

METHODOLOGIC ISSUES

Research on injury prevention: topics for systematic review

F P Rivara, J M Johansen, D C Thompson

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See end of article for authors' affiliations

Correspondence to:
Dr Fred Rivara,
Harborview Injury
Prevention and Research
Center, Box 359960, 325
Ninth Ave, Seattle, WA
98104-2499, USA

Background: Duplication should be avoided in research and only effective intervention programs should be implemented.

Objective: To arrive at a consensus among injury control investigators and practitioners on the most important research questions for systematic review in the area of injury prevention.

Design: Delphi survey.

Methods: A total of 34 injury prevention experts were asked to submit questions for systematic review. These were then collated; experts then ranked these on importance and availability of research.

Results: Twenty one experts generated 79 questions. The prevention areas with the most number of questions generated were fires and burns, motor vehicle, and violence (other than intimate partner), and the least were other interventions (which included Safe Communities), and risk compensation. These were ranked by mean score. There was good agreement between the mean score and the proportion of experts rating questions as important or very important. Nine of the top 24 questions were rated as having some to a substantial amount of research available, and 15 as having little research available.

Conclusions: The Delphi technique provided a useful means to develop consensus on injury prevention research needs and questions for systematic review.

Injury control as a field is beginning to enter maturity. Over the last four decades, thousands of research articles have been published, and fatalities for most injuries have declined in industrialized countries. Resources both for research studies and implementation of intervention programs, however, are still scarce and must be used wisely. This requires that duplication be avoided in research and that only effective intervention programs be implemented.

One of the keys to accomplish both of these goals is systematic reviews of intervention research. These systematic reviews attempt to include the complete universe of research done on a topic, examine the quality of the research, and determine if there is evidence for an effect, evidence for no effect, or inadequate evidence by which to make a judgment. If the latter, systematic reviews can serve as an important guide to both investigators and funding agencies on important research questions which should be further investigated.

Since quality systematic reviews are time consuming to conduct, priorities for conducting these reviews should be established. These priorities include the importance of the research question (in terms of morbidity and mortality), the availability of information with which to conduct a review, and the degree of uncertainty that experts in the field have about the research question. This study was undertaken to address the last criterion by determining the degree of uncertainty of experts in the field about a topic and asking the experts to rank the importance of different injury control topics for review. It used a Delphi design to arrive at a consensus among injury control investigators and practitioners on the most important research questions for review in the area of injury prevention.

METHODS

Web based Delphi design

This study utilized a modified web based Delphi method to collect expert opinion and achieve consensus on research questions in the field of injury prevention. The Delphi method

was used because it affords anonymity to participants and privacy for iteration and to change one's mind over several rounds.¹ Pressure from dominant individuals within groups is eliminated by anonymity. The Delphi method also helps to minimize the effects of group interactions and maximizes the ability to elicit expert knowledge.^{2,3}

We used a web based Delphi as an economical and efficient method for the survey, avoiding the time spent on data entry and conventional mailing. A list of research questions for systematic review was determined through three rounds of the Delphi surveys. All three rounds were posted electronically on a web site hosted by the University of Washington. Individuals located nationally and internationally were able to participate in group consensus and determination of research priorities using this system.

Experts

Experts were selected based on prior published research in the area of injury prevention or had been nominated by directors of injury prevention programs. These experts were chosen to represent the broad field of injury prevention, ranging from investigators to program managers, and to be representative of the English speaking world of injury prevention experts. They were chosen from various membership lists, including the editorial board of *Injury Prevention*, ISCAIP (International Society for Child and Adolescent Injury Prevention), and the directors of injury control research centers. Separate experts were chosen for consideration of systematic reviews in acute care of trauma and rehabilitation of trauma. There is no requisite number of experts in a Delphi survey; commonly, between 20 and 40 people are included.⁴ We invited 34 experts from seven different countries to participate in the first round. Each expert was contacted through an email invitation letter and provided with a unique URL link to the web site and their own survey. In the majority of cases, surveys were completed online and the data was directly downloaded into a database. Because of the length of the surveys in the second and third rounds, experts were provided with the option of printing out

a hard copy and faxing it back to us. In such cases, the data were entered electronically by the research coordinator. The web based system further enabled us to track non-respondents. Reminder emails were sent to those experts who had not submitted responses within four weeks. Upon completion of each round the data were transferred from the web system to an Excel spreadsheet for analysis.

Background information

We provided all experts with a list of 64 systematic review topics that had been published in 16 different injury prevention areas. The topics were available online at the Harborview Injury Prevention Research Center web site (www.hiprc.org). This information was provided to avoid generating questions that had already been subjected to systematic review and to establish a common base of knowledge for all participants. This imbalance in topic knowledge among participants has been a prior criticism of the Delphi method.⁵⁻⁷ Delphi critics contend that some experts, because they are less informed or familiar with the research available in particular topic areas, may not be as qualified or experienced to vote on or provide an opinion in that area. Published systematic reviews were identified through extensive directed literature searches and communication with health agencies and professional organizations including the National Center for Injury Prevention and Control, the Cochrane Injuries Group, and the US Community Preventive Services Task Force.

Delphi round 1: question generation

The first round consisted of open ended question generation. Each of the 34 experts was asked to provide up to 10 injury prevention research questions that would be appropriate for systematic review. Each expert was provided with "tips for building research questions", which asked them to define five elements for each question. These included the research topic, patient population or problem, intervention, comparison intervention (if applicable), and outcome. This technique was utilized to minimize ambiguity on the part of the investigators, and to collect research questions that were more specific and appropriate for systematic review. Experts were asked to select topics for frequent and severe injury problems, and prevention strategies that have been evaluated, but for which clear conclusions about the size of the intervention effect are currently not available. The five elements were then combined to form a research question. The experts were specifically told to focus on prevention, and not the acute care of trauma patients or their rehabilitation.

Participants were given one month to formulate questions. Investigators then gathered, reviewed, and posted on the web a modified list of questions for the second round. Questions that were similar in nature were combined, and questions that focused only on risk factors for injury without studying an intervention were eliminated.

Delphi round 2: rating

All 34 experts were included in the second round whether or not they submitted questions in the first round; they were given one month to respond. In round 2, each expert rated the relative importance of each topic on a five point scale, which considered importance, frequency of the problem, morbidity/mortality, and its priority for review. A score of 5 (very important), was defined as a very common injury problem, with very significant morbidity/mortality, and/or very high priority for review. At the other end of the scale 1 (very unimportant) was defined as a very uncommon problem, with very low morbidity/mortality, and/or very low priority for review. Experts were offered the opportunity to comment on the research questions, and to clarify or provide additional comments to support any of their ratings. These comments

were reviewed only by the investigators. The scores were collected via the web or by fax, and analyzed.

There are no established rules for determining consensus within the Delphi method.⁶⁻⁸ Our goal was to achieve consensus over the most important questions, as well as to develop a list of questions that was reasonable in length and scope. Questions were ranked by average score with questions in the highest tertile selected for final consensus scoring. We also calculated standard deviations and the proportion of respondents rating each question as important or very important.

Delphi round 3: final consensus rating

In round 3, the remaining questions were presented to the experts for final rating; who were again given one month to respond. The questions were sent only to the 28 experts who responded to the second survey. For each question, the average score and per cent of experts voting 4 or 5 on the second round was presented for them to consider in the process of final scoring. Experts again were asked to rate each question in terms of importance, and also to indicate the amount of research they believed was available for a systematic review on each respective question. This was measured using a three point scale: 3 a substantial amount of research available, 2 some research, and 1 very little research conducted to date.

RESULTS

Of the 34 experts who were sent the initial survey, 21 (62%) provided questions in the first round. There were 126 questions generated, with a mean (SD) of 6 (3.9) questions per person. These were combined into 79 distinct questions for the second round of the survey. Twenty eight experts (82%) participated in the second round and 26 (76%) in the third round).

The 79 questions were grouped into 21 areas of research (table 1). The prevention areas with the most number of questions generated were fires and burns, motor vehicle, and violence (other than intimate partner), and the least were other interventions (which included Safe Communities), and risk compensation.

Table 1 Summary of generated research questions sent to experts in round 2 listed by topic area

Research topic area	No of questions generated
Bicycles	4
Child injury	3
Drowning	2
Drug/alcohol related injuries	6
Falls	6
Firearms	3
Fires and burns	8
Home injuries	2
Motorcycles	5
Motor vehicle	7
Occupational	3
Other interventions	1
Pedestrians	3
Poisoning	2
Sexual assault	2
Sports and recreational injury	3
Suicide	4
Risk compensation	1
Traffic calming and road safety	2
Violence: intimate partner	5
Violence: other	7
Total questions included in round 2	79

Table 2 Summary of final ranking of the top tertile injury prevention research questions

Ranking and question	Category	Mean importance score*	Mean amount of research available†
1. Do specific existing gun control laws and regulations reduce risk of violent injury and death?	Firearms	4.72	2.1
2. Does having a gun in the home increase or decrease the risk of homicides and suicides among household members?	Firearms	4.5	2.38
3. Do speed control interventions in urban areas such as cameras and police, and traffic calming, compared to no intervention, reduce motor vehicle related injuries for all age groups?	Motor vehicle	4.19	2.16
4. Does eliminating or reducing access to mechanisms favored by suicide attempters (suicide prevention fencing on bridges, reducing access to firearms) reduce suicides over-all, or do people simply use other means?	Suicide	4.08	2
5. Does parenting education reduce child abuse?	Violence: other	4.00	1.92
6. Does physical conditioning among the elderly reduce the potential for falls and for fall related injury?	Falls	4.00	2.44
7. Are court mandated abuse deterrence programs effective in reducing repeat domestic violence among domestic violence offenders?	Violence: intimate partner	3.96	1.79
8. Do measures to attenuate the impact of a fall (for example, hip pads and cushioned flooring) reduce the incidence of hip fractures in the elderly?	Falls	3.96	2.19
9. Do school based suicide prevention programs reduce the risk of suicide attempts and suicide among adolescents?	Suicide	3.92	1.53
10. How effective are helmet laws in the reducing motorcycle injuries and deaths?	Motorcycles	3.92	2.6
11. Do civil restraining orders reduce violence against women?	Violence: intimate partner	3.88	1.75
12. Do engineering changes (bicycle/pedestrian paths, bicycle crossings, traffic calming measures) reduce bicycling and pedestrian injuries and deaths?	Bicycles and pedestrian	3.85	1.86
13. How effective are various (specified) methods of traffic calming in reducing collisions and injuries to pedestrians and bicyclists, both children and adults? Are these particularly useful in any geographic setting within a community (for example, near schools)?	Traffic calming and road safety	3.85	1.89
14. Do road safety training programs for children 5–13 years prevent serious pedestrian road traffic injuries?	Pedestrian	3.81	2.21
15. Do hospital—or clinic—based programs to enhance the identification, treatment, and referral of battered women reduce the risk of future physical injuries to women identified in such programs compared to those who are not identified?	Violence: intimate partner	3.8	1.56
16. Are living space design changes effective in reducing fall injuries among the older population?	Falls	3.76	1.79
17. Do state concealed gun carrying laws reduce or increase the frequency of gun related homicide?	Firearms	3.72	1.86
18. Is license revocation effective in reducing motor vehicle crashes and injuries among older drivers?	Motor vehicle	3.68	1.67
19. Does installation of playground safety surfaces prevent head injuries and arm fractures in children under 14 years?	Sports and recreational injuries	3.62	1.95
20. Do smoke alarm installation programs prevent fire related injuries and deaths in residential settings compared with other incentives to install alarms and/or no program?	Fires and burns	3.42	1.7
21. Do medical treatments to increase bone mass reduce the incidence of hip fracture in the elderly?	Falls	3.42	2.23
22. Do residential sprinkler systems, compared to smoke alarms, reduce fire and burn injuries in children and adults?	Fires and burns	3.36	1.33
23. Do bicycle helmet use laws change ridership (as noted by Victoria, Australia early after their state based law was passed)? If such an effect does occur, how long does it last?	Bicycles	3.27	1.74
24. Do helmets prevent TBI among children in winter sports such as skiing, snowboarding, and snowmaching?	Sports and recreational injuries	2.96	1.41

*The mean importance score is the average score for each question utilizing a 1 to 5 scale with 5 being the most important and 1 being the least important.

†Amount of research available is based on a 1 to 3 scale with 3 being a substantial amount and 1 being very little research available.
TBI, traumatic brain injury.

In the second round, there was a strong correlation between the mean score and the proportion of experts who scored a question as important or very important ($r=0.956$). In the top tertile, consisting of 27 questions, the scores ranged from 4.42 to 2.82, and the standard deviation was <1 in 78% of these questions.

The final ranking of the top tertile questions and the mean score for the amount of information available for systematic review is shown in table 2. Two questions were removed from the top tertile because a review had already been done or a review was in progress, and two questions were combined into one. The final list consisted of 24 questions. Nine of these 24 questions were rated as having some to a substantial amount of research available, and 15 as having little research available.

The complete list of questions and their scores is available

on the Harborview Injury Prevention and Research Center web site (www.HIPRC.org).

DISCUSSION

The electronic Delphi design proved to be an economical and feasible method to solicit questions and develop consensus on research topics for systematic review. While it has the disadvantage of not including face-to-face discussion, it avoids dominance of the group by one or a small number of individuals, and allows equal input from all. In the top tertile of questions, there was good agreement on the importance of the questions. Unfortunately, many of these questions were viewed as having little published evidence available for review.

There are limitations that must be considered. The intent of the survey, as stated in the directions to the participants, was

to solicit research topics for systematic review. Appropriate questions for review are those that are important and for which there are studies which need to be critiqued and summarized. Nevertheless, many participants suggested questions, which while important, were more appropriate for primary research than for review because of the lack of sufficient prior studies.

We attempted to get a representative sample of injury control investigators and individuals who focus on injury prevention program implementation as participants in this study. We tried to achieve inclusiveness in the group of experts and avoided having the panel dominated by either investigators or program managers. The group was international, and represented diverse interests.

Given the scarce resources available for injury prevention research and program implementation in all countries of the world, focus of research on important, previously unanswered questions is necessary. Systematic reviews should be done on available research to guide both new research and prevention efforts. We believe this survey will be of use to both investigators and practitioners in working to accomplish these goals.

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Authors' affiliations

F P Rivara, J M Johansen, D C Thompson, Harborview Injury Prevention and Research Center and the Departments of Pediatrics and Epidemiology, University of Washington

REFERENCES

- 1 Rowe G, Wright G, Bolger F. Delphi: a reevaluation of research and theory. *Technological Forecasting and Social Change* 1991;**39**:235-51.
- 2 Linstone HA, Turoff M. *The Delphi method: techniques and applications*. Reading, MA: Addison-Wesley, 1975.
- 3 Woudenberg F. An evaluation of Delphi. *Technological Forecasting and Social Change* 1991;**40**:131-50.
- 4 Reid N. The Delphi technique: Its contribution to the evaluation of professional practice. In: Ellis R, ed. *Professional competence and quality assurance in the caring professions*. New York: Chapman & Hall, 1988: 230-54.
- 5 Custer RL, Scarcella JA, Stewart BR. The modified Delphi technique: a rotational modification. *Journal of Vocational and Technical Education* 1999;**15**:11pp.
- 6 Fink A, Kosecoff J, Chassin M, et al. Consensus methods: characteristics and guidelines for use. *Am J Public Health* 1984;**74**:979-83.
- 7 Woolf S. H. Practice guidelines, a new reality in medicine. II. Methods of developing guidelines. *Arch Intern Med* 1992;**152**:946-52.
- 8 Williams PL, Webb C. The Delphi technique: a methodological discussion. *J Adv Nurs* 1994;**19**:180-6.

LACUNAE

Kissing rattlesnakes

A medical research article on unusual rattlesnake bites described several bizarre human-snake interactions, including an intoxicated 45 year old man who was "bitten on the tongue after placing his pet rattlesnake's head in his mouth in an attempt to calm the snake". The authors note that "although human beings are not rattlesnake prey, envenomations (commonly) follow intentional encounters with snakes". Bill Geissert found this information in "Rattlesnake envenomation: unusual case presentations", by D A Tanen et al (*Arch Intern Med* 2001;**161**:474-9).

"Like some fries with that?"

It was meant to develop leadership skills but the fire walking exercise for 30 managers of the KFC fast food chicken restaurant chain was too hot to bear. Eleven ambulances responded to an emergency call, seven people received burns requiring treatment at hospital, 13 were treated at a clinic, and 10 were treated at the scene for minor blisters. The mass burning took place on the last day of a management development conference for 180 KFC managers. Inquiries by the company and by the government agency WorkCover are under way (*The Age* (Melbourne), February 2002).

New Year fireworks deaths

The China news agency Xinhua reports that nine were killed and 60 injured in a firework factory blast in the south east Province of Jiangxi in December. An initial explosion in a warehouse set off a series of blasts that destroyed 10 of the 11 separate buildings within the factory complex, in Huangmao town of Wanzai district. Only the building containing the factory's offices was left standing. Shockwaves from the blasts could be felt 60 kilometres away in the regional capital, according to a resident quoted by the *Yangcheng Evening News* from Guangzhou.

At least 270 Peruvians are reported dead in a firework blaze on New Year's Eve. The fire engulfed four blocks in the historic Mesa Redonda shopping area of Lima. More than 130 were injured in the blaze, doctors said many of those hurt had suffered first, second and third degree burns, but others were in a coma or had suffered severe mental trauma. According to witnesses, the fire began late Saturday in a store selling fireworks for New Year's celebrations, after vendors tested firecrackers for some clients. Fireworks are widely used for Christmas and New Year celebrations in Peru and Lima officials said huge quantities of fireworks were stockpiled in downtown shops, as well as private attics and basements.