWD behavior. The type of driver's license was associated with TWD: after controlling for the effect of age and the other factors in the multivariate context, the odds of TWD among those with a G2 or full driver's license was 9.43 times those of students with a G1 license (95% CI: 5.19-17.16).

The results of risky motor vehicle behavior on the odds of TWD are also presented in Table 2. Two variables had a significant multivariate effect. First, riding in a car with a driver who had been using substances was associated with increased odds of TWD (AOR=1.99; 95% CI: 1.31-3.00). There was also a significant association between self-reported collisions and TWD during the past year (AOR=2.33; 95% CI: 1.04-5.20).

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Table 2 about Here

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DISCUSSION

Our results indicate that 36% of licensed students in grades 10-12 in Ontario, Canada reported writing a text message or email while driving during the past twelve months. Of those who reported TWD, fifty-six percent reported doing so four or more times. While these prevalence rates may be slightly lower than among studies done in the United States (Ehsani, Li, & Simons-Morton, 2015; Harrison, 2011; Olsen et al., 2013) and higher than other estimate from Ontario, Canada (Tucker et al., 2015), the prevalence of TWD varies according to how it is operationalized. Previous research has found that students are more likely to read text messages than send them while driving (Atchley, Atwood, & Boulton, 2011; Ehsani et al., 2015), and experimental research has found that sending text messages is more highly predictive of collisions than reading text messages (Caird et al., 2014). The measure of TWD used in this study—frequency of typing messages—yields lower prevalence estimates but isolates a more dangerous form of TWD behavior. The results from this study therefore demonstrate that typing text messages while driving is common among Ontario students, and consistent with other research, this behavior is reported at relatively equal rates among both male and female students (Struckman-Johnson, Gaster, Struckman-Johnson, Johnson, & May-Shinagle, 2015).

Graduated licensing had the strongest association with TWD, as students with a G2 or full license were at nearly 10 times the odds of students with a G1 license to report TWD after controlling for the effect of age and other factors. Students with a G1 license must be supervised at all times by a fully licensed driver; the frequency of TWD increased dramatically for students who were no longer supervised. It seems likely that Ontario's graduated licensing system may have a supervisory effect that minimized the opportunity for novice drivers to text while driving. A similar effect of graduated licensing on substance use and driving has been observed (Cook, Shank, Bruno, Turner, & Mann, 2017), suggesting that adult supervision of young drivers inhibits the participation in risky driving behaviors generally.

Other authors have identified education as a potential strategy to reduce TWD (Benden, Smith, Henry, & Congleton, 2012; Caird et al., 2014; Cismaru & Nimegeers, 2016; Shell, Newman, Córdova-Cazar, & Heese, 2015). The results from this study found no evidence that participation in driver education reduced the frequency of TWD. Although this finding suggests that driver education in Ontario, as it is currently constituted, may not be effective at reducing TWD, we do not know to what extent distracted driving is currently addressed in these programs. Driver educational training is not mandatory, and while there are government-approved courses, the quality of the training varies considerably across the province (Mayhew, 2007). Thus, future research is needed to assess current programming or develop and evaluate appropriate curriculum to address texting while driving in the context of driver education. These findings point to the need to develop effective and evidence-based educational strategies to prevent distracted driving that are rigorously evaluated and can be incorporated into driver training.

Interestingly, drivers living in more rural locations were less likely to report TWD than those living in more urban locations. A similar finding was reported in a recent study among American college students (Basch, Cadorett, MacLean, Hillyer, & Kernan, 2017), and a number of possibilities may account for this observation. First, students in more rural locations may have less access to networks that support text messaging, or be less likely to own cellular telephones or smart phones. They may also have more restricted social networks and thus receive and send fewer text messages. As well, students who spend 1-2 and 3+ hours

per day on social media were more likely to report TWD than those who reported spending less than 1 hour per day on social media. This result suggests that more engagement with electronic devices and the Internet is also predictive of TWD. We also observed that students who described their ethnoracial background as White were more likely to report texting and driving than other students. This observation is consistent with other findings suggesting that this group of students may be more likely to engage in risk-taking behaviors such as cannabis use (Hamilton, Owusu-Bempah, Boak, & Mann, 2017).

TWD was also associated with other indicators of risky driving. Those who texted while driving were more likely to report riding with a driver who had been using alcohol or cannabis and to have been involved in a collision in the past year. In addition, those who reported driving under the influence of these substances were significantly more likely to text while driving in the analyses focused on risky driving (Model 3) although this effect was not significant in the full multivariate model (Model 4). These results are similar to those reported by other investigators (Cook & Jones, 2011; Olsen et al., 2013). Although the present study cannot identify causal relationships, the findings support the concern that TWD increases collision risk. As well, these results and others point to the clustering of risky driving behaviors. This clustering could be the result of underlying causes such as sensation seeking (Jonah, 1997). Additionally, the results are consistent with Problem Behavior Theory, which proposes that problem behaviors cluster in individuals as a result of developmental, social and cognitive processes (Donovan, Jessor, & Costa, 1988). This clustering suggests that prevention strategies that target risky driving more generally may be more efficient, as many unsafe drivers engage in more than one type of risky roadway behavior.

While the results of this study are of substantial interest, important limitations need to be kept in mind. First, as with any study relying on self-report data, it is possible that students inaccurately recalled or underreported TWD. Second, there is no measure for exposure to a vehicle in this study, which is significant because the likelihood of TWD has been linked with the frequency of driving among young people (Ehsani et al., 2015). There is also no measure asking students whether they own a cellphone, which is a notable limitation. The reported prevalence rates are therefore most probably an underestimate of the TWD rates among those who regularly drove a vehicle and owned a cellphone. Third, while this study differentiated between students who reported writing one to three text messages and those who reported writing four or more text messages during the past year, neither of these categories captures the highly problematic group of students who report TWD multiple times per day. Future research should examine the risk profile of students who report frequent texting and driving. Fourth, the data from this study are cross-sectional, and thus causal inferences cannot be made from these results. Future research using longitudinal data can help to better understand the causal sequencing associated with TWD. Finally, it is possible that student TWD has changed since these data were collected in 2013. A decrease in the rate of TWD has been observed in a recent community-based study in Toronto (Tucker et al., 2015), suggesting that changes in enforcement, awareness, and technology may be changing TWD behavior.

Keeping these limitations in mind, this study found that TWD is common among Ontario's adolescent drivers, particularly among those who have a G2 or full license. Writing text messages while driving is also associated with other risky driving behaviors and outcomes such as collision involvement, underscoring the need to reduce harms associated with this behavior. Many researchers have called for legislation to address hazardous driving among young drivers, including increased supervision (Caird et al., 2014; Olsen et al., 2013;

Qiao & Bell, 2016). This study provides support for the beneficial effects of supervision embedded within graduated licensing programs, and is consistent with a body of research that has demonstrated a positive impact of graduated licensing on public safety (Cook et al., 2017). Road safety initiatives to reduce TWD continue to expand, including increases in legislative penalties (Nurullah, Thomas, & Vakilian, 2013; Qiao & Bell, 2016), the introduction of applications to restrict smart phone use while driving (Caird et al., 2014; Creaser, Edwards, Morris, & Donath, 2015; Delgado, Wanner, & McDonald, 2016), and public education campaigns (Benden et al., 2012; Caird et al., 2014; Cismaru & Nimegeers, 2016). It is important that future research continue to monitor the prevalence of TWD, as well as public attitudes and social norms regarding the use of handheld devices while driving.

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Table 1: Descriptive Statistics and risk factors by frequency of texting while driving, 2013 OSDUHS

	Total Sample (n=1133, Wn=149,084)		Texting While Driving					
			Never (n=787, Wn=95,884)		1-3 times (n=175; Wn=23,195)		4 or more times (n=210, Wn=30,005)	
	Percent	95% CI	Percent	95% CI	Percent	95% CI	Percent	95% CI
Male	56.4	51.2, 61.3	57.9	51.2, 63.6	51.2	45.1, 65.4	55.4	51.3, 61.3
Age (mean)	17.0	16.9, 17.0	16.8	16.7, 16.9	17.2	17.0, 17.4	17.3	17.2, 17.4
White	70.0	64.1, 75.2	67.3	61.2, 72.9	66.9	52.4, 78.8	80.7	64.1, 75.2
Rural	15.1	6.5, 31.2	16.3	7.1, 32.9	13.6	4.8, 33.1	12.4	6.5, 31.2
Daily Social Media								
<1 hour daily	17.8	14.6, 21.6	20.5	15.6, 26.4	16.7	9.4, 28.0	10.1	6.75, 14.9
1-2 hours daily	43.8	39.4, 48.3	37.0	31.4, 48.1	60.5	50.4, 69.7	52.8	44.3, 61.2
3 > hours daily	38.4	34.2, 42.7	42.5	37.2, 48.1	22.8	15.7, 32.0	37.1	28.9, 45.9
Driver Training	67.4	62.4, 72.1	58.3	52.9, 63.5	79.3	66.7, 88.0	87.3	78.5, 92.8
G2/Full License	44.9	39.7, 50.0	25.3	20.0, 31.5	65.6	54.4, 75.3	91.5	0.40, 50.2
Irregular Seat Belt	22.9	18.7, 27.6	22.4	17.4, 28.2	25.7	15.4, 39.6	22.3	18.7, 30.9
Driving After Substance Use	12.6	9.6, 16.3	7.8	4.8, 12.6	17.4	9.5, 29.8	24.1	17.4, 32.3
Riding After Substance Use	29.9	26.0, 34.1	23.3	19.5, 27.6	40.7	29.9, 52.6	42.5	34.9, 50.5
Collision Involvement	8.2	6.4, 10.5	4.5	2.8, 7.1	13.3	6.1, 26.8	16.3	10.5, 24.4

n=subpopulation sample size; Wn=weighted sample size

Table 2. Weighted Ordinal Logistic Regression Predicting Frequency of Texting While Driving Behavior, 2013 OSDUHS

	Model 1: Social-Demographic Factors		Model 2: License Type and Driver's Education		Model 3: Risky Motor Vehicle Behavior		Model 4: Full Multivariate Model	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95% CI
Social-Demographics								
Male (ref.=female)	0.94	0.63, 1.88	1.06	0.70, 1.61	0.85	0.56, 1.24	1.00	0.65, 1.54
Age	2.22***	1.82, 2.70	1.39*	1.03, 1.88	2.30**	1.85, 2.86	1.47*	1.06, 2.04
White (ref.=non-white)	2.03**	1.21, 3.42	1.68	0.93, 3.06	2.31**	1.41, 3.78	1.96*	1.14, 3.35
Rural 10k (ref.=urban)	0.67	0.42, 1.09	0.52*	0.30, 0.89	0.63	0.38, 1.04	.48**	0.28, 0.82
Daily Social Media (ref. = <1 hr)								
1-2 hrs	3.29***	2.15, 5.04	2.85***	1.71, 4.65	2.84***	1.82, 4.43	2.46**	1.55, 3.92
3+ hrs	2.76***	1.78, 4.27	2.91***	1.69, 5.0	2.15**	1.41, 3.78	2.29**	1.25, 4.21
Licensing & Education								
Education Training (ref.=no training)			1.35	0.77, 2.35			1.53	0.87, 2.71
G2/Full License (ref.=G1 license)			9.84***	3.57, 17.36			9.43***	5.19, 17.16
Risky Motor Vehicle Behavior								
Irregular Seat Belt (ref.=regular seat belt use)					0.99	0.57, 1.71	1.52	0.96, 2.40
Driving after Substance Use (ref.=no)					1.81	0.96, 3.41	1.46	0.66, 3.23
Riding with driver who had been using Substances (ref.=no)					2.02***	1.40, 2.91	1.99**	1.31, 3.00
Collision involvement (ref.=no)					2.41*	1.17, 4.95	2.33*	1.04, 5.20

* p<0.05, ** p<0.01, *** p<0.001
AOR = adjusted odds ratio
ref. = Reference