Role of mobile phones in motor vehicle crashes resulting in hospital attendance: a case-crossover study

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Abstract

Objectives To explore the effect of drivers' use of mobile (cell) phones on road safety.
Design A case-crossover study.
Setting Perth, Western Australia.
Participants 456 drivers aged ≥17 who owned or used mobile phones and had been involved in road crashes necessitating hospital attendance between April 2002 and July 2004.
Main outcome measure Driver's use of mobile phone at estimated time of crash and on trips at the same time of day in the week before the crash. Interviews with drivers in hospital and phone company's records of phone use.
Results Driver's use of a mobile phone up to 10 minutes before a crash was associated with a fourfold increased likelihood of crashing (odds ratio 4.1, 95% confidence interval 2.2 to 7.7, $P<0.001$). Risk was raised irrespective of whether or not a hands-free device was used (hands-free: 3.8, 1.8 to 8.0, $P<0.001$; hand held: 4.9, 1.6 to 15.5, $P=0.003$). Increased risk was similar in men and women and in drivers aged ≥30 and <30 years. A third ($n=21$) of calls before crashes and on trips during the previous week were reportedly on hand held phones.
Conclusions When drivers use a mobile phone there is an increased likelihood of a crash resulting in injury. Using a hands-free phone is not any safer.

Introduction

Surveys indicate that drivers often talk on mobile (cell) phones.[1–4] Because of concerns about risks of potential crashes, use of hand held phones while driving is illegal in most countries in the European Union, all Australian states, and parts of Canada and the United States.

Most research on the safety of drivers' use of mobile phones has been experimental in design, involving volunteers, and has found that phone use affects reaction time, variability of lane position and speed, following distance, and situational awareness in simulated or instrumented driving tasks. Distractions are associated with conversations using both hands-free[5 6] and hand held[7 8] phones. Studies have also reported effects of physical distraction from handling phones.

A few epidemiological studies have assessed the risk of crashes associated with phone use. Two studies found modest increases in risk among drivers observed using hand held phones[9] and among more frequent versus less frequent users according to billing records from mobile phone companies.[10] Another study compared phone use immediately before crashes involving property damage with use during the previous week. The estimated risk while using phones was four times higher than when phones were not used. Hands-free phones seemed to offer no safety advantage, though few were used.[11]

Important questions remain about whether phone use affects the risk of more serious crashes involving personal injuries and whether the risk differs for hands-free versus hand held phones. We studied drivers involved in injury crashes in Perth, Western Australia. Since 1 July 2001 it has been illegal to use a hand held phone when driving in Western Australia.

Methods

We used a case-crossover design and compared a driver's use of a mobile phone at the estimated time of a crash with the same driver's use during another suitable time period. Because drivers are their own controls, the design controls for characteristics of the driver that may affect the risk of a crash but do not change over a short period of time. We compared phone activity during the hazard interval (time immediately before the crash) with phone activity during control intervals (equivalent times during which participants were driving but did not crash) in the previous week.

Study setting and participants

Participants were consenting drivers aged ≥17 who were involved in a crash between April 2002 and July 2004, were seen in one of three main hospital emergency departments in the area, and reported owning or using a mobile phone.

Data collection

We interviewed drivers and collected data on demographics, usual patterns of driving and mobile phone use, description of crash and preceding events (including phone use), and type of phone. We accessed records of participants' mobile phone use for two hours before and after the crash as well as for the same time window during three control periods (24 hours, 72 hours, and 7 days before the crash). Phone activity was defined as calls made or received and text messages sent. Voice mail and text messages received were excluded unless drivers checked these while driving. We considered reported availability of a hands-free device in the vehicle as hands-free phone use. Drivers were not asked what type of phone they used during the crash trip because of concerns about the veracity of responses and hospital concerns about legal issues.

The three major telecommunication networks provided records of relevant phone activity.

ELPS *This is the abridged version of an article that was posted on bmj.com on 12 July 2005: http://bmj.com/cgi/doi/10.1136/bmj.38537.397512.55*

Time of crash

Time of crash was estimated from emergency response records, medical records, and self report from drivers interviewed in hospital, including a review of call records stored on the drivers' phones where possible. For most cases, we used the earliest reported time to reduce the misclassification of calls made after the crash as occurring before. We also compared data from the phone company with self reported data. If a participant reported a single call after the crash and mobile phone data recorded a single call placed just before the crash, we assumed that the crash time was imprecise and the call was classified as after the crash. This would favour the null hypothesis that phone use was not associated with risk of crash.

Hazard and control intervals

The hazard interval was defined as the 10 minute period before the crash. For drivers who had driven less than 10 minutes when a crash occurred, we considered only phone activity while they were driving. We compared phone activity during a hazard interval with activity during control interval(s) of the same time and duration 24 hours, 72 hours, and 7 days before the crash when drivers confirmed, during the interview, that they had been driving. We analysed a hazard or control interval of up to 5 minutes to test the robustness of the results.

Statistical analysis

We used conditional logistic regression to calculate the odds of having an injury crash in association with mobile phone use. The primary analysis involved 1:multiple (1:M) matching: phone use during the hazard interval for any driver was compared with between one and three control intervals depending on whether the driver reported driving during those control intervals. Paired analyses were conducted as sensitivity analyses; a hazard interval was compared with a single control interval (24 hours, 72 hours, or 7 days) according to a participant's reported driving during each interval. Subgroup analyses based on sex, age group, and phone type (hand held or hands-free) used 1:M matching.

Table 1 Characteristics of 456 drivers in case-crossover analysis based on interview

	No (%) of drivers*
Men	192 (42.1)
Age (years):	
17-29	220 (48.2)
30-49	169 (37.1)
>50	67 (14.7)
Driving experience (years):	
0-9	217 (47.6)
10-19	100 (21.9)
20-29	71 (15.6)
≥30	68 (14.9)
Type of mobile phone in vehicle:	
Hand held	218 (47.8)
Fully installed hands-free kit	45 (9.9)
Earpiece	164 (35.9)
Headset	20 (4.4)
Speaker phone on handset	9 (2.0)
Other hands-free device	—
Mobile phone use while driving:	
Never use	126 (27.6)
Occasionally use	225 (49.3)
Sometimes use	60 (13.2)
Frequently use	45 (9.9)
Carrying phone on trip	411 (90.1)
Reported using phone before crash	32 (7.0)
Reported using phone after crash	234 (51.3)
Regular weekly driving pattern	362 (79.4)
Automatic transmission in vehicle	228 (50.0)

*Those with available records on mobile phone activity who reported driving during at least one control interval.

Table 2 Risk of injury crash and use of mobile phone while driving

	Hazard interval (up to 10 minutes before crash)		Control driving interval(s)		
Type of matching	Drivers using phones	All drivers	Drivers using phones	Total	Odds ratio (95% CI)
1:M (multiple control intervals)	40	456	25	801	4.1 (2.2 to 7.7)
1:1 (24 hours before crash)	26	248	10	248	3.7 (1.5 to 9.0)
1:1 (72 hours before crash)	15	227	4	227	4.7 (1.3 to 16.2)
1:1 (7 days before crash)	32	326	11	326	4.5 (1.9 to 10.9)

Results

A total of 1625 drivers were approached, 454 (28%) did not own or use a mobile phone, 133 (8%) met an exclusion criterion, and 97 (6%) declined participation. The remaining 941 drivers were interviewed and the mobile phone activity records were available for 744, 456 (61%) of whom verified driving during at least one control interval. These were the study subjects and the basis of the case-crossover analyses (table 1). See bmj.com for summary of crashes.

Most drivers (n=423, 93%) had at least one injury and 44% (n=201) had two or more. Injuries were predominantly mild to moderate in severity. Among the 238 participants with a hands-free device in their vehicles, 30 (13%) said they never used a phone while driving; 159 (67%) reported using the hands-free device at least 90% of the time; and only 21 (9%) reported using it less than half the time. Thus, of drivers who had hands-free devices and reported using a phone while driving, almost all said they generally used these devices.

Of the 456 participants, 192 (42%) had driven during one control interval, 183 (40%) had driven during two, and 81 (18%) had driven during all three. This resulted in 456 case intervals and 801 control intervals available for analysis with multiple control periods (table 2). Based on the reported availability of hands-free devices, about one third (n=13) of calls during the hazard interval and one third (n=8) of calls during control intervals were on hand held phones. Of drivers with hands-free devices who used their phones during the hazard interval, 89% (n=24) reported that they used their hands-free devices to phone when driving at least 90% of the time.

Mobile phone use within the period during and up to 10 minutes before the estimated time of the crash was associated with a fourfold increase in the likelihood of crashing (table 2). Similar results were obtained when we analysed only the interval up to 5 minutes before a crash (3.6, 1.8 to 7.0, $P<0.001$). Analyses with paired matching to compare the hazard interval with an equivalent single control interval also showed significant associations between mobile phone use and the likelihood of a crash, similar in magnitude to the association with 1:M matching.

Sex, age group, or type of mobile phone did not affect the association between phone use and risk of

What is already known on this topic

Many drivers use mobile phones while driving and laboratory based research has highlighted that this impairs driving performance

Epidemiological research has shown an association between phone use and increased risk of crashes that result in property damage

What this study adds

Use of mobile phones is associated with an increased likelihood of serious road crashes resulting in hospital attendance

The use of currently available hands-free devices does not seem to reduce the risk

crash ($P > 0.05$) (see bmj.com). In particular, both hand held and hands-free phone use while driving was associated with increased risk (4.9, 1.6 to 15.5, $P = 0.003$ *v* 3.8, 1.8 to 8.0, $P < 0.001$, respectively).

Discussion

A person using a mobile phone when driving is four times more likely to have a crash that will result in hospital attendance. Sex, age group, or availability of a hands-free device did not affect the increased likelihood of a crash. In this study, we measured the seriousness of crashes by participants' injuries; almost all had at least one injury and almost half had two or more.

Comparison with other research

Some authors have suggested that drivers who use mobile phones while driving may inherently take more risks than other drivers.[9] Our case-crossover design, however, controlled for risk taking and other characteristics of drivers that may affect risk but do not change over a short period of time.

Our findings are similar to those of another case-crossover study that found a fourfold increased risk of crashes that result in damage to property associated with phone use.[11] However, there were some methodological differences between the studies. Unlike the other study, our subjects included only those who, in the interview after the crash, reported that they had been driving during at least one control period. The lengths of hazard and corresponding control intervals in our study were not fixed, as used by Redelmeier and Tibshirani,[11] but varied up to 10 minutes according to the duration of the driving trip in which a crash occurred. As 63% (n = 288) of drivers reported a trip length of 10 minutes or less before crashing this could have been an important consideration.

Limitations

We minimised misclassification bias of the precise time of the crash by subsequent verification of self report and mobile phone records when these sources differed. This did not eliminate the possibility that for legal or social reasons participants said they had not used the phone before crashing. However, the overall effect of non-reporting would have been to bias the result toward the null hypothesis, underestimating the risk of phone use. Participation rates were high, and we did not identify important differences among drivers who were interviewed, drivers whose phone records were obtained, and study participants. However, it is possible that drivers who refused to take part or refused access to phone records differed from our remaining participants. Again, the overall effect would have been to bias the result toward the null hypothesis.

We verified that participants were driving during the hazard and control intervals, but circumstances of the control driving intervals may have differed from the crash driving interval and the findings point to a statistical rather than causal association. Our results, however, reflect those reported by others.

Policy implications

The distracting effects of different types of hands-free phones may not be equivalent—for example, using an earpiece versus a fully installed hands-free kit. Although voice activated units are becoming more common, only 6% of mobile phone users in our study had these phones. Periodic roadside observations conducted in Perth before, during, and after our study indicated that about 2% of drivers were illegally using hand held phones. Furthermore, 37% (n = 122) of participants who reported using phones while driving, at least on occasion, reported not having a hands-free device in their vehicle.

Laws limiting all phone use while driving would be difficult to enforce. More and more new vehicles are being equipped with Bluetooth technology, facilitating voice activation and therefore totally hands-free phone use. Though this may lead to fewer hand held phones used while driving in the future, our research indicates that this may not eliminate the risk. Importantly, if this new technology actually increases mobile phone use in cars, it could contribute to even more crashes.

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