The Impact of In-Vehicle Cell-Phone Use on Accidents or Near-Accidents Among College Students

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Abstract. With in-vehicle use of cell phones rapidly increasing, the safety of young drivers, who represent 14% of licensed drivers but 26% of drivers involved in fatal crashes, may be disproportionately threatened. The authors used a questionnaire to examine the association between in-vehicle cell-phone use and accidents or near-accidents among 1,291 conveniently recruited college students in 4 states. Of the 1,185 respondents who were drivers, 87% had a cell phone, and 86% of the cell-phone owners reported talking while driving at least occasionally. Of the 762 reported accidents or near-accidents, 21% (n = 159) involved at least 1 of the drivers talking while driving. Chi-square tests and logistic regression analyses showed that the frequency, not the duration, of drivers talking while driving was related to experiencing accidents or near-accidents. Differences between drivers who used cell phones and nonusers in unsafe driving behaviors and attitudes were also examined, and target groups for intervention efforts against talking on a cell phone while driving are suggested.

Key Words: cell-phone use, college students, safe driving, talking while driving

Forty-four percent of all motor vehicle deaths result from unintentional injuries.[1] As the number of people who use cell phones has increased dramatically in recent years, great social concern is related to the association between talking while driving (TWD) and traffic accidents. As of June 1, 2003, wireless telephone subscribers in the United States totaled more than 146 million,[2] whereas the figure stood at 5 million in 1990, 50 million in 1997, and 100 million in 2000.[2] This explosive growth also resulted in an increase in the number of people who use cell phones while driving. A 2003 National Highway Traffic Safety Administration (NHTSA)[3] survey revealed that 85% of cell-phone owners use their telephones at least occasionally while driving. Thus, at any time of day, approximately 500,000 drivers of passenger vehicles are talking on a handheld cell phone.[4]

Many studies[3,5–11] indicate that talking on a cell phone while driving significantly contributes to driver distraction, which increases the risk of a crash. Redelmeier and Tibshirani[8] conducted a carefully designed study of 699 drivers with cell phones who were involved in collisions and concluded that when a driver used a cell phone while driving, the risk of a collision was between 3 and 6.5 times higher than when the phone was not used and that this increased risk was similar to that of driving with a blood-alcohol level above the legal limit. In scientific experiments, Strayer and Johnston[6] found that people who were engaged in TWD missed twice as many simulated traffic signals as they would when they were not talking on their cell phones. Findings in a 2003 study[11] confirmed that drivers talking on an in-vehicle cell phone had a consistent pattern of slower reaction times.

Driver distractions are a substantial problem in motor vehicle crashes. The US Department of Transportation estimated that 25% of the 6.3 million crashes each year involve some degree of driver distraction or inattention.[12] In recognition of the increased risk of traffic accidents that are related to in-vehicle cell-phone use, 4 countries, including Japan and Singapore, have prohibited drivers' use of all types of cell phones, and at least 18 other countries have banned drivers' use of handheld cell phones.[13] In the United States, however, New York was the only state that prohibited drivers' use of handheld cell phones before the District of Columbia and New Jersey joined the prohibition on July 1, 2004. More than 30 other states are considering similar legislation.[5]

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One reason that US states and municipalities are sluggish in adopting legislation against TWD appears to be the lack of hard data, perhaps because only a few states include specific boxes on police crash reports for reporting on cell-phone use. Oklahoma is the only state that collects usable crash data on in-vehicle telephone use.[14] To make matters worse, few drivers are likely to admit to a police officer that they were talking on or dialing a cell phone when they failed to notice traffic signals.

In addition to the shortage of data, we found little research about young drivers' safety while using cell phones. Unlike other major health problems such as cardiovascular disease and cancer, motor vehicle deaths and injuries disproportionately affect young people. Drivers aged 24 years and younger represent 13.6% of licensed drivers, yet they are involved in 25.9% of total fatal crashes.[1] Given the moderate differences in the intoxication rates for different age groups in fatal crashes (ages 16–20, 17%; 21–24, 33%; 25–34, 28%; 35–44, 26%; and 45–64, 17%),[15] we believe that controlling the effect of drinking and driving would not change the disproportionate vulnerability of young drivers in fatal crashes. Because college-aged students are at relatively high risk of traffic accidents, the potential hazards of young drivers who use cell phones in moving vehicles may be even higher than the hazards of other age groups.

In this study, we examined the association between traffic accidents that either happened or nearly happened and in-vehicle cell-phone use among college students enrolled in 2 midwestern and 2 southern states. We also examined the association between hands-free cell-phone use and accidents, as well as drivers' attitudes toward TWD, other unsafe driving behaviors related to cell-phone use, and demographic characteristics. We initially hypothesized that drivers' longer and more frequent conversations when using cell phones might be associated with more accidents or near-accidents and that hands-free units might not offer a safety advantage over handheld units.[5,6,8]

METHOD

Participants and Procedures

Participants in our study were from a purposive sample of college students drawn from 5 universities in 4 different midwestern and southern states. To ensure a proper number of African American students for analyzing racial differences, we included a university whose students are predominantly African American. Colleague instructors and research assistants administered a questionnaire to a sample of 1,340 students enrolled in health-related courses on all campuses during the academic year of 2002/2003. We excluded 49 inconsistent or systematic responses (eg, a response to frequencies of cell-phone use by a person who reported not having a cell phone or a patterned response throughout the survey), thus decreasing the sample size to 1,291. The Institutional Review Boards or Human Subjects Committees at the participating institutions approved the study protocol. A passive consent letter was attached to the front of the questionnaire to ensure voluntary and anonymous participation.

Instrument

For this study, we developed a 28-item closed-format questionnaire that we based on a comprehensive literature review.[3–14] Four items dealt with demographic characteristics to examine the students' association with accident or near-accident experiences or TWD-related variables of interest; 2 items measured the type of vehicle and driving experience of the respondents; 5 asked respondents to report the extent to which they were involved in representative unsafe driving behaviors (including speeding and driving while intoxicated); and 11 items measured in-vehicle cell-phone use and experiencing accidents or near-accidents. The other 6 items measured attitudes toward TWD on a 5-point summed Likert-type scale that yielded a Cronbach's alpha of .85. A jury of experts reviewed the instrument to ensure content validity, and 23 Indiana University students who were not in the study sample pilot-tested the questionnaire.

Data Analysis

We used the *Statistical Package for the Social Sciences*, Windows version 11.0 (SPSS Inc, Cary, NC: November 2001) to conduct statistical analyses and calculated frequencies and percentages of each response by item for students who drive vehicles, as well as for all respondents. We used chi-square significance tests to examine associations between categorical dependent variables and other variables of interest to identify variables to be submitted to logistic regression analyses. We collapsed the response options that had few cases into an adjacent option to satisfy the assumption of adequate cell size in chi-square tests. In the case of 2 by 2 tables, we used the chi-square values with continuity correction in significance tests. For the categorical dependent variables that showed significant associations with 1 or more variables of interest in the chi-square tests, we further conducted logistic regression to examine odds ratios (ORs) of each level of significant predictors in the logistic regression model. When we coded categorical variables, the category that was clearly defined was chosen as a reference for stable comparisons.

The differences in unsafe driving behaviors between cell-phone users and nonusers and between male and female students were examined using Mann-Whitney *U* tests because the scale of the outcome variables was ordinal. We set the level of significance at .01, rather than at .05, considering multiple comparisons for the same data set. We examined the difference in the summed scores of the attitudes toward TWD between different groups, using one-way analysis of variance (ANOVA). We submitted significant variables found in the one-way ANOVA to factorial ANOVA to account for interactions among them.

RESULTS

Demographic Characteristics

Of the 1,340 students who participated in this study, 1,291 (96%) provided usable responses. A majority of the respondents were aged 18 to 23 years, and 5% were aged 24 to 44

years. Sixty-two percent of the respondents were women, and 38% were men. In terms of academic standing, about 35% of the students were freshmen, 24% sophomores; 21% juniors; 18% seniors; and 2% from other categories. Of the 1,185 students who reported driving vehicles, 14% had driven for less than 1 year; 29% for 1 to 2 years; 39% for 3 to 4 years; 15% for 5 to 7 years; and 3% had driven more than 7 years; 79% were non-Hispanic White (henceforth labeled White), 13% were African American, 3% Asians or Pacific Islanders, 3% Hispanics, and 2% reported some other racial identity.

TWD and Accident Experience

Of the 1,185 students who drive vehicles, 87% (n = 1,030) reported that they had a cell phone, and 86% (n = 889) of the cell-phone owners reported that they used their cell phones at least occasionally while driving, which was consistent with the NHTSA national survey data (85%).[3] Female students were more likely than male students to use a cell phone while driving, $\chi^2(1, N = 1,174) = 30.2$, $p < .001$; odds ratio (OR) = 2.54, $p < .001$, 95% confidence interval (CI) = 1.77–3.63. Sixty-four percent (n = 762) of the student drivers reported that they had experienced accidents or near-accidents.

Respondents reported that 21% of the accidents or near-accidents they had experienced involved at least 1 driver's using a cell phone. The most frequently cited reason for the cell-phone-involved accidents or near-accidents was the driver's TWD rather than her or his attempting to dial or answer, which is consistent with previous research findings.[5,6] The prevalence of hands-free mode use, the frequency of in-vehicle cell-phone use, and average time for each call while driving is shown in Table 1.

We used chi-square significance tests to examine associations between students who had experienced accidents or near-accidents and other variables of interest and to determine relevant variables to be included in the logistic regression model. As the data in Table 2 show, we found significant associations with race/ethnicity, frequency of TWD, driving above the posted speed limit, eating or drinking while behind the wheel, and driving after consuming drugs or alcoholic drinks. Fifty percent of the Hispanic student drivers had experienced accidents or near-accidents; 69% of the African American students and 77% of the White student drivers had also done so.

We found an interesting association between hands-free cell-phone use and experience of accidents resulting in property damage or injury when at least 1 driver was using a cell phone, $\chi^2(1, N = 434) = 7.3$, $p < .01$. Twenty-five students (2.1% of the total sample and 6.1% of the accident-experienced sample who were driving) reported experiencing real accidents when at least 1 driver was using a cell phone. Contrary to our expectations, more of the students who had experienced accidents were using hands-free models (14%) than handheld cell phones (4%). Because the survey did not ask about temporal relationships between the installation of hands-free mode and accident experience, we urge caution in interpreting this finding.

TABLE 1. Accident or Near-Accident Experience and In-Vehicle Cell Phone Use of 1,185 Students Driving Vehicles

Variable	n	%
Car accident experience		
Resulted in property damage or injury	407	34
Near accident with contact with a bumper	171	14
Close call or near hit without contact	184	16
No accident or near-accident	259	22
No response	164	14
At least one driver was using a cell phone in an accident or near-accident (n = 762)		
Yes	159	21
No	576	76
No response	27	3
Reason for the cell phone-involved accidents or near-accidents (n = 159)		
Result of startling ringing	12	7
Attempted to dial	32	20
Attempted to answer	20	13
Talking while driving	71	45
No response	24	15
Have a cell phone		
Yes	1,030	87
No	146	12
No response	9	1
Use a hands-free mode when talking in a moving vehicle (n = 1,030)		
Yes	154	15
No	876	85
How often one uses a cell phone while driving (n = 1,030)		
Frequently or very frequently	514	50
Occasionally	375	36
Seldom or never	136	13
No response	5	1
Average time per each call while driving (n = 1,030)		
< 1 min	116	11
1 < min < 3	417	41
3 < min < 5	263	26
5 < min < 7	132	13
> 7 min	87	8
No response	15	1

As for the characteristics of hands-free cell phone users, we found that 19% of the total cell-phone-using men and 42% of the total cell-phone-using African Americans were more likely to use hands-free models while driving than were female students (13%) and White students (11%); men: OR = 1.53, $p < .05$, 95% CI = 1.05–2.24; African Americans: OR = 5.35, $p < .001$, 95% CI = 3.52–8.14.

Attitudes Toward TWD

Of the 1,185 students who drove vehicles, 68% indicated that TWD interferes with driving, and 74% maintained that it increases the risk of an accident. This is consistent with Szyfman and associates'[11] previous findings on TWD among college students. However, only 6% of the respondents advocated banning drivers' use of all types of cell

TABLE 2. Chi-square Test and Logistic Regression Results for Correlates of Accident or Near-Accident Experience Among 1,185 Students Driving Vehicles

Variable	χ^2	OR†	95% CI
Race/ethnicity	12.3*		
White		3.43**	1.41–8.38
African American		2.52	0.97–6.55
Asian or Pacific Islander		2.50	0.75–8.40
Some other race		1.72	0.44–6.73
Hispanic (reference)			
Frequency of cell phone use while driving	13.2***		
Frequently or very frequently		1.66*	1.05–2.62
Occasionally		1.18	0.76–1.83
Seldom or never (reference)			
Driving above the posted speed limit	6.2*		
Frequently or very frequently		1.32	0.74–2.35
Occasionally		1.05	0.58–1.92
Seldom or never (reference)			
Eating or drinking behind the wheel while driving	7.5*		
Frequently or very frequently		1.32	0.74–2.35
Occasionally		1.05	0.58–1.92
Seldom or never (reference)			
Driving after consuming alcoholic drinks or drug	20.4***		
Frequently or very frequently		1.68	0.82–3.43
Occasionally		1.05	0.68–1.62
Seldom or never (reference)			

Note. OR = odds ratio. CI = confidence interval.
†Odds ratio adjusted for all variables in the model.
*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

phones, and 16% supported banning drivers' use of handheld cell phones (see Table 3).

We summed the scores of the 6 items measuring attitudes toward TWD on a 5-point Likert-type scale (Cronbach's $\alpha = .85$) and used one-way analysis of variance (ANOVA) to examine the difference in the summed attitudes toward TWD between different groups of students. We found significant differences at the .01 level between different ages, years of driving, frequencies of TWD, and average TWD time, but no significant differences between women and men in the sample and between hands-free and handheld cell-phone users.

We submitted the 4 significant variables in the one-way ANOVA to factorial ANOVA analysis to account for interaction effects. Three main effects (years of driving, frequency of TWD, and average TWD time/call) and 1 interaction (years of driving and frequency of TWD) were significant at .05. Figure 1 shows that, except for those who seldom or never used a cell phone while driving, respondents' attitudes against TWD were moderate or moderately high among students with less than 1 year of driving experience; lowest at 3 to 4 years of driving; and highest at more than 7 years of driving. Attitudes against TWD expressed by students who seldom or never talked while driving grew as the respondents drove more years. They reached their peaks among students who had more than 7 years of driving experience.

As we expected, students who seldom or never talked while driving had the strongest attitudes against TWD, whereas students who frequently talked while driving held the lowest level of attitudes against TWD. In terms of average TWD time per call, Tukey's Honestly Significant Difference (HSD) multiple comparisons categorized the 5 levels into 3 subsets (1) < 1 minute, (2) 1 minute to < 5 minutes, and (3) > 5 minutes (see Table 1). The longer the time for each period of TWD, the more acceptance toward TWD (mean attitude scores; 19.48, < 1 minute; 17.60, 1 minute to < 5; and 16.32, > 5 minutes). Standard errors of the mean differences varied from 0.32 to 0.58.

Unsafe Driving Behaviors and Cell-Phone Use

Whereas 89% of college students reported that they wore a seat belt always or most of the time, 64% reported frequently or very frequently driving above the posted speed limit (see Table 3). To examine the differences in representative unsafe driving behaviors between cell-phone users and nonusers who were driving vehicles, we used Mann-Whitney *U* tests at .01. We found that users listened to music or radio ($z = 3.10$, $p = .002$) and ate or drank behind the wheel while driving ($z = 2.96$, $p = .003$) more often than did nonusers.

We also observed differences between men and women in unsafe driving behaviors and cell-phone use. Female student drivers said that they more frequently ate or drank

TABLE 3. Attitudes Toward Talking While Driving (TWD) and Unsafe Driving Behaviors of 1,185 Students Driving Vehicles

Variable	Percentage				
	SA	A	U	D	SD
TWD interferes with driving	15	53	20	10	2
TWD is more distracting than tuning a car radio	14	34	21	26	4
TWD is more distracting than eating or drinking behind the wheel	10	22	23	39	6
TWD increases the risk of an accident	21	53	18	6	1
TWD using a handheld cell phone must be banned	5	11	27	37	20
All types of TWD must be banned	3	3	15	39	39
I wear a seat belt when I drive†	71	18	6	4	1
I drive above the posted speed limit‡	26	38	28	6	1
I listen to the music or radio when I drive‡	89	8	2	1	0
I eat or drink behind the wheel while I am driving‡	7	17	51	21	4
I drive after I consume alcoholic drinks or drug‡	3	4	14	23	56

Note. Percentages may total 99% because of a maximum of 1% of no responses. SA = strongly agree (†always, ‡very frequently); A = agree (†most of the time, ‡frequently); U = undecided (†‡sometimes); D = disagree (†‡seldom); SD = strongly disagree (†‡never).

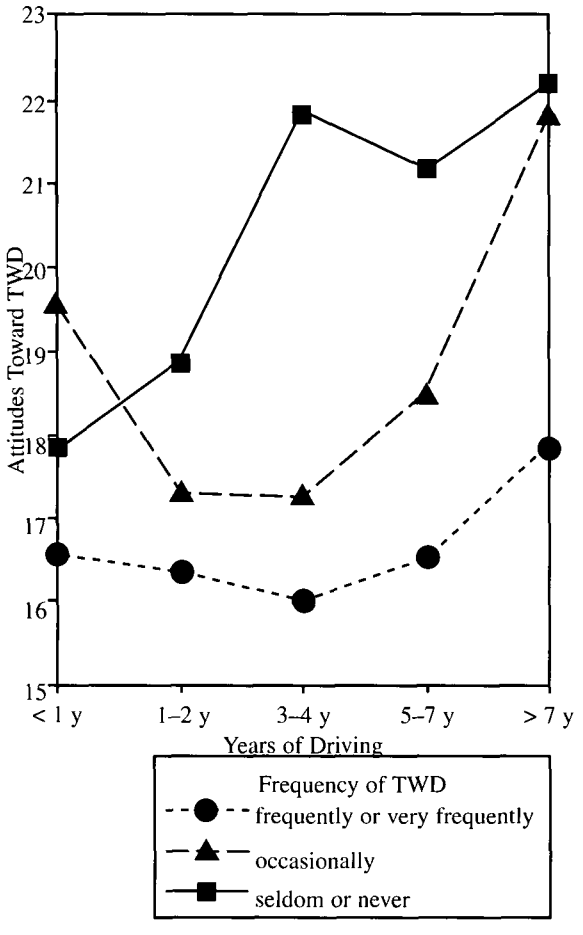

FIGURE 1. Interaction Between Frequency of Talking While Driving (TWD) and Years of Driving in Factorial ANOVA for Attitudes Toward TWD of 1,185 Students Driving Vehicles. ANOVA = analysis of variance.

while behind the wheel ($z = 3.20$, $p = .001$) and had longer TWD time per call ($z = 7.18$, $p < .001$) than did male students. Conversely, male students more frequently drove while intoxicated ($z = 4.69$, $p < .001$) than did their female counterparts. We found no differences in unsafe driving behaviors between drivers who used hands-free and handheld cell phones.

COMMENT

We believe that it is alarming that 34% of the college students in our sample experienced car accidents resulting in property damage or injury and that at least another 30% experienced near-accidents (we asked those who experienced both accidents and near-accidents to mark accidents, not near-accidents). It is more alarming that 21% of those who reported accidents and near-accidents involved at least 1 driver's using a cell phone. Our findings in this study support the association of in-vehicle cell-phone use with accidents or near-accidents. One finding was that the more frequently drivers used a cell phone while driving, drove above the posted speed limit, ate or drank behind the wheel, and drove while intoxicated, the more accidents or near-accidents they experienced. This supported another finding: That more frequent TWD was associated with more cell-phone-involved near-accidents than less frequent TWD.

Attitudes toward TWD of those who more frequently used in-vehicle cell phones were more accepting than those of other participants in TWD. Although this was a cross-sectional study, these findings warrant further investigations (eg, a nationwide survey or longitudinal cohort study) into how frequently in-vehicle cell-phone use and car accidents are related.

Readers should pay particular attention to 2 seemingly contradictory findings: (1) that the most frequently cited reason for drivers' cell-phone-involved accidents or near-

accidents was when TWD, rather than while attempting to dial or answer the phone; (2) that we found no significant associations between drivers' experiencing accidents or near-accidents and average TWD driving time per call or use of a hands-free model cell phone. We think these 2 findings are complementary, not contradictory.

That using hands-free cell phone use while driving did not differentiate from using handheld cell phones in accidents or near-accidents implies that reduced physical distraction does not necessarily enhance driving safety. What seems to matter is to deter cognitively distractive barriers to safe driving, thereby focusing on driving mentally as well as physically.[5-6,11] These findings also imply that mental distraction caused by more frequent TWD rather than by longer duration of each cell call increases the risk for car accidents.

That cell-phone-involved accidents were more strongly associated with users of hands-free models than handheld cell phones is an interesting finding that can be interpreted under 2 different temporal assumptions. If the hands-free model users who were involved in cell-phone-use accidents installed the devices *after* they experienced accidents, they might have been thinking that the hands-free mode would enhance their driving safety because they believed that handheld cell-phone use had contributed to the accident. On the other hand, if the users of hands-free models who were involved in cell-phone-related accidents had the devices *before* they experienced accidents, they might have conducted TWD more frequently because of their false belief that it would increase safety, which could have led to more accidents. This finding warrants more study beyond demographic characteristics of hands-free model users that were revealed by this study.

In terms of effective interventions to prevent automobile accidents among young drivers, the results of this study indicate the value of targeting the following groups:

- Female college students aged 18 to 21 years with 1 to 4 years of driving experience should be the target population because they constitute the largest proportion of drivers who are frequent cell-phone users. Disproportionate intervention focus on female students is further justified by our finding that female student drivers more frequently eat or drink while driving than do male students—behavior that may endanger the frequent TWD drivers even more.
- Male college students should be provided with additional intervention efforts to prevent driving while under the influence of alcohol or drugs, which is consistent with national motor vehicle accident data.[1]

We found conspicuous ambivalence about in-vehicle cell-phone use. Although 68% of the students driving vehicles indicated that TWD interferes with driving, and 74% said it increases the risk of an accident, only 6% approved of banning drivers' use of cell phones, a dilemma that will face any legislative initiative against drivers' use of cell phones. The results of this current study support the literature[5,6,8,11] already cited in that the use of hands-free models does not provide greater safety over handheld units. Prohibition of all types of cell phone use while driving, therefore, seems to be a logical conclusion for the sake of traffic safety, especially when we disregard other benefits of in-vehicle cell phone use, including life-saving emergency calls. But the total ban of all types of in-vehicle cell phone use might not be a practical option, especially when one considers the general public's overwhelming opposition to the idea. Although society seeks safe and viable measures for in-vehicle cell phone use, health and safety professionals must try to educate and introduce brief interventions for the people who are most vulnerable to causing cell phone-involved accidents.

Limitations

The findings of this study should be interpreted in light of several limitations. Even though we attempted to select the sample from classes that properly represented college students with diverse majors and class standings in the 4 states, the findings may not be generalizable to all midwestern and southern college students because the sample was conveniently recruited. We recommend that future research use probability sampling. Also, self-report may have biased the results of this study, although we attempted to minimize the limitation by meticulous arrangement of items, incorporation of several cross-checking items to detect inconsistent responses, and emphasis on the voluntary, anonymous, and confidential nature of the survey. A further limitation is the assumption of equal intervals between the 5 Likert-type response categories in the 6-item scale measuring attitudes toward TWD. Although it showed high internal consistency reliability, the measure has not been formally validated. In addition, causal relationships should not be inferred from our findings because we used a cross-sectional survey design.

NOTE

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