

The Development of an Instrument for Evaluating Core Competencies in Violence and Injury Prevention

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Objectives: To develop and evaluate the characteristics of an instrument for assessing core competencies for injury and violence prevention. **Methods:** We developed a preliminary tool and pilot tested it with a small sample. After refining the tool, we recruited 401 participants to respond to the questions and provide information about demographic characteristics, injury activities, education, and current injury- and violence-related work. With the obtained data, we conducted a categorical confirmatory factor analysis to determine domains of knowledge for questions. We then evaluated the properties of the assessment, using item response theory. **Results:** Results of item evaluation using item response theory provide a 26-item Injury Prevention Assessment scale, which reliably assesses injury prevention knowledge at an entry-level ability.

Conclusions: This initial assessment is useful both for individual practitioners and for institutions as a tool for determining the need for training in injury prevention concepts. Additional tools should be developed to assess higher-proficiency levels of knowledge of injury prevention.

KEY WORDS: education, injury prevention, methods, questionnaire, violence prevention

Injury, including unintentional injuries and violence, is a major public health problem in the United States. The leading cause of death for ages 1 to 44 years, injuries are responsible for more years of potential life lost than any other health problem accounting for more than 30 percent of all years of life lost annually.¹ Between 1996 and 2006, injuries have ranked among the top-five most costly conditions and have had the greatest increase in expenditures than other costly conditions

such as heart disease, cancer, mental disorders, and asthma.² Despite this epidemiologic impact, injuries receive far less attention than other health problems, as evidenced by federal expenditures³ and lack of training programs in schools of public health and medicine.⁴⁻⁸ Even if schools of public health offered more extensive training in injury, the majority of practitioners in public health agencies do not have training in public health and so require continuing education to be fully prepared to achieve their organizations' goals.⁹

A 1999 report of the National Academies of Sciences noted that one of the greatest challenges in injury and violence prevention is translating what we know into practice, citing the gaps in training of the existing workforce to accomplish prevention.³ Recent assessments of injury practitioners have documented perceived needs for further workforce development to bolster the public health response.¹⁰⁻¹² Other reports have noted that one of the greatest challenges in injury and violence prevention is translating state-of-the-art knowledge into practice, citing gaps in training and poor infrastructure

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as barriers to effective injury prevention.^{3,13–15} Poor preparation leads to fewer evaluation and dissemination efforts and lesser sound choices of evidence-based interventions,^{16,17} stalling progress in prevention. There are several areas where knowledge of injury is poor or capacity is needed: (1) only 24 percent of 49 states have a mandated injury prevention program; (2) many staff members in injury and violence prevention programs are new to the field, with about 50 percent having worked less than 5 years; (3) staff members play more than one role apart from injury and violence prevention; (4) state-level injury information is collected incompletely; (5) there is still little understanding of the application of injury prevention theoretical models to public health prevention and poor knowledge of best practices; and (6) proper analytical and evaluation methods for injury prevention are not implemented adequately.¹⁸ The State and Territorial Injury Prevention Directors' Association (STIPDA), as a national leadership group of injury control practitioners, has acknowledged these issues and is working to make improvements, including helping to support the development of training and assessment practices.

To respond to the need for training in the injury field, the National Training Initiative for Injury and Violence Prevention (NTI) was created in 2000 as a collaboration between STIPDA and the Society for Advancement of Violence and Injury Research (formerly the National Association of Injury Control Research Centers) through their Joint Committee on Infrastructure Development. This initiative aims to combine the expertise of STIPDA and Society for Advancement of Violence and Injury Research in injury and violence prevention through orchestrating training opportunities to reduce mortality and morbidity from injury and violence in the United States through enhanced training infrastructure for state, local, and tribal health departments and their many partners.

Among the accomplishments of the NTI initiative has been the creation of core competencies (Appendix) for injury and violence prevention. These competencies were created by a group of experts from injury organizations (universities and health agencies) in the United States and were reviewed by a panel of 52 experts from throughout the world, including the Centers for Disease Control and Prevention, the Association of Schools of Public Health, the American Association of Medical Colleges, multiple universities' experts in the field of injuries, and the World Health Organization.¹⁵

The competencies were intended to help injury and violence prevention practitioners and their organizations achieve a common understanding of essential skills and knowledge for competent practice. The definition of *practitioners* used here is based on the work activities conducted by individuals whose job is to develop, implement, monitor, or evaluate injury and vio-

lence prevention programs or interventions. The competencies were also designed to serve as the foundation for identifying essential training needs and directions so as to strengthen the field as a whole. The competencies are grouped into proficiency levels, to help guide the progressive development of expertise.¹⁵

To facilitate application of the core competencies by individuals or organizations in determining training needs for personnel requires a mechanism through which practitioners can assess their competencies and ultimately steer their efforts toward improved training. As a first step, we designed a tool to assess the most basic level of proficiency. This article describes the process of creating the instrument and the subsequent evaluation of its items.

● Methods

Questionnaire development

We created an initial draft of the instrument containing multiple-choice items corresponding to eight of the NTI's core competencies. The ninth core competency, which refers to areas of knowledge and expertise in specific injury topics, was excluded. The study team included eight experts in injury prevention and public health education who reviewed sets of questions through several iterations to improve clarity of both questions and response options. These items were derived from previously used university-based injury prevention questionnaires or from existing injury prevention curricula used in public health academic or practice settings such as the PREVENT (Preventing Violence through Education, Networking and Technical Assistance) Institute.^{19–21} A team of eight experts in injury prevention and public health education reviewed these items through several iterations to improve clarity of both questions and also response options. We then narrowed the question set to 34 items with a minimum of two items per competency. The measure was then pilot tested with a convenience sample of 25 individuals from either academic or practice settings who worked on injury prevention and control. A large proportion of these respondents included staff members of the North Carolina Injury and Violence Prevention Branch in the NC Department of Health and Human Services. We also asked pilot study respondents to identify confusing items or instances in which response options were ambiguous. As a final review, three external injury experts made several minor adjustments to the instrument.

Upon completing this phase, we invited respondents from throughout the United States to complete the instrument on-line. We recruited 401 respondents through their institutional representatives from the

following three groups: (1) more than 800 alumni of the PREVENT program operated by University of North Carolina Injury Prevention Research Center²¹; (2) a national mailing list of more than 350 members of STIPDA; and (3) injury specialists employed by the US Indian Health Service (IHS). These groups were recruited because of their geographic distribution, their work in injury and violence prevention, and the feasibility of easy contact through STIPDA, PREVENT, and IHS.

Respondents were invited to pilot test the Injury Prevention Assessment (IPA) via a mass e-mail sent to the list servers of all three groups. In the e-mail, we explained the purpose of the IPA and the instrument was not intended to be exhaustive of the core areas. Respondents were also told that (1) responses were voluntary; (2) the instrument should take no more than 20–25 minutes to complete; (3) responses were anonymous; and (4) results would be aggregated and analyzed to help determine the pedagogical characteristics of the instrument. We also told respondents that we were not interested in scoring the performance of individuals but said that they do their best. Individuals who completed the pilot test were given the opportunity to enter into a drawing for a gift certificate. Study procedures were considered by the institutional review board of the University of North Carolina's Gillings School of Global Public Health and determined to be exempt of full review.

To determine demographic characteristics of this larger sample, we asked respondents about their sex, age, maximum level of education, and previous injury training. If respondents indicated prior injury training, we asked them about the specific training they had received. We also asked respondents whether or not they currently worked on injury or violence prevention, what percentage of their work was dedicated to this field, what percentage of their work in the field was remunerated, and their particular area of focus within injury prevention. Lastly, we asked respondents to identify from which network (PREVENT, STIPDA, or IHS.) they had been recruited to participate.

After responding to the opening questions, respondents completed the IPA via an on-line survey system that provided them with immediate scoring once they had answered all questions. Their responses were then used to examine item characteristics and assess the reliability of the IPA.

Analytical process

Factor analysis

Initially we needed to test the dimensionality of the 34 items to establish the degree to which they measured injury prevention knowledge as best represented by a single construct. Using Mplus version 5.2,²² we conducted

single-factor categorical confirmatory factor analysis (CCFA) for binary data and used mean and variance-adjusted weighted least squares estimation. Comparisons of goodness-of-fit indices provided evidence for the appropriateness of the hypothesized single factor (injury prevention knowledge). Items not pertaining to this construct, as indicated by low or nonsignificant factor loadings, were removed from further analysis.

Item response theory

Following CCFA, we conducted item response theory (IRT) analyses. The IRT is a broad framework widely used in psychological and educational testing to aid in scale development and item evaluation.²³ Unlike classical test-theory approaches where the unit of analysis is the summed score of the test, IRT uses each individual's pattern of item responses in determining the properties of both the items and the respondents. In IRT, items are assumed to relate to a unidimensional latent trait, or rather, a single construct is assumed to account for the relationships between item responses. In this case, the latent trait is injury prevention knowledge.

The relationship between each item and injury prevention knowledge is represented by an item characteristic curve. The item characteristic curve, commonly a logistic function, provides information regarding both the strength of the association between the latent variable and the item and the relative degree of item difficulty. The IRT model used in this analysis was the two-parameter logistic model (2PL) for binary item responses, which is formally written as follows:

$$T_i(\theta) = \frac{1}{1 + \exp[-a_i(\theta - b_i)]},$$

where T traces the probability that an individual with a given level of injury prevention knowledge (θ) will correctly respond to item i given the item's *discrimination* power (a) and *difficulty* (b). The discrimination parameter indicates how strongly each item distinguishes between individuals at a given level of knowledge, while the difficulty parameter indicates the location of knowledge where an individual has a .50 probability of correctly responding to a given item. Hence, items with high discrimination parameters better distinguish between levels of injury prevention knowledge, and negative difficulty parameters indicate items that distinguish between individuals with low levels of injury prevention knowledge (ie, items that are relatively easy).

After obtaining a unidimensional subset of items in a CCFA framework, item response calibration was conducted using MULTILOG version 7.03.²⁴ Item parameters were evaluated to ensure that the questionnaire adequately measured individuals over an appropriate range of injury prevention knowledge.

After selecting items with desirable characteristics (acceptable item discrimination and difficulty), the final set of items was recalibrated separately using both the 2PL model and the three-parameter logistic model (3PL), which estimates an additional *guessing* parameter for each item. Because the 2- and 3PL models are nested, a likelihood ratio test was used to determine the better fitting model.

● **Results**

Sample characteristics

The sample consisted of 401 respondents, 87 percent were female and 76 percent between 30 and 59 years. We had an average 85 percent response rate for the overall questionnaire. Almost 90 percent reported that they were currently working on injury and/or violence prevention topics, of which 69 percent indicated that their work was all paid, 26 percent reported that their work was mostly paid, and the remaining 5 percent reported that they did mostly or exclusively volunteer work. Approximately 60 percent reported having more than 5 years of experience in the field and 44 percent of respondents reported that in the past year they had worked exclusively on injury or violence prevention issues. The respondents' maximum educational attainment ranged from high school (5%) to bachelor or associate degree (33%), to master's degree (48%), or to doctoral degree (14%). Respondents indicated that only 28 percent of these degrees were directly related to injury or violence prevention.

However, almost 82 percent of respondents said that they had received some type of training in injury or violence prevention in the last 5 years. We also asked respondents whether they had participated in specific types of training courses. Training mostly came from short courses (26%), certificates in injuries (12%), undergraduate courses (2%), graduate courses (10%), or courses offered by the IHS (3%). The remaining 16 percent responded that they had received training from other venues (eg, summer courses at a university). About 10 percent of respondents answered that they learned about the survey through the PREVENT network, 43 percent through STIPDA, and 47 percent through the IHS. Additional cross tabulations by gender and age are presented in Table 1.

IPA characteristics

Confirmatory factor analysis

Of the 34 original variables, one was removed because of a lack of response variability. Using indices that compare the fit of the model to the data, results from a one-factor CCFA conducted on 33 items provided strong ev-

TABLE 1 ● Demographic and educational characteristics of respondents by previous level of injury prevention training

Demographic characteristics	Reported no previous injury prevention training in last 5 years, n (%) ^a	Reported any type of previous injury prevention training in last 5 years, n (%)
Sex		
Male	16 (24)	29 (10)
Female	51 (76)	267 (90)
Age group, y		
20–29	9 (13)	36 (12)
30–39	15 (22)	73 (25)
40–49	20 (29)	66 (22)
50–59	20 (29)	84 (28)
60–69	4 (6)	37 (12)
≥70	0 (0)	1 (0.3)
Education		
High school	16 (23)	33 (11)
Associate degree	31 (45)	148 (50)
Bachelor degree	17 (25)	88 (30)
Master's degree	1 (1)	14 (5)
Doctoral degree ^b	4 (6)	13 (4)

^aPercentages may not add to 100 due to rounding.

^bDegree not necessarily related to injury prevention and control.

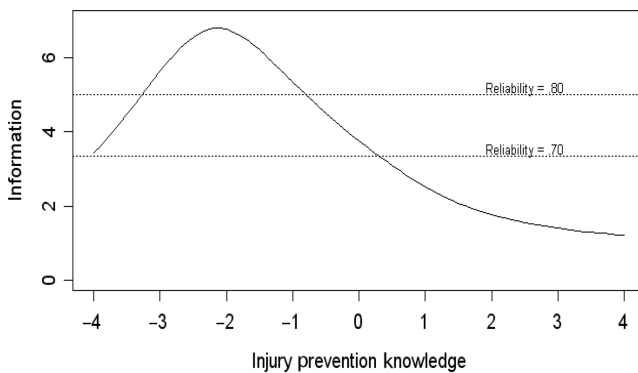
idence that the scale was unidimensional ($\chi^2 = 133$, $df = 104$, Comparative Fit Index = 0.859, Tucker Lewis Index = 0.882, root-mean-square error approximation = 0.028). While all indices suggested a good fitting model, 4 of the 33 items had low or nonsignificant factor loadings, indicating that these items were only weakly related to injury prevention knowledge and were therefore removed from the analysis.

Item response theory

The 2PL model was next fit to the remaining 29 items. Of these 29 items, three were removed both because they poorly discriminated between levels of injury prevention knowledge and because their difficulty parameters suggested that they were overly easy for the majority of respondents. The final 26 items were then recalibrated using both the 2PL and the 3PL models to determine the better fitting model. Using a likelihood ratio test, the 2PL model was selected as the final model, indicating that correct guessing was not prevalent ($\chi^2 = 29.2$, $df = 26$, $P > .05$).

Results indicate that the IPA provides precise scores for examinees with low levels of injury prevention knowledge. Comparisons of item parameter estimates indicate that the majority of items best discriminate between individuals with a lower or entry-level proficiency. Figure 1 illustrates that information, or

FIGURE 1 ● Test Information for the 26-item Self-Assessment Tool. This figure indicates the precision of scores across a range of injury prevention knowledge. Higher *information* indicates more score precision. The mean level of injury prevention knowledge is 0 and scores above or below the mean are indicated in units of standard deviations (SD). *Information* may be conceived of as reliability, such that reliability is $1 - 1/\text{information}$. For example, the high amount of information for the range of ability between approximately -3 and -1 SD below the mean indicates that these scores, for individuals with low levels of injury prevention knowledge, have a reliability greater than 0.80.



reliability, is greater for scores associated with lower levels of injury prevention knowledge.

Table 2 provides item parameter estimates for the 29-item IPA. As an interpretive aid, item parameters indicate that an individual at the mean level of injury prevention knowledge had a greater than 0.5 probability of correctly responding to any particular item (with one exception, “Laws related to primary prevention”). While the overall reliability was $\alpha = .73$, the reliability was greater than $\alpha = .80$ for scores between 1 and 3 SD below the mean (as indicated by Figure 1).

● Discussion

Through this study, we have succeeded in developing a self-administered, Web-based instrument that will permit individual assessment of overall knowledge of injury and violence prevention at the basic level of proficiency. Participants obtain feedback regarding their overall score, which items were answered incorrectly, and the core competency of any incorrect item. Currently this is the only way the instrument can identify specific competency areas for improvement. The present 26-item test was typically completed in less than 1 hour, an acceptable time commitment for respondents. The study, the first effort to develop a standardized instrument for assessing injury and violence knowledge in line with the NTI core competencies, does have some limitations. First, our initial testing was con-

ducted with professionals already involved in the injury field. One might expect that the test is considerably more difficult for users who have less familiarity with the field; however, whether this limitation affects the factor structure of the instrument is unknown. Future testing of the instrument should include a broader range of participants.

Our results indicate that greatest reliability was evidenced among those who knew least. Second, factor-analytic results supported a single factor for general injury prevention knowledge rather than separate factors for each competency. As such, the analyses conducted did not differentiate between separate competencies. Thus, the instrument provides an overall assessment of injury knowledge but is not suitable for discerning specific areas of weakness or strength, although it is still possible to score each specific area separately to obtain scores for any competency of interest. Future research providing more questions for each competency could potentially allow each to be considered a separate “dimension” of overall injury prevention knowledge.

The IRT assumption of unidimensionality, in the strictest sense of the word, is never practically met.²⁵ This has led some to adopt the practice of considering “essential unidimensionality.”²⁶ At present, there are no clear guidelines on when violations of unidimensionality (eg, local dependence and multidimensionality) are severe enough to affect the validity of test scores,²⁷ although there are methods of detecting potential violations (eg, CCFA).²⁸

Comparisons of discrimination parameters provide insights regarding strong items (those with large discrimination parameters) and weak items (those with small discrimination parameters). In particular, one of the more discriminating and difficult items asks for the definition of the Cochrane Injuries Group, whereas the two most poorly discriminating items are based on scenarios of injury prevention. The question pertaining to the Cochrane Injuries Group, which is the better, or more discriminating item, is fact-based (ie, the respondent either knows or does not know the definition), whereas the two lesser-performing items are scenario-based and the correct answers are potentially ambiguous. Thus, comparing the content of the item with IRT item parameters suggests that future improvements to the IPA should include more fact-based questions rather than items that are scenario-based.

Nevertheless, despite these limitations, this is the first tool to be developed and thoroughly evaluated for this purpose. It is designed to be useful to a broad audience as an initial step in guiding organizations and individuals in assessing the need for further professional development. Results indicate that its greatest strength is in distinguishing between individuals at lower levels of expertise—where training needs are the greatest.

TABLE 2 • Item parameters for the 26-item injury prevention assessment tool^a

Competency	Section	Question no.	Item theme	Slope	Difficulty ^b
2	A	1	Limitations of police or court records	1.91	−2.27
4	A	2	Tasks of an evaluator	1.45	−2.84
8	A	1	Definition of Cochrane Collaboration	1.45	−0.01
2	B	2	Use of evidence in policy making	1.40	−1.44
6	A	2	Meaning of framing data for communication	1.36	−2.26
3	C	1	Example of engineering modifications	1.36	−1.77
8	A	2	Meaning of peer review	1.33	−1.96
1	C	2a	Example of primary prevention	1.27	−3.23
7	A	1	Example not related to primary prevention	1.09	−2.44
1	B	1	Classification of prevention activities	1.07	−1.89
3	A	1	Statement about the value of using data	1.03	−3.26
1	A	3	Definition of injuries	0.96	−2.30
3	A	2	Selection of the best sources of information	0.91	−1.67
1	C	2c	Example of tertiary prevention	0.87	−1.12
3	B	6	Example of individual-level intervention	0.83	−0.78
1	A	1	Classification of injuries	0.83	−1.41
5	A	1	Examples of ethical principles	0.77	−1.95
6	A	3	Information communication strategies	0.75	−1.92
7	A	2	Laws related to primary prevention	0.67	0.41
4	A	1	Purpose of using a logic model	0.66	−1.68
3	C	2	Statement about application of regulations	0.64	−0.18
6	A	1	Communication strategies and advocacy	0.55	−0.09
2	A	2	Useful data sources for injury and violence	0.52	−2.84
2	B	1	Uses of injury rates	0.49	−0.65
1	C	2b	Example of secondary prevention	0.46	−1.14
3	B	5	Example of relationship-level intervention	0.42	−1.04

^aItems have been sorted by the magnitude of the slope parameter; items with higher slopes better discriminate between individuals at the given level of injury prevention knowledge.

^bLower difficulty parameters indicate easier items. As an interpretative example, the difficulty parameter for the item "Definition of Cochrane Collaboration," which was particularly difficult, indicates that individuals with a mean level of injury prevention knowledge (0.01), have a 0.50 probability of correctly answering this item.

Although core competency testing in injury and violence prevention is still in its infancy, we believe that this instrument is a useful first step. The IPA provides practitioners insight when low levels of expertise are present, and helps identify needs for additional workforce development. We encourage the use of the IPA to help aid employers in guiding their employees to workforce development opportunities as they build a capacity for injury prevention and control. Currently, this tool is available for use at the Web site of the National Training Initiative for Injury and Violence Prevention, available at <http://www.injured.org>.²⁹

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● Appendix

Core Competencies for Injuries and Violence Prevention

1. Ability to describe and explain injury and/or violence as a major social and health problem.
2. Ability to access, interpret, use, and present injury and/or violence data.
3. Ability to design and implement injury and/or violence prevention activities.
4. Ability to evaluate injury and/or violence prevention activities.
5. Ability to build and manage an injury and/or violence prevention program.
6. Ability to disseminate information related to injury and/or violence prevention to the community, other professionals, key policy makers, and leaders through diverse communication networks.
7. Ability to stimulate change related to injury and/or violence prevention through policy, enforcement, advocacy, and education.
8. Ability to maintain and further develop competency as an injury and/or violence prevention professional.
9. Demonstrate the knowledge, skills, and best practices necessary to address at least one specific injury and/or violence topic (eg, motor vehicle occupant injury, intimate partner violence, fire and burns, suicide, drowning, and child injury) and be able to serve as a resource regarding that area.