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A Web-based survey on students' conceptions of 'accident'

DANILO BLANK[1], GUILHERME HOHGRAEFE NETO[2], ELISA GRANDO[2], PAULINE Z. SIQUEIRA[2], ROBERTA P. LUNKES[2], JOÃO LEONARDO PIETROBELI[2], NORMA REGINA MARZOLA[3] & MARCELO Z. GOLDANI[1]

[1]*Professor, Department of Pediatrics,* [2]*Research Fellow, Department of Pediatrics, and* [3]*Graduation Program on Education, Núcleo de Estudos da Saúde da Criança e do Adolescente (NESCA), Hospital de Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil*

Abstract
To report the implementation of an open source web survey application and a case study of its first utilisation, particularly as to aspects of logistics and response behaviour, in a survey of Brazilian university students' conceptions about injury causing events. We developed an original application capable of recruiting respondents, sending personal e-mail invitations, storing responses and exporting data. Students of medical, law, communication and education schools were asked about personal attributes and conceptions of the term accident, as to associations and preventability. The response rate was 34.5%. Half of the subjects responded by the second day, 66.3% during the first week. Subjects around 4.2% (95% CI 3.3–5.4) refused to disclose religious persuasion, and 19.2% (95% CI 17.2–21.3) refused to disclose political persuasion, whereas only 2.8% (95% CI 2.1–3.8), on average, refused to answer questions on conceptions and attitudes. There was no significant difference between early and late respondents in respect to selected attributes and conceptions of accident (*P*-value varied from 0.145 to 0.971). The word accident evoked the notion of preventability to 85.1% (95% CI 83.2 to 87.0) of the subjects, foreseeability to 50.3% (95% CI 47.7–53.0), fatality to 15.1% (95% CI 13.3–17.1) and intentionality to 2.3% (95% CI 1.6–3.2). Web surveying university students' conceptions about injuries is feasible in a middle-income country setting, yielding response rates similar to those found in the literature.

Keywords: *Wounds and injuries, health surveys, Internet, health, knowledge, attitude, medical information systems, open source software, software development*

1. Introduction

Health-related web surveys have been experiencing an astounding expansion, for several operational reasons: mostly broader coverage, swift application, interactive answering, easier appraisal of response rates, automatic building of databases, respondents' anonymity and cost-effectiveness [1–4]. Moreover, online questionnaires yield information not significantly different from that retrieved through traditional modes, and allow valid inferences, even if drawn from the usual convenience samples [5–7]. Further, more studies regarding

Correspondence: Danilo Blank, Departamento de Pediatria, Faculdade de Medicina, Universidade Federal do Rio Grande do Sul, Rua Ramiro Barcellos 2400, Porto Alegre, RS, CEP 90035-003 Brazil. Tel: +1-55-51-3019-0092. Fax: +1-55-51-3331-1571. E-mail: blank@ufrgs.br

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methodological and validity issues have recently dealt with web-based survey than any other information gathering technique, which makes it even more trustable [8–10]. Brazil, like most low- and middle-income countries, follows the worldwide trend of rapid growth of Internet access, but there are very few studies based upon web surveys.

Within the injury field, survey studies of safety attitudes and behaviours have been seen as appropriate for fostering prevention actions. However, although a good many of such surveys are being reported these days, they are mostly done by mail or telephone [11–13]. Among the few Internet-based questionnaires dealing specifically with safety issues [14–18], just a couple have intended to describe behaviours [19,20].

The injury epidemic, a public health calamity that imposes a grievous toll worldwide, strikes in a highly uneven distribution, being particularly prominent among low- and middle-income countries. As awareness about the magnitude of the problem is scantier exactly in such countries, they are less apt to apply science-based approaches to injury control which have proven successful in developed regions. Thus, any effort to improve data collection that might foster prevention initiatives is sorely needed [21]. This applies to accessible information technology applications, particularly those intended for web-based surveys, for there are dozens of survey software packages, but free basic versions are often insufficient for higher breadth studies, while those versions with advanced features are rather expensive.

This article aims at describing the development and implementation of an original open source researcher-friendly application especially designed to perform web-surveys; and reports the case study of its first utilisation, particularly as to aspects of logistics and response behaviour, in a survey of university students' conceptions about injury causing events.

2. Methods

We used a cross-sectional observational design to collect quantitative information by means of a self-administered web-based questionnaire. The target sample comprised students of medical, law, communication and education schools in the greater Porto Alegre, a southern Brazilian city of just over 1.5 million people. The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [22] is provided in the Appendix.

2.1. The software

We devised an original open-source software application chiefly aimed at allowing the non-informatician researcher to carry out a web-based survey autonomously, with full control of the evolving data. The application has a researcher-friendly interface, and organises the recruited information concerning prospective respondents, sends out customised e-mail invitations, gathers and houses response data in an online database, and facilitates exportation of data to statistical softwares. Its development was based upon the PHP 4.4.7 programming language; the programming editor was Bluefish 1.0.

The questionnaire form, written with OpenOffice 2.2.1, was designed to be displayed with the simplest layout, with the use of colours was used sparingly. We avoided using advanced programming capabilities, such as screen-by-screen display, skip patterns, applets, and animation, to make sure that most browsers and operating platforms could handle the survey without becoming overloaded. We did not exceed horizontal limits, allowing the questionnaire to be displayed by most resolution configurations without requiring sidewise scrolling. We used mainly radio button answer choices and only two drop-down boxes.

The files were sent to a machine running Linux with Apache2 server. The data were stored in a My Structured Query Language (MySQL) version 4.1.22 database and were exported through PHPMyAdmin version 2.8.2.

A spreadsheet was created in BrOffice.org Calc to gather e-mail addresses and course identification, which were imported to the table 'invitations'. We then accessed the addresses through the administrative layer and commanded that individual customised messages be automatically sent to each prospective respondent, carrying a unique Uniform resource locator (URL) hash as a token to access the survey website. By clicking on the indicated URL, the subject was linked to the Hypertext transfer protocol (HTTP) server, which displayed the questionnaire according to routines written in Personal Home Page Hypertext Preprocessor (PHP). The survey application checked the database to assert that each respondent filled out the form only once, and that the URL token corresponded to the correct e-mail address to which the invitation had been sent. This exempted us from providing a personal identification number for limiting undue access or preventing multiple response.

After the questionnaire was completed, its form was sent to the HTTP server, which relayed the message to the PHP processor. The processor verified whether all questions had one field each adequately checked; no error being found, it saved the data in the database and sent back a thank-you message. In case at least one mistake was detected, the processor issued a message asking the respondent to make the due corrections and to resubmit the questionnaire. At the closing of the survey, the data were exported through PHPMyAdmin in spreadsheet format.

All software and data were hosted in a project specific site at the university server, with continuous Internet access. All data kept in the database were password protected. The survey application was implemented by using free software throughout.

2.2. Questionnaire development

The main object of the questionnaire was to evidence university students' conceptions of the term 'accident' as to nature of damages, associations, and preventability. The instrument was based upon previous publications [23,24], but this is the first attempt to assess such issues in a Portuguese-speaking sample.

For the sake of analysis, we set some subjects' attributes (including safety behaviours, attitudes and knowledge) as predictor variables and some conceptions about injuries as outcome variables. Predictor variables dealt with in the present report were: age, sex, course, course stage, political and religious persuasion, risk-taking proclivity, personal (or close relation) injury history, sources of safety orientation and the habit of wearing seat belt (as a measure of safety behaviour). The outcome variables were conceptions of the term accident: we specifically asked the subjects if upon hearing it they usually thought that what happened was done on purpose, was the work of fate, could have been predicted, or could have been prevented. We also asked them what percentage of mortal accidents they found to be preventable.

We conducted a primary assessment of face and logical validity of the instrument by sending an e-mail invitation to selected faculty of medicine, education and linguistics, requesting each one to access the survey website, complete the questionnaire, and comment on understandability, usability of the web form and the time it took to go through all questions. The questionnaire was revised based on this first feedback material.

We then discussed the revised questionnaire in three focus groups composed of students of medicine and law, who did not belong to the population frame. They assessed how well the

students understood the wording of the questionnaire and previewed some of their peers' conceptions about the issues investigated. The three sessions were recorded and the material whereupon extracted allowed us to further revise the questionnaire.

Last we performed cognitive interviews, in which nine medical students, who also did not belong to the population frame, were gathered in the school informatics laboratory and asked to sit each one in front of a computer to participate in a simulation of the survey answering procedure. We sent each personal e-mail a customised message carrying a unique URL token to access the survey website. In a real time procedure, each subject completed the questionnaire item-by-item, and wrote down why each answer was chosen, difficulties encountered, as well as criticisms on wording and usability. Next we discussed the written reports with the whole group, as this has been demonstrated to reduce distorted interpretations [25–27].

2.3. Pilot testing

We carried out a pilot study with a sample of 148 medical students, which elicited a response rate of 53%. Half of the responses arrived within the first 4 days after the e-mail invitation. After three weekly reminders, replies ceased to come in altogether on the 39th day. In this pilot, one of the researchers personally visited half of the classes in the sample frame and asked them to participate in the survey; while the other half just received the e-mail invitation. In addition, both groups were offered the chance to win a memory flash pen drive in a lottery among respondents. In the end, the response rate of the stimulated group (39%; 95% CI 28–50) was smaller than that of the other (54%; 95% CI 43–65), although the difference was not statistically significant [28].

2.4. Sample and recruiting logistics

The study's inclusion criteria were: (a) to be registered as first or last year student of medicine, law, education or communication in one of the eight universities in the greater Porto Alegre (further analyses not dealt with in this report considered contrasts between such subsets of the sample); and (b) having a valid e-mail address. There were no exclusion criteria.

Recruitment was initiated by sending a formal document of request on University of Rio Grande do Sul (UFRGS) Faculty of Medicine letterhead to the director of each academic institution, accompanied by the corresponding ethics committee approval, which explained the nature of the research project and solicited the list of the students' e-mail addresses. In whichever case the institution retorted not having the right to reveal any individual's e-mail address, we asked for permission to either direct the same request to the student council or resort to visiting every class composing the study sample and personally asking each student to volunteer his/her e-mail address.

We gathered 5322 e-mail addresses, 3216 of them in electronic files either provided by the institutions or student councils, and the remaining 2106 supplied personally by the students. Such addresses were typed or preferably pasted into spreadsheets and exported to the survey software.

We sent each subject an initial e-mail invitation, followed by four reminders on days 7, 14, 21 and 28. Before the first e-mail invitation was sent, one of the researchers personally visited the greatest number of classes in the study frame, to incite the subjects to respond. However, based upon the results of the pilot study, we did not attempt to visit all potential respondents.

2.5. Definitions of final dispositions and outcomes

We calculated the outcome or response rates according to the operational definitions and formulas recommended by the American Association for Public Opinion Research for Internet surveys of specifically named persons [29]. Accordingly, we used the minimum response rate, which is the number of complete questionnaires divided by the number of questionnaires (complete plus partial) plus the number of 'non-interviews' (refusal and break-off plus non-contacts plus others) plus all cases of unknown eligibility (unknown if invitation was ever delivered, plus unknown, other).

2.6. Statistics

To calculate the minimum number of invitations to be sent, we considered that web-based surveys usually have response rates between 30 and 60%, but may reach much higher rates in defined university populations. Assuming a response rate of 100%, a 95% confidence level, a margin of error of five percentage points, and extreme proportions of answers (50% for a dichotomic option), we would need a number of subjects varying between 278 (for a population of 1000 individuals) and 370 (for a population ten times larger). A conservative estimate of 50% response rate led us to a minimum of 740 invitations. Having gathered seven times as many e-mail addresses, we decided to send out all invitations, based on the capability of the survey application to manage a large amount of data.

All answers were coded before analysis in the following scheme: ascending numbers were attributed to alternatives in simple choice questions, while Likert scale items were collapsed from five to three items and reverse coded so that 1 referred to 'yes' or 'always', 2 referred to 'don't know' or 'sometimes', and 3 referred to 'no' or 'never'.

We tested whether early and late respondents differed statistically and whether subjects' conceptions were dependent of any of their personal attributes through either chi-square test for categorical variables or t test for continuous ones. The significance level was set at $P < 0.05$.

We conducted chi-square analyses to compare differences in conceptions across attributes. If the overall chi-square was significant, we examined the adjusted standardised residuals (non-parametric equivalent of z-scores) for the cell percentage of each attribute/conception crossing. An adjusted standardised residual greater than 1.96 for a given cell indicated with 95% confidence that the observed frequency count in the cell in question was significantly different from that which would have been expected had there been no association between the two related variables. Moreover, we assumed that the bigger the adjusted standardised residual, other things being equal, the less likely the null hypothesis of no association between the two variables was to hold, i.e. the bigger would appear to be the strength of association between such variables.

We used Statistical Package for Social Sciences (SPSS) version 13 (SPSS, Chicago, IL, USA) to conduct statistical significance analyses; and Stata Statistical Software, release 9 (Stata 9) (StataCorp LP, College Station, TX) to determine confidence intervals.

2.7. Ethics matters

Subjects' free and informed consent to participate in the survey was obtained through a tacit consent strategy, whereby the approval of the terms of the research was understood as the invitee chose to click on the link to the survey website, which was explicitly positioned in the invitation e-mail message right after the following statement: 'This is an absolutely

confidential academic research. No personal information will ever be disclosed or associated to any answer. To access the survey website, please click on the following link (or, if you prefer, type or copy and paste the URL in your browser'.

The study was approved by the Committee on Research Ethics of the UFRGS, and also by the research ethics committees of all other universities involved.

3. Results

3.1. Survey response

Of 4718 valid e-mail addresses, 1626 students completed the survey (response rate of 34.5%). Figure 1 shows the sample disposition: after having excluded non-eligible respondents (persons who were neither first-year nor last-year students, whose e-mail addresses had been included by mistake in the invitation list), we finally analysed 1450 questionnaires, which correspond to 30.5% of invitees with valid e-mail addresses.

As to the willingness to provide specific answers, 4.2% (95% CI 3.3–5.4) subjects refused to disclose spirituality status, and 19.2% (95% CI 17.2–21.3) refused to disclose political persuasion, whereas only 2.8% (95% CI 2.1–3.8), on average, refused to answer questions on conceptions and attitudes.

3.2. Temporal pattern of response and completion time

Figure 2 shows the temporal profile of responses: each weekly reminder incited a new surge of responses, with smaller amplitude than that of the preceding one. Half of the complete questionnaires had been submitted by the second day, 66.3% by the day seven (first reminder); and 91.1% by the day 21 (second reminder). The 95th percentile for responses was reached in four weeks (last reminder), and no response was sent after the 40th day.

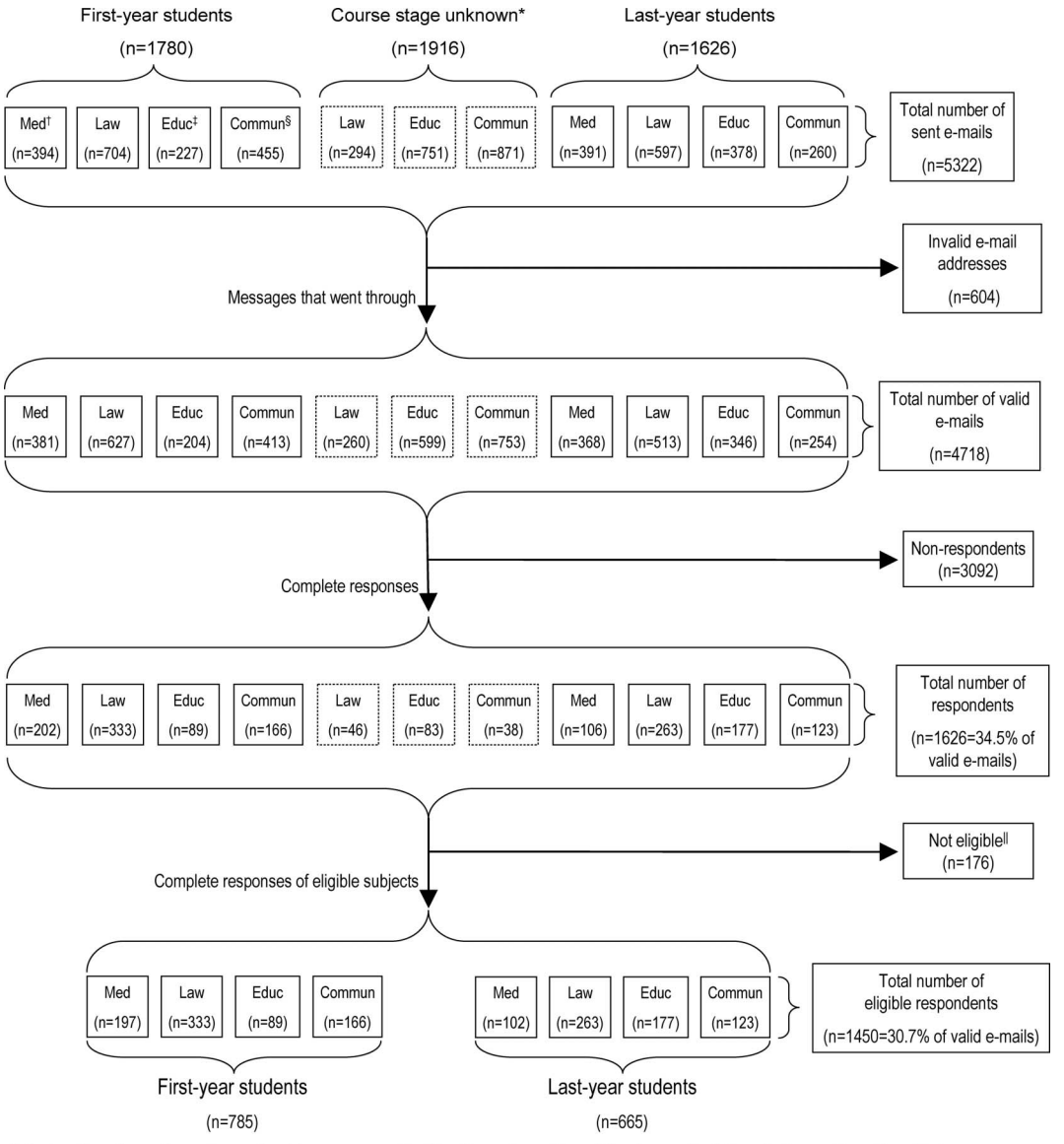
As to completion time, we did not record the time between logging to the survey website and the submit time, because it would be impossible to estimate any 'lurking' period. However, it is worth noting that one respondent submitted the complete questionnaire less than 5 min after the invitation had been sent; 20 subjects responded in upto 10 min, 58 responded in upto 20 min, and 83 responded in upto 30 min.

3.3. Assessment of non-response bias

We applied the continuum of resistance model, [30] which assumes that those subjects who respond only after considerable time and effort resemble non-respondents in the behaviours of interest. Table I shows that there was no statistically significant difference between early and late respondents in respect to 10 selected subject attributes. Likewise, Table II shows that early and late respondents were not different concerning their conceptions of accident and preventability.

3.4. Students' conceptions about the term acidente (accident)

The overall conceptions of the entire sample concerning how the word *acidente* (accident) conveys notions of 'act of God' or fatality, intentionality, previsibility and preventability are depicted in the second column of Table II. The four questions were responded by more than 98% of the subjects, but the incidence of the 'don't know' option varied: 5.5% for intentionality, 8.6% for preventability, 13.4% for fatality and 15.3% for previsibility. The figures evince significantly inverse associations between the word accident and the ideas of



* A significant number of e-mail addresses provided by the universities did not specify if they belonged to either first-year or last-year students.
† Medicine.
‡ Education.
§ Communication.
‖ Respondents whose course stage was other than first or last year.

Figure 1. Study recruitment and sample disposition.

preventability (~85% positive association) and fatality (~85% lack of association). Whereas the association of the word accident with non-intentionality was nearly unanimous, it evoked the notion of foreseeability for half of the respondents.

Table III shows the stratification of the same answers according to the course stage. Chi-square and adjusted residual analysis indicated a strong association of the notion of

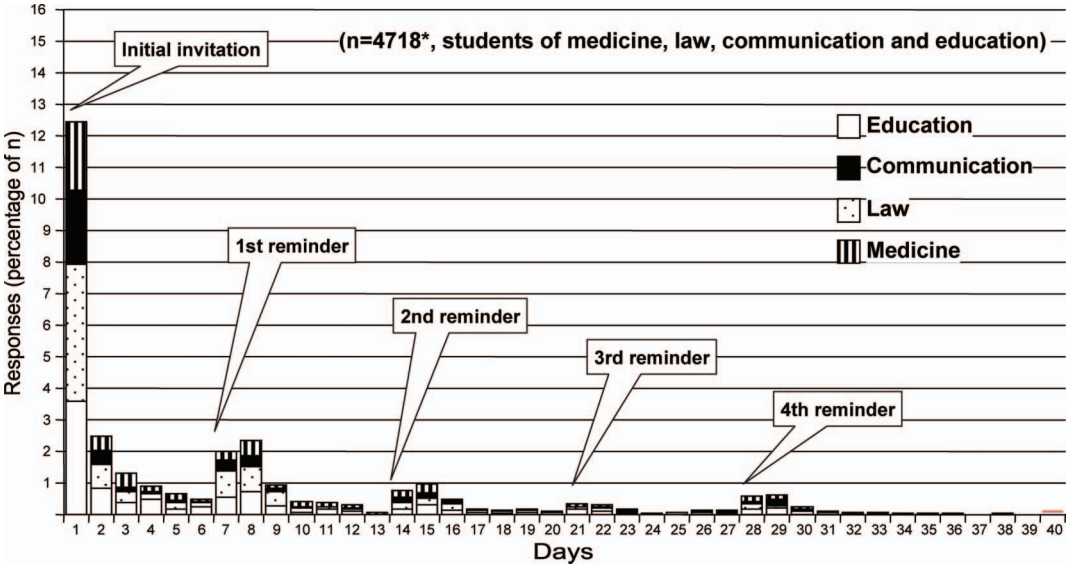


Figure 2. Temporal profile of survey responses as percentages of total sample frame (*n refers to total number of valid e-mails).

foreseeability with last-year students, while there was no significant association between course stage and the remaining issues.

4. Discussion

4.1. On the software and its application

The objectives of this study were accomplished, as our project-specific application proved effective in allowing non-informaticians to input texts and more than 5000 e-mail addresses, with no further worry than to monitor its every step in sending out the customised invitations and housing the response data as they were submitted, so that they were ready for exportation to statistical softwares. In this instance, we concur with published reports noticing the advantages of tailor-made applications, which provide full system customisation and expedited data processing, without error-prone data entry [9,31]. Although some point out that hard-to-estimate human labour costs should not be overlooked as one uses such free-from-commercial-constraint applications [32], studies like this, totally carried out within a public university setting, tend to have zero cost, except for the researchers' time.

The use of open source softwares throughout enhanced such assets. A literature review of web-based surveys associated with university students, health issues and injury revealed only one article, written by Koru *et al.*, which specifically reported a similar option [33]. It is interesting to note that such methodology is of particular significance to low- and middle-income countries, which struggle to overcome technology barriers. That is why – having in mind that the Internet experience shows the effectiveness of an open source strategy for interoperability [34] – we put deliberate effort to describe our methods in this article.

Further, we must point out that, among all articles in our review, counting out those few that informed having used commercial web-survey products, only seven described particulars of the implementation of study-specific websites [9,31,33,35–38]. What is more important, only the referred article by Koru *et al.* [33] provided a CHERRIES statement [22]. This

Table I. Respondents' attributes: total sample and according to temporal pattern of response*.

Attributes	Total† , $n = 1450$	Temporal pattern of response		P
		Early‡ , $n = 871$	Late§, $n = 122$	
Sex				0.511¶
Male	506 (34.9%)	302 (34.7%)	46 (37.7%)	
Female	944 (65.1%)	569 (65.3%)	76 (62.3%)	
Age	24.6 ± 7.44	24.4 ± 7.52	25.4 ± 6.91	0.145**
Course				0.277¶
Medicine	299 (20.6%)	181 (20.8%)	23 (18.9%)	
Law	596 (41.1%)	361 (41.4%)	42 (34.4%)	
Communication	289 (19.9%)	176 (20.2%)	32 (26.2%)	
Education	266 (18.3%)	153 (17.6%)	25 (20.5%)	
Stage				0.209¶
First year	785 (54.1%)	481 (55.2%)	60 (49.2%)	
Last year	665 (45.9%)	390 (44.8%)	62 (50.8%)	
Spirituality††				0.559¶
Religious	894 (64.4%)	530 (62.9%)	77 (65.8%)	
Mystic. non-religious	201 (14.5%)	125 (14.8%)	13 (11.1%)	
Irreligious	294 (21.2%)	187 (22.2%)	27 (23.1%)	
Political persuasion††				0.401¶
Conservative	169 (14.4%)	106 (14.9%)	11 (11.2%)	
Moderate	603 (51.5%)	358 (50.4%)	56 (57.1%)	
Progressist	400 (34.1%)	247 (34.7%)	31 (31.6%)	
Personal injury history††				
Death of loved one	516 (36.2%)	305 (35.5%)	45 (37.8%)	0.650‡‡
Hospitalisation (respondent himself)	228 (15.8%)	128 (14.7%)	20 (16.4)	0.722‡‡
Risk-taking proclivity††				0.164¶
Yes	49 (3.4%)	23 (2.6%)	7 (5.8%)	
Sometimes	380 (26.3%)	225 (25.9%)	29 (24.0%)	
No	1015 (70.3%)	620 (71.4%)	85 (70.2%)	
Wears seatbelt††				0.510¶
Yes	1346 (94.3%)	813 (94.4%)	118 (96.7%)	
Sometimes	53 (3.7%)	31 (3.6%)	2 (1.6%)	
No	28 (2.0%)	17 (2.0%)	2 (1.6%)	
Safety orientation source††				0.851¶
Media, friends, product manuals	1061 (88.7%)	642 (89.8%)	94 (90.4%)	
Health services, physician, scientific literature	135 (11.3%)	73 (10.2%)	10 (9.6%)	

*Data are shown as mean ± SD or n (%).
†Total n includes 457 respondents who submitted between the first reminder (first 6 complete days) and the 90th percentile of survey time span (last 20 complete days); refusals account for differing totals within column.
‡Number of respondents who submitted before the first reminder (first 6 complete days).
§Number of respondents who submitted after the 90th percentile of survey time span (last 20 complete days).
¶P value for chi-square test comparing early and late responders.
**P value for t test comparing early and late responders.
††Absolute numbers add upto valid cases (refusals were considered missing cases); percentages of valid cases.
‡‡P value for chi-square test, considering the answers 'yes' and 'no', excluding refusals for each of the two situations.

deserves proper stress, for that checklist is instrumental in ensuring thorough descriptions of electronic survey (e-survey) methodology, so that readers can grasp the intricacies of study reports. Such seeming carelessness on the part of researchers indicates that the CHERRIES statement – one of the few of many similar research reporting guidelines to be absent from the EQUATOR Network, the conjoining initiative to foster reliability of medical research literature [39] – is in need of wider promotion.

Table II. Brazilian university students' conceptions of accident and preventability: total sample and according to temporal pattern of response*.

Conceptions	Total†, $n = 1450$	Temporal pattern of response		P
		Early‡, $n = 871$	Late§, $n = 122$	
When you hear the word accident, do you usually think that what happened was (could have been)...¶				
Done on purpose	33 (2.3%)	19 (2.2%)	4 (3.3%)	0.399**
Work of fate	215 (15.1%)	117 (13.7%)	21 (17.4%)	0.390**
Predicted	720 (50.3%)	451 (52.4%)	61 (51.7%)	0.757**
Prevented	1225 (85.1%)	739 (85.4%)	103 (84.4%)	0.943**
What percentage of death causing accidents is preventable?				0.971††
Less than 30%	93 (6.6%)	54 (6.4%)	8 (6.8%)	
30–70%	438 (31.2%)	266 (31.5%)	38 (32.2%)	
More than 70%	874 (62.2%)	524 (62.1%)	72 (61.0%)	

*Data are shown as *n* (%).
†Total *n* includes 457 respondents who submitted between the first reminder (first 6 complete days) and the 90th percentile of survey time span (last 20 complete days); refusals account for differing totals within column.
‡Number of respondents who submitted before the first reminder (first 6 complete days).
§Number of respondents who submitted after the 90th percentile of survey time span (last 20 complete days).
¶Absolute numbers indicate how many respondents chose 'yes' or 'I think so' to each of four non-exclusive options.
***P* value for Chi-square test, comparing early and late responders, and considering the answers 'yes', 'I think so', 'don't know', 'I don't think so' and 'no' for each of the four options.
††*P* value for Chi-square test comparing early and late responders.

Table III. Brazilian university students' conceptions about the term *acidente* (accident) by course stage*.

	First year	Last year	Total
Preventable?† ($n = 1439$)			
Yes	658 (84.6%)	567 (85.8%)	1225 (85.1%)
Don't know	68 (8.7%)	56 (8.5%)	124 (8.6%)
No	52 (6.7%)	38 (5.7%)	90 (6.3%)
Predicted?‡ ($n = 1430$)			
Yes	360 (46.3%) [−3.3]	360 (55.1%) [3.3]	720 (50.3%)
Don't know	122 (15.7%) [.2]	100 (15.3%) [−0.2]	222 (15.5%)
No	295 (38.0%) [3.3]	193 (29.6%) [−3.3]	488 (34.1%)
Work of fate?§ ($n = 1422$)			
Yes	114 (14.8%)	101 (15.4%)	215 (15.1%)
Don't know	104 (13.5%)	90 (13.8%)	194 (13.6%)
No	550 (71.6%)	463 (70.8%)	1013 (71.2%)
Done on purpose?¶ ($n = 1437$)			
Yes	18 (2.3%)	15 (2.3%)	33 (2.3%)
Don't know	47 (6.0%)	33 (5.0%)	80 (5.6%)
No	713 (91.6%)	611 (92.7%)	1324 (92.1%)

*Data are shown as *n* (%) [adjusted residual, presented only in cases where $P < 0.05$].
†$P = 0.744$; ‡$P = 0.002$; §$P = 0.937$; ¶$P = 0.694$.

4.2. On response behaviour and inciting strategies

This study's fulfilment is also illustrated by the response behaviour. Our overall response rate was not much below the average of those studies in our review that focused on university students' perceptions about health issues, which ranged from 22.6 to 82%. Whereas some studies did not try to determine response rates and shut down their

websites upon having reached a target response quota [40,41], the best results were obtained by Cashell-Smith *et al.*, who assessed a sample of university students very similar to ours, the difference having been a discreet incentive [42]. Those authors reported quite favourable respondents' comments towards such modest incentive, which is in stark contrast to quite meagre response to surveys that offered monetary incentives but were directed to broader samples [43,44]. This adds to the idea that defined target samples such as university students may negate the presumptive advantage of money incentives over altruistic motives for participation, such as contribution to scientific research [45,46]. The latter was specifically emphasised in our invitation e-mail, as we pursued Dillman's directions on applying the elements of the social exchange theory – reward, cost and trust – to boost responses [3]. To that end, we tailored the invitation to highlight the support of the UFRGS, to show positive regard to respondents in advance, assuring that completing the questionnaire would be quick and would foster control of a public health problem. In a way, all evidence attesting that social rather than economic exchange has a stronger effect on response behaviour, compensate for us not having been able to test the effect of the memory flash pen drive lottery that we had included in the pilot study [28], as the ethics committee deemed such procedure unsuitable for the larger sample.

An additional comment concerning response behaviour is on the temporal profile of survey submissions and the means to elicit them. It is generally held that e-surveys provide faster reaction times; many studies having reported that most responses arrive within three days following the initial contact [32]. Dillman's Tailored Design Method relies on evidence that response rates are 30% lower without follow-up contacts to prescribe three additional contacts along a period of upto 8 weeks after the questionnaire mailing; although such recommendations are based on experience with mail and telephone surveys [3]. We decided to send four weekly reminders, exclusively by e-mail, under the assumption that the web survey mode would elicit faster responses; and, in fact, we got half of the complete questionnaires back by the second day, and two thirds before the first reminder was out. Therefore, we can only concur with Kypri *et al.* in that a follow-up beyond the 3rd week is probably not warranted in most e-surveys, and that limiting the recruitment effort to that early period can free up resources and allow a greater target sample and a reduced data collection time span [30].

A further notable issue is that we found no significant difference between early and late respondents in respect to selected attributes and conceptions of accident. This adds to one of the conclusions of the latter cited article [30], as it exemplifies that the effect of nonresponse bias in a web survey is at the worst too small to be of significant concern.

We did get a few nasty replies from students who either reckoned our invitation was a virus threat or bluntly stated that they would not endorse medical research, which certainly raise ethical concerns as to viewing unsolicited e-mail as an invasion of one's private space. It has been argued that as e-mail is no longer a novelty, response rates to e-surveys will keep diving even faster than telephone survey rates did, because they are bothering and frightening [32,46]. To overcome such problem we tried to convey the senses of trust and convenience by carefully choosing the wording for the e-mail invitation, but also by using plain text, holding back on design capabilities, and addressing each message personally rather than as part of bulk transmission.

4.3. On what and how they respond

One last methodology issue that deserves attention is that of the influence of self-administration on social desirability bias. Virtually all respondents related having ridden

a motor vehicle during the previous month, 94% of whom asserted to have always or almost always worn a seat belt, which is a safer behaviour than usual. Considering the literature evidence that absence of interviewers tend to reduce social desirability bias and that computerisation itself may have similar effects to self-administration [5,43], such a finding is intriguing at the least. As this study had the obvious limitation of not having been able to check the veracity of the answers, we could only conclude that the students in this sample bear themselves particularly well as to vehicle safety, which is anyhow consistent with the prevailing traffic safety promotion actions in our setting. On the other hand, to corroborate that web surveys can enhance reporting of sensitive information, 97% of the students agreed to answer questions on safety attitudes, and 96% disclosed their spirituality status. This supports the effectiveness of a web survey to tackle such sensitive issues, although we must concede that nearly 20% of the students refused to reveal their political attitude. Although it remains to be shown how such findings can be generalised to more probabilistic samples or to populations from other developing regions, we believe that this study is helping to pave the way for further progress of injury research in low and middle-income countries.

4.4. On accident conceptions

As to the contrasts between first-year university students' conceptions about the term *acidente* (accident) and those of their last-year counterparts, we must first consider that the motivation for this study stemmed from observing that the argumentation over whether or not the word 'accident' is indeed a deterrent to effective safety education and policy making is an ever-going conundrum [47,48]. Whereas the injury research community has been long discussing terminology, and hence recognising the relevance of studying the dichotomy in conceptions between the community and specialists, this is still a largely unsettled matter [49]. Second and importantly, these goings-on hardly transcend the confines of the lingua franca of current scientific communication, i.e. English [49–51]. Under such perspective, this study's most blatant limitation – to have focused on a non-anglophone population – becomes its chief asset, as we have succeeded in showing that Portuguese-speaking university students' conceptions of the word *acidente* (accident) coincide very closely with those of North-American samples. The section of our questionnaire that assessed people's conceptions of accident as to the notions of fatality, intentionality, previsibility and preventability was directly duplicated from the survey instrument of the study by Girasek, a keen analysis of how a nationally representative sample of USA residents interpret the word accident [23]. That study also found remarkable inverse associations between the word accident and the ideas of either preventability (about 85% of subjects think accidents are preventable) or fatality (about 85% of subjects do not think accidents happen by work of fate). Similar findings had been reported by Eichelberger *et al.*, whose survey of USA parents indicated that 87% agreed with the statement that most accidents are preventable [52]. Hooper *et al.* asked New Zealanders a parallel question, albeit nowhere in their article they refer to the word accident; they inform instead that 84% of interviewees agreed with the statement that most injuries are preventable [53].

With regard to contrasts between conceptions of students in different course stages, we did find a strong association of the notion of accident foreseeability with last-year students. This is also in accordance with Girasek, who found that education was significantly associated with predictability interpretations, with subjects who had earned less than a college degree being about 40% less likely than those with a graduate degree to say that they usually thought accidents could be predicted [23]. Thus, we can conclude that going through a higher education course indeed changes one's conceptions of the word in question.

5. Closing remarks

Like any cross sectional observational study, this one is not suitable for determining causal relationships, so that it does not allow risk estimates, particularly in infrequent outcomes such as severe injuries. However, this is not a serious concern since we are actually aiming at contributing to terminology discussion within the realm of the science of injury control and to acting more as a question-raiser. In fact, the main limitation that could be pointed out concerns the nature itself of online questionnaires, allegedly with incomplete coverage, unreliable sampling frames, high non-response rates and incomplete data. The frame reliability issue disappears when one can access a list of addresses, such as students at a university, which even allows a probabilistic sample [54]. Furthermore, there is evidence that studies involving selected populations bearing significant rates of Internet access, such as college students, provide higher quality data, and with lower non-response rates [30]. So much so that we were able to gather information that is consistent with that provided by studies in diverse settings and cultures.

In summary, we showed that Internet-based survey research is a tangible reality in middle-income countries, and arguably for mostly everyone in less developed settings as well. We demonstrated that web surveying university students' conceptions about injuries is not only feasible, but yields response rates similar to those found in the literature.

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What is already known on this topic

- Survey studies of safety attitudes and behaviours have been growingly seen as fit for fostering injury prevention actions, but there have been few web surveys in non-English speaking low- and middle-income countries, despite the rapid growth of Internet use.
- Self-administered web surveys have many advantages concerning sampling, coverage, answering facilities, data handling and cost-effectiveness.

What this article adds

- Web surveying university students' conceptions about injuries is feasible in a middle-income country setting, yielding response rates similar to those found in the literature.

Appendix

Checklist for Reporting Results of Internet E-Surveys (CHERRIES).

Study project: An orginal open source application designed to implement web-based surveys: The case of students' conceptions of accident

Guarantor: Danilo Blank (blank@ufrgs.br)

Item category	Checklist item	Explanation
Design	Describe survey design	The study followed a cross-sectional observational design to collect quantitative information by means of a self-administered web-based questionnaire. The target sample frame comprised the entire population of first and last-year students regularly registered in each and every medical, law, communication and education schools in the greater Porto Alegre, a southern Brazilian city of just over 1.5 million people. Since we gained access to lists of e-mail addresses of such university students, who have virtually 100% Internet access, the sample can be viewed as probabilistic.
IRB (Institutional Review Board) approval and informed consent process	IRB approval	The study was approved by the Committee on Research Ethics of the University of Rio Grande do Sul (UFRGS), and also by the research ethics committees of all other universities involved.
	Informed consent	Subjects' free and informed consent to participate in the survey was obtained through a tacit consent strategy, whereby the approval of the terms of the research was understood as the invitee chose to click on the link to the survey website, which was explicitly positioned in the invitation e-mail message right after the statement concerning the absolute confidentiality of the research. The translation of the Portuguese e-mail invitation is: 'Dear student of (..) School of (. . .) University, I would ask a few minutes of your time to participate in a scientific research within the health promotion field. It is a study that aims at understanding university students' conceptions of external causes of health damage. Your help will be very important to the making of preventive actions. It will not take more than five minutes to answer all 31 questions of the online questionnaire. This is an absolutely confidential academic research. No personal information will ever be disclosed or associated to any answer. To access the survey website, please click on the following link (or, if you prefer, type or copy and paste the URL in your browser: %URL% Many thanks for your collaboration. Prof. Danilo Blank Departamento de Pediatria e Puericultura Faculdade de Medicina Universidade Federal do Rio Grande do Sul'
	Data protection	All software and data were hosted in a project specific site at the university server, with continuous Internet access. All data kept in the database were password protected.
Development and pre-testing	Development and testing	We devised an original open-source software application with a researcher-friendly interface. Its development was based upon the PHP 4.4.7 programming language; the programming editor was Bluefish 1.0. The questionnaire form was written with OpenOffice 2.2.1, and it can be viewed at [http://tiny.cc/injurywebsurvey]. The files were sent to a machine running Linux with Apache2 server. Data were stored in a MySQL version 4.1.22 database and were exported through PHPMyAdmin version 2.8.2 to a spreadsheet created in BrOffice.org.

(*continued*)

Appendix. (*Continued*).

Item category	Checklist item	Explanation
		We conducted a primary assessment of the instrument by sending an e-mail invitation to selected faculty of medicine, education and linguistics, requesting each one to access the survey website, complete the questionnaire, and comment on understandability, usability of the Web form, and the time it took to go through all questions. We performed cognitive interviews, in which nine medical students, who did not belong to the population frame, were gathered in the school informatics laboratory and asked to sit each one in front of a computer to participate in a simulation of the survey answering procedure. In a real time procedure, each subject completed the questionnaire item-by-item, and wrote down why each answer was chosen, difficulties encountered, as well as criticisms on wording and usability. Next we discussed the written reports with the whole group. Last, we carried out a pilot study with a sample of 148 medical students.
Recruitment process and description of the sample having access to the questionnaire	Open survey *versus* closed survey	An 'open survey' is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey). The survey was a closed survey. The survey tool automatically created e-tokens (long and complex URLs) that allowed access to the on-line survey form, and emailed them to the respondents. Each potential respondent received one token.
	Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.) Respondents received e-mails explaining the goals and purposes of the survey and asking their contribution. Emails included the tokens which took the potential respondents to the on-line survey form. After the first email, reminder e-mails were sent over a period of six weeks for non-respondents after the first week.
	Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix. No advertising was made.
Survey administration	Web/E-mail	State the type of e-survey (e.g. one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses? The contacts were made by e-mails. However, the survey was web-based. The respondents used their web-browsers to respond. The data were collected automatically after their submission on researchers' computer that hosts the web server and MySql database. All data kept in this database are password protected.
	Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunisation Web site will have different results from a Web survey conducted on a government Web site. Following the special URL (token) given in the e-mail, the respondents were only able to view the survey form. They were not shown any other content.

(*continued*)

Appendix. (*Continued*).

Item category	Checklist item	Explanation
	Mandatory/ voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey? The respondents were able to view the survey form without filling out the survey and submitting their answers. Responding to the survey was voluntary. Upon clicking on the submission button, it was checked whether the response was a complete response or not. The respondent was reminded and asked to answer in case any question was left unanswered.
	Incentives	Were any incentives offered (e.g. monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)? No incentive was given other than telling respondents that they would be informed about any resulting report or publication of this research.
	Time/Date	In what timeframe were the data collected? The survey was conducted between Oct 10 and Nov 17, 2005.
	Randomisation of items or questionnaires	To prevent biases items can be randomised or alternated. No items or questionnaires were randomised.
	Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions. Adaptive or conditional questioning was not used.
	Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate. The survey questions relevant for this paper are shown in Appendix 1.
	Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate. The whole questionnaire was a single page, the respondents replied by scrolling down to the next question.
	Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if 'yes', how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as 'not applicable' or 'rather not say', and selection of one response option should be enforced. Each submitted response was checked for completeness. This functionality was available in the survey instruments by making all of the questions mandatory.
	Review step	State whether respondents were able to review and change their answers (e.g. through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct). The respondents could review their answers before submission by scrolling up the page.
Response rates	Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.

(*continued*)

Appendix. (*Continued*).

Item category	Checklist item	Explanation
	View rate (Ratio unique site visitors/unique survey visitors)	Requires counting unique site visitors (not page views!) divided by the number of unique visitors of the first page of the survey. It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.
	Participation rate (Ratio unique survey page visitors/agreed to participate)	Count the unique number of visitors who visit the first page of the survey (or the informed consents page, if present) divided by the number of people who filled in the first survey page (or agreed to participate). This can also be called 'recruitment' rate.
	Completion rate (Ratio agreed to participate/ finished survey)	The number of people agreeing to participate (or submitting the first survey page) divided by the number of people submitting the last questionnaire page. This is only relevant if there is a separate 'informed consent' page or if the survey goes over several pages. This is a measure for attrition. Note that 'completion' can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word 'completeness rate'). The individual response rate was 18.4% (the number of individuals responded / the number of individuals that had valid e-mail addresses and invited with personal tokens), and the project response rate was 46.3% Completion rate 100%
Preventing multiple entries from the same individual	Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (e.g. the first entry or the most recent)? Each respondent received a token which is a long and complex URL that can be used to complete the survey only once.
	IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (e.g. 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (e.g. the first entry or the most recent)? Not used
	Log file analysis	Indicate whether other techniques to analyse the log file for identification of multiple entries were used. If so, please describe. Some e-mail addresses were not valid anymore. The emails sent to these addresses were returned, and they were detected from the e-mail logs of the root account of our server machine. We excluded these individuals in calculating our response rate.
	Registration	In 'closed' (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey results and later eliminated? If the latter, which entries were kept for analysis (e.g. the first entry or the most

(*continued*)

Appendix. (*Continued*).

Item category	Checklist item	Explanation
		recent)? The user could view the survey page only until s/he submitted the completed survey. The survey was never shown again to this user with the token that he used.
Analysis	Handling of incomplete questionnaires	Were only completed questionnaires analysed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analysed? All of the survey forms were completed since the instrument checked for completeness and only accepted the complete forms.
	Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined. Time to fill out the survey was not tracked. However, respondents only had one opportunity to submit the survey with their e-token, after which that token was disabled.
	Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.