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# Correlates of hazards education for youth: a replication study

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**Abstract** Youth and families have been identified as particularly vulnerable to the effects of hazardous events. This study examined correlates of hazards education involvement for youth. Participants were 407 youth between the ages of 7 and 18 who filled out several indices reflecting hazards awareness, risk perceptions, psychological factors, knowledge, and adoption of hazards adjustments and family emergency plans. Additionally, interactive factors were assessed, the extent to which education programs encouraged youth to discuss their learning with parents and whether such discussions occurred. Overall, findings replicated and extended previous research. First, younger children were generally seen to be more prepared; girls, more knowledgeable. Second, youth involved in education programs had significantly higher levels of correct knowledge of readiness and response behaviors, lower levels of incorrect knowledge, and reported more home-based hazards adjustments. One important area where no differences were seen was in the area of family emergency planning. Predictors of increased educational benefits included program recency, encouragement to interact with parents and, to a slightly lesser extent, parent discussion willingness. Combined with previous research indicating that even simple and brief reading and discussion programs can produce tangible benefits, findings here encourage the incorporation of easy-to-do features that can increase benefits for youth and their families.

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**Abbreviations**
FEMA Federal Emergency Management Agency
NIMH National Institute of Mental Health

## 1 Introduction

The majority of research related to hazards and children's functioning has focused on children's reactions following a disaster (Hock et al. 2004; LaGreca et al. 1996; Ronan 1997a; Vernberg et al. 1996; Weems et al. 2007). This line of research includes studies that have evaluated the effectiveness of programs aimed at reducing children's adverse reactions to hazards (Chemtob et al. 2002a, b; Giannopoulou et al. 2006; Goenjian et al. 1997; Ronan and Johnston 1999; Shooshtary et al. 2008). In line with our own view, research has started to focus on the benefits of preventive interventions in the form of hazards education programs (Klingman and Cohen 2004; Ronan and Johnston 2005). However, based on our literature review, it appears that this line of research is limited to a handful of studies (Ronan and Johnston 2001, 2003; Ronan et al. 2001; Shaw et al. 2004).

Previous research has examined the effectiveness of hazards education programs for adults (e.g., Faupel and Styles 1993; Karanci et al. 2005; Mishra and Suar 2007; Whitney et al. 2004). We have chosen to focus on children as they have been found to be the most vulnerable to the effects of hazards (Wisner et al. 2004). For example, in a large scale review, Norris et al. (2002) concluded that children are the most vulnerable demographic group, experiencing severe effects of disasters much more than do adults and the elderly. One line of reasoning has suggested that when a hazardous event does occur, it may for some children represent one of their major, and perhaps unspoken fears (e.g., Campbell and Gilmore 2006; Johnston et al. 2005; Kendall and Ronan 1990; Ollendick et al. 1989; Muris 2002; Muris et al. 2002; Ronan and Deane 1998). In support of this idea, even relatively benign hazardous events (e.g., volcanic eruption with no loss of life and no major disruption) can lead to significant problems for some children (e.g., Ronan 1997a, b; Ronan and Johnston 1999).

Following a hazardous event, the reactions of children have been found to vary greatly. The majority of research examining children's responses to natural disasters has focused on hurricanes (see La Greca and Prinstein 2002). This being said, research that has focused on other hazards (i.e., earthquakes, volcanoes) has yielded similar results (Ronan 1997b; Stoppelbein and Greening 2000). Post-traumatic stress symptoms have been the most widely examined cluster of symptoms. In the short-term, research has provided consistent support for a relatively high prevalence of moderate to severe post-traumatic symptoms in children (range = 30–90%; Belter et al. 1991; Chemtob et al. 2002a; LaGreca et al. 1996; Lonigan et al. 1991; Vernberg et al. 1996; Pynoos et al. 1993; Wolmer et al. 2005).

Children's adverse reactions to hazards (as with adults) are often resolved with time and support (Norris et al. 2002; Speier 2000). This has been found over a short- (Ronan and Johnston 1999) and a long term time period (Chemtob et al. 2002a). Despite this, the fact remains that some children do develop psychological problems that do not naturally resolve. For example, Chemtob et al. (2002a) found that 248 school children (6.42% of those assessed) were experiencing severe traumatic symptoms 2 years after the occurrence

of Hurricane Iniki. The finding that a small percentage of children continue to suffer significant symptomology is relatively consistent across the literature (Garrison et al. 1993; Green et al. 1994; McFarlane 1987; Pynoos et al. 1993; Wolmer et al. 2005).

The severity and longevity of some children's symptoms following a hazard has prompted researchers to investigate what risk factors make children more vulnerable to the effects of hazards. Specific variables that have been found to be related to the development of an adverse reaction include: proximity to the disaster area, perceived life threat, injury (Pynoos et al. 1993; Vernberg et al. 1996), female gender (Lonigan et al. 1994; Garrison et al. 1995; LaGreca et al. 1996; Weems et al. 2007), younger age (Lonigan et al. 1994); ethnicity (African-American; LaGreca et al. 1998; Lonigan et al. 1994), pre-existing anxiety and depressive symptoms (Garrison et al. 1995; Hock et al. 2004; LaGreca et al. 1998; Lonigan et al. 1994; Nolen-Hoeksema and Morrow 1991; Weems et al. 2007), access to social support, the use of maladaptive coping styles (LaGreca et al. 1996), reduced coping ability (Huzziff and Ronan 1999), and parental functioning (Huzziff and Ronan 1999; LaGreca et al. 1998, 1999). With a focus on non-static risk factors, preventive efforts with these children would be thought to enhance their ability to cope more effectively should a hazard occur.

While research investigating hazards education programs is limited, preliminary research with both children (Ronan et al. 2001; Ronan and Johnston 2001, 2003) and adults (Karanci et al. 2005; Mishra and Suar 2007; Whitney et al. 2004) has found that participants in hazards education programs are more likely than non-participants to experience benefits, including the adoption of hazard adjustments. This finding is particularly important because community members, including those living in disaster prone areas, tend not to adopt hazard adjustments (Cuny 1983; Eisenman et al. 2006; Karanci et al. 2005; Lindell 2000; Lindell and Whitney 2000; Paton and Johnston 2001; Peek and Mileti 2002; Tierney et al. 2001; Whitney et al. 2004).

Low levels of preparedness in communities has prompted researchers to examine what variables predict a greater number of household hazard adjustments. Done with adult participants, this line of research has found a number of modifiable factors that predict increased adjustment activities: risk perceptions (e.g., Eisenman et al. 2006; Lindell and Prater 2000; Mishra and Suar 2007), increased awareness of the value of hazard adjustments (e.g., Lindell and Whitney 2000; Russell et al. 1995), hazard-related knowledge and awareness (e.g., Drabek 1986; Lindell and Perry 2000; Mileti and Fitzpatrick 1993; Mileti and O-Brien 1993; Mishra and Suar 2007), and an optimal level of emotional arousal (Rü stelmi and Karanci 1999; see also Yerkes and Dodson 1908). Therefore, the goal of hazards education programs, in our view, should be to increase the number of hazard adjustments within children's households by placing an emphasis on correct knowledge, realistic risk perceptions, increasing awareness of hazard adjustments, reducing excess fear, and increasing children's perception of their own ability to cope. We would also add that helping children bring both enthusiasm and information home is likely to assist (Ronan and Johnston 2005).

A review of the sparse literature that has examined the effect of children's participation in hazards education programs is promising. For example, the first study in this area was done with 409 schoolchildren. Findings from this correlational study indicated that participation in a hazards education program was associated with realistic risk perceptions, increased hazard mitigation knowledge, lower child fears and perceptions of parental fear, and an increased discussion among family members about hazards (Ronan et al. 2001). Unexpectedly, this study did not find a significant relationship between participation in hazards education and the adoption of household adjustments. However, the assessment of

hazard adjustments for this study was based on a limited number of child-reported household adjustments. To overcome this limitation, the next study with a sample of 560 schoolchildren assessed both child and parent reports of an expanded list of hazard adjustments (see Ronan and Johnston 2001). This study found that hazards education was related not only to an increase in knowledge but also to reports of household adjustments. In another more recent quasi-experimental study with over 200 schoolchildren, we found that two types of hazards education programs, including one that simply focused on reading about disasters and discussing them in class, were found to lead to increased home-based preparedness as well as emotional benefits for children (Ronan and Johnston 2003). A similar study conducted in Japan also found that school-based hazards education programs were useful for increasing community preparedness (Shaw et al. 2004).

Given overall effectiveness, the relationship between more specific features of hazards education and the adoption of hazard adjustments has been further explored. For example, Ronan and Johnston (2001) examined which specific hazards education-related factors predicted an increased number of hazard adjustments. This study found that increased knowledge, program recency, involvement in repeated hazards education programs, and hazard-related discussions between family members predicted an increased number of household adjustments. The finding that increased discussions between children and their parents predicted the adoption of hazard adjustments was also reflected using a quasi-experimental methodology (Ronan and Johnston 2003).

While these findings are promising, this research is still in its infancy. As a consequence, the current research was carried out to replicate and extend previous findings (Ronan and Johnston 2001; see also Ronan et al. 2001). The main aim here was to assess, with a separate sample, at a different time, in an area prone to a different set of hazards, whether (a) hazards education involvement is beneficial, (b) in which areas it is most beneficial, and (c) predictors of benefits. Specifically, it was expected that when compared to children who had not participated in a hazards education program, children who participated in a hazards education program would:

1. Report an increased awareness of the most common local hazards;
2. Report an increased level of knowledge surrounding correct response-related protective behavior and a decreased level of knowledge surrounding incorrect response-related protective behavior;
3. Be more likely to engage in readiness behaviors (e.g., emergency plans and practice) and hazard adjustments;
4. Report more accurate risk perceptions;
5. Report a lower level of fear, a decreased perception of parental fear; and
6. An increased ability to cope with a hazard should it occur in the future.

In addition to these hypotheses, this study also aimed to further explore a number of issues. Specifically, we aimed to examine:

1. Active ingredients (i.e., predictors of benefits) in hazards education programs;
2. The relationship between child emotion- and problem-focused factors; and
3. The factor structure of the commonly reported hazard adjustments as assessed in the current and previous studies.[1]

[1] We would like to thank an anonymous reviewer for this suggestion.

## 2 Methods

### 2.1 Overview of the design

The current study was intended to replicate features of earlier studies (Ronan and Johnston 2001; see also Ronan et al. 2001). Consequently, this was a correlational study that intended to examine the effect of prior hazards education programs on a number of aspects, including risk perceptions, emotion-focused factors (e.g., hazard-related fear in children, perceived parental upset, and perceived emotion-focused coping ability in the event of a hazard), knowledge surrounding protective behaviors in the event of a hazard, readiness behaviors (e.g., family emergency plans, home- and school-based practice), and the number of hazard adjustments reported by children. Additionally, this study intended to explore features that underpin relationships between various features of education programs as well as predictors of education program effectiveness.

### 2.2 Participants

Participants were 407 primary school students from the Napier, New Zealand region. Overall, there were 207 female and 196 male participants.[2] The participants' ages ranged from 7 to 18 years with a mean age of 11.31 years (SD = 2.19). Children came from a variety of ethnic and cultural backgrounds: Caucasian/European descent ("Pakeha") ($n = 234$, 57.49%), Maori ($n = 81$, 19.90%), Maori/Pakeha ($n = 28$, 6.88%), Asian ($n = 11$, 2.70%).[3] The remainder of the sample ($n = 47$, 11.55%) was of Asian, Pacific Island, African, Australian, New Guinean, Dutch, German, European (unspecified nationality), Croatian, English, Canadian, Italian, Scottish, or Polish ethnicity—either alone or mixed.[4]

### 2.3 Measures

The measures used within this study were adapted from Ronan and Johnston (2001, 2003) and Ronan et al. (2001) and are embedded together within a single survey. Across these studies, these measures have been demonstrated to have reasonable reliability, convergent validity and treatment sensitivity.

#### *2.3.1 Hazards education program involvement and interaction with parents*

Children were asked to indicate whether or not they had participated in any prior hazards education programs. Those children who reported participating in a prior education program were then asked to indicate whether the program was school based. Children were also asked to specify whether they had participated in a hazards education program with a specific emergency management perspective. Additionally, children were asked to indicate the recency of their participation within the program (e.g., past year, prior to a year ago) and give an estimate of the number of programs that they had participated in. Finally,

[2] Totals do not add up to 407 here and regarding other demographics owing to missing data.

[3] Pakeha is a conventional New Zealand term used to indicate a New Zealander of European descent.

[4] Specific breakdowns are available from the authors.

children were asked to indicate whether the program they participated in encouraged them to discuss what they had learned with their parents, if they had actually discussed the program with their parents, and if their parents appeared interested in the discussion if they had raised the topic.

#### 2.3.2 Readiness: knowledge of response-related protective behaviors

This section of the questionnaire assessed the knowledge children possessed in relation to hazards and the best course of action to take in the event of a hazard. Three to six answers for each of the eight hazards assessed (floods, storms with high winds, fires, earthquakes, volcanic eruptions, tsunamis, chemical spills, and tornados) were presented. For each hazard, children were asked to indicate which behavior or behaviors they would endorse in the event of a certain hazard (e.g., moving 1 km inland in the event of a tsunami). The inclusion of possible behaviors was based on issues that are often highlighted in hazards education programs and emergency management recommendations (Ronan and Johnston 2001; Ronan et al. 2001). Overall, there was a total of 13 correct responses and 15 incorrect responses. The alpha reliabilities for the correct and incorrect responses were 0.70 and 0.55, respectively. Of the 13 correct responses, nine were identified to be of vital importance (e.g., move to an area higher than flood level in the event of a flood; see Sect. 3 for more information).

Added for this study was another knowledge item related to what to do in the event of hearing a new emergency management siren that had been upgraded and was to be tested within a few weeks of this research being completed. Local emergency management had been publicizing the test in the weeks preceding this research in the local media. The main recommendation from emergency management was (a) upon hearing the siren, immediately tune in to a local radio station to be given updates and instructions, including "staying where you are unless instructed otherwise." Of course, for children, given that they look to adults for guidance in such situations, another second-line response for them would be to "seek out a parent or caregiver." Consequently, here there were two correct responses (listen to radio; go and ask a parent or caregiver what to do) and two incorrect responses (do nothing, go outside and look around).

#### 2.3.3 Readiness: family plans and home- and school-based practice

Three questions addressed whether or not the child believed: (a) a family emergency plan to be in place, assessed on a 3-point scale (1 = no, 2 = not sure, 3 = yes), (b) emergency drills at home (1 = no, 2 = yes), and (c) emergency drills at school (1 = no, 2 = yes).

#### 2.3.4 Readiness: hazard adjustments

In order to assess what protective behaviors children's families employed, children were asked to identify which, if any, of a range of hazard adjustments their family had carried out. The 23 specific hazard adjustments assessed, included: having a torch (flashlight), rearranging breakable items, putting strong latches on cabinet doors, storing hazardous materials safely, adding lips to shelves, strapping the water heater, installing flexible piping, bracing house walls, securing the house foundation (two items here: bolting house to foundation and bracing the pile foundation), having a radio with spare batteries, having a first aid kit, having water and food provisions for 3 days, having a fire extinguisher, having

a smoke detector, storing emergency equipment, placing a wrench (spanner) near turn-off valves, picking a contact person, someone in the family learning how to put out fires, someone in family learning how to administer first aid, finding out which hazards are more likely in their area, and having the home inspected for resistance to earthquakes. The alpha reliability of the 23 hazard adjustments was 0.86.

#### *2.3.5 Hazard awareness and risk perceptions*

Children were asked a series of 17 questions that addressed their knowledge of a number of issues including: (a) one item asking about the two hazards that are most likely to affect them, (b) the likelihood of occurrence of each of the eight hazards on a 3-point scale (1 = unlikely, 2 = a chance, 3 = likely), and (c) the child's perception of the likelihood that they would be injured in the event of each of the eight hazards on a 3-point scale (1 = unlikely, 2 = a chance, 3 = likely). The alpha reliabilities for each of the eight-item measures were 0.64 and 0.72, respectively.

#### *2.3.6 Psychological/emotional issues*

With regard to psychological issues, children were asked three questions that addressed the following: (a) their level of overall fear or upset experienced when discussing hazards on a 3-point scale (1 = not at all, 2 = sometimes, 3 = often), (b) their perception of any parental upset when discussing hazards on a 3-point scale (1 = no, 2 = not sure, 3 = yes), and (c) the child's perception of their emotional coping ability in the event of a hazard on a 7-point scale (1 = not at all able, 4 = somewhat able, 7 = completely able "to help self feel comfortable/less upset").

### 2.4 Procedure

The current study was archival; the questionnaire had been administered to participants within each school by teachers as part of the standard curriculum and in advance of a hazards education module reflecting a partnership between the school and local emergency management. After the instructions were read aloud by teachers, children were asked to complete the survey by reading to themselves. If children had difficulty understanding a particular item, they were encouraged by teachers to ask questions. Overall, the total time necessary for completion of each survey was reported to be 25–35 min.

### 2.5 Plan of analysis

The current study had six hypotheses and three exploratory questions. The primary analyses were planned to examine these hypotheses. Therefore, bivariate correlations, chi-square analyses, and independent sample *t*-tests were conducted to examine the relationship between participation in hazards education programs and the following dependent (criterion) variables: correct and incorrect hazard-related knowledge, readiness behaviors (e.g., emergency plans and practice), hazard adjustments, risk perceptions, and emotion-focused coping (e.g., child fear, perceived parental upset, and perceived coping ability).

Prior to the primary analyses, preliminary analyses were conducted. For this, a series of independent sample *t*-tests were conducted to examine the effects of age and gender on the dependent (criterion) variables.

The final set of analyses conducted were designed to answer the exploratory questions. In order to examine the predictors of hazard adjustments a standard multiple regression analysis was conducted. The criterion variable here was the number of home-based hazard adjustments and the predictor variables entered into the prediction equation were as follows: participation in a hazards education program; a teacher-taught or civil defense taught program; program recency (taught either prior to or in 2004); the number of hazards education programs, overall correct knowledge; vitally correct knowledge; overall incorrect knowledge; encouragement to discuss what was learned in a hazards education program; discussion with parents about what was learned in a hazards education program; parent's willingness to discuss what was learned in a hazards education program; risk perception of the likelihood of hazards; and risk perception of the likelihood of being injured due to a hazard. Next, a one-way ANOVA was conducted to examine the effect of child-related emotional arousal (i.e., hazard fear) on a number of variables, including hazard-related knowledge, hazard adjustments, parental fear, and perceived coping. Finally, a factor analysis was conducted to examine the structure of the 23 hazard-based adjustments. Given the number of overall analyses, and the fact that alpha levels were not adjusted, it is important to acknowledge that this research was more concerned about Type II versus Type I error. That is, our preference was to have the possibility of an increased number of false-positive findings (i.e., Type I) versus false-negative findings (i.e., Type II) given that this area of research is still in its infancy. In other words, the idea of identifying variables for future study versus premature discarding of variables was the preference in this research.

## 3 Results

### 3.1 Preliminary analyses

In order to ensure that the impact of hazards education variables was not confounded by demographic factors, preliminary analyses were conducted.

#### *3.1.1 The impact of gender*

An independent *t*-test revealed that when compared to males, females were significantly more likely to be scared, have more correct and vitally correct knowledge, and to perceive the risk of hazards as more likely (see Table 1).

#### *3.1.2 The impact of age*

An independent *t*-test revealed that when compared to older children (aged 12–18), younger children (aged 7–11) were significantly more likely to be scared, perceive a higher level of parental fear, engage in more hazard adjustments, and perceive the likelihood of injury due to the occurrence of a hazard as greater. Additionally, the following factors approached significance: the ability to cope if a hazard occurred and incorrect knowledge (see Table 2).[5] In addition to this age split, age was also correlated with study variables and highlight differences as a function of age (see correlation table in Appendix).

[5] An expanded zero-order correlation matrix has also been included in Appendix for reader inspection. This includes all relevant variables including age.

**Table 1** Preliminary analysis: the impact of gender on key variables

| | Female | | Male | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Knowledge: vital | 6.55 | 1.91 | 5.94 | 1.97 | $t(401) = 3.14$** |
| Knowledge: total | 8.43 | 2.39 | 7.52 | 2.51 | $t(401) = 3.72$*** |
| Knowledge: incorrect | 2.12 | 1.79 | 2.20 | 1.67 | $t(401) = -0.45$, NS |
| Hazard adjustment | 9.62 | 5.04 | 10.29 | 5.17 | $t(401) = -1.30$, NS |
| Child upset | 1.90 | 0.59 | 1.51 | 0.61 | $t(382) = 6.30$*** |
| Parental upset | 1.87 | 0.49 | 1.80 | 0.59 | $t(394) = 1.30$, NS |
| Coping ability | 4.65 | 1.70 | 4.65 | 1.95 | $t(398) = -0.02$, NS |
| Event likelihood | 16.22 | 2.64 | 15.07 | 2.50 | $t(387) = 4.40$*** |
| Injury likelihood | 17.84 | 3.26 | 17.41 | 3.35 | $t(376) = 1.28$, NS |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

**Table 2** Preliminary analysis: the impact of age on key variables

| | 7–11 years | | 12–18 years | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Knowledge: vital | 6.23 | 2.02 | 6.32 | 1.85 | $t(396) = -0.42$, NS |
| Knowledge: total | 8.13 | 2.67 | 7.84 | 2.21 | $t(396) = 1.15$, NS |
| Knowledge: incorrect | 2.29 | 1.83 | 1.98 | 1.60 | $t(396) = 1.80^{\dagger}$ |
| Hazard adjustment | 11.06 | 5.37 | 8.60 | 4.28 | $t(396) = 4.90$*** |
| Child upset | 1.86 | 0.60 | 1.53 | 0.60 | $t(377) = 5.28$*** |
| Parental upset | 1.91 | 0.54 | 1.73 | 0.52 | $t(389) = 3.34$*** |
| Coping ability | 4.79 | 1.90 | 4.45 | 1.74 | $t(393) = 1.79^{\dagger}$ |
| Event likelihood | 15.73 | 2.53 | 15.68 | 2.79 | $t(382) = 0.18$, NS |
| Injury likelihood | 18.02 | 3.09 | 17.16 | 3.52 | $t(373) = 2.49$* |

$^{\dagger}$ $p < 0.10$ (approaching significance); * $p < 0.05$; *** $p < 0.001$

### 3.2 Hazards education participation

Endorsement of the item indicating prior participation in a hazards education program was reported by a total of 382/407 (93.86%) participants, of whom 275 (72.00%) indicated that they had participated in a program and 107 (28.00%) indicated that they had not participated in a program. The majority of those who participated in a hazards education program ($n = 222$, 80.73%) indicated involvement in a program taught by their teacher. A smaller percentage ($n = 104$; 37.82%) reported involvement in a program administered by civil defense with a specific emergency management focus. Participants with prior education involvement reported participating in a program in 2004 ($n = 123$; 44.73%), or prior to 2004 ($n = 232$; 84.36%). Of the 275 participants who reported being involved in an education program, 263 (95.64%) responded to the item asking about the number of prior programs that were participated in as follows: reported participating in one ($n = 45$, 17.11%), two ($n = 59$, 22.43%), three ($n = 83$, 31.56%), four ($n = 26$, 9.88%), five ($n = 17$, 6.46%), or more than five ($n = 33$, 12.55%) separate hazards education programs.

A majority of hazards education program participants, 66.54% ($n = 183/275$) reported being encouraged by the hazards education program to engage in discussions with their parents about what they had learned throughout the program. Following participation in hazards education programs, a majority of participants, 77.81% ($n = 214/275$), reported actually having a specific discussion with their parents about what they learned and 53.09% ($n = 146/275$) indicated that parents wanted to discuss the material when the child raised the topic.

### 3.3 Hypothesis one: hazard awareness

Within the geographic area studied, the most likely hazards to occur include fires, floods, and storms with high winds. A total of 104 students (25.40%) correctly chose at least two of these three as the most likely to occur. Of the children who reported participating in a hazards education program, 27.64% ($n = 76/275$) correctly chose two of these as the most likely to occur hazards. Similarly, 24.30% ($n = 26/107$) of children who had reported not participating in a hazards education program also correctly chose two of these as the most likely to occur hazards. There was no significant difference in the knowledge about the most likely hazards between those children who had and had not reported participating in a hazards education program, $\chi^2$ (1) = .44, $p > .05$, ns.

### 3.4 Hypothesis two: knowledge of response-related protective behaviors

In order to determine children's knowledge of protective behaviors in the event of a hazard, a number of analyses were carried out. Overall, there were 13 correct responses, the mean number of correct responses was 7.90 (SD = 2.61). As expected, participants who had participated in a hazards education program answered significantly more correct than those participants who had not participated in a hazards education program (see Table 3). There was a possibility of nine vitally correct responses. The mean number of vitally correct items was 6.19 (SD = 2.04). As expected, participants who had participated in a hazards education program answered significantly more correct than those participants who had not participated in a program (see Table 3). In addition to correct responses, there were also 15 incorrect responses, the overall mean was 2.16 (SD = 1.75). Again, as expected, participants who had participated in a hazards education program had significantly fewer incorrect responses than those participants who had not participated in a hazards education program (see Table 3). See Table 4 for a breakdown of correct and incorrect hazard-related knowledge for each specific hazard.

**Table 3** Readiness: knowledge and hazard adjustments mean total scores (and standard deviations)

| | Education | | No education | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Knowledge: vital | 6.42 | 1.86 | 5.87 | 1.94 | $t(380) = 2.56^{**}$ |
| Knowledge: total | 8.11 | 2.27 | 7.54 | 2.55 | $t(380) = -2.11^{*}$ |
| Knowledge: incorrect | 2.07 | 1.60 | 2.47 | 2.04 | $t(380) = -1.99^{*}$ |
| Hazard adjustment | 10.22 | 4.82 | 8.85 | 5.51 | $t(380) = 2.40^{**}$ |

*M* mean, *SD* standard deviation

* $p \leq 0.05$; ** $p \leq 0.01$ (one-tailed)

**Table 4** Readiness: specific hazard-related protective knowledge

| | Education | | No education | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Flood | | | | | |
| Go outside | .18 | .39 | .14 | .35 | $t(380) = -1.05$ |
| Stay inside[a] | .42 | .49 | .34 | .47 | $t(380) = 1.59$ |
| Listen to the radio[b] | .38 | .49 | .35 | .48 | $t(380) = .72$ |
| Move to an area higher than flood[b] | .77 | .42 | .76 | .43 | $t(380) = .29$ |
| Volcanic eruption | | | | | |
| Go outside | .12 | .32 | .11 | .32 | $t(380) = .21$ |
| Listen to the radio[b] | .49 | .50 | .49 | .50 | $t(380) = -.14$ |
| Close all windows and doors[a] | .80 | .40 | .74 | .44 | $t(380) = 1.31$ |
| Open all windows and doors | .03 | .17 | .04 | .19 | $t(380) = -.42$ |
| Fire | | | | | |
| Leave by the shortest route[b] | .86 | .35 | .80 | .40 | $t(380) = 1.31$ |
| Stay inside | .07 | .25 | .10 | .30 | $t(380) = -1.10$ |
| Close any doors that you pass[a] | .32 | .47 | .41 | .49 | $t(380) = -1.76$ |
| Open all doors and windows | .20 | .40 | .16 | .37 | $t(380) = 1.00$ |
| Earthquake | | | | | |
| Go outside | .06 | .24 | .17 | .38 | $t(380) = -3.27^{***}$ |
| Stay inside and take cover in a doorway[b] | .91 | .29 | .86 | .35 | $t(380) = 1.41$ |
| Curl into a turtle shape[b] | .48 | .50 | .37 | .49 | $t(380) = 1.81^{\dagger}$ |
| Stay right where you are and wait | .09 | .29 | .08 | .28 | $t(380) = .32$ |
| Storm with high winds | | | | | |
| Do nothing | .19 | .39 | .31 | .46 | $t(380) = -2.44^{**}$ |
| Run outside and take cover | .04 | .20 | .08 | .28 | $t(380) = -1.56$ |
| Stay inside[b] | .74 | .44 | .68 | .47 | $t(380) = 1.17$ |
| Open window on side of house closest to wind | .03 | .17 | .06 | .25 | $t(380) = -1.64$ |
| Close all windows | .63 | .48 | .58 | .50 | $t(380) = .96$ |
| Chemical spill | | | | | |
| Evacuate as advised on radio, TV or people in charge[b] | .84 | .36 | .72 | .45 | $t(380) = 2.79^{**}$ |
| Run outside and take cover | .19 | .39 | .28 | .45 | $t(380) = -1.87^{\dagger}$ |
| Stay inside and wait for it to be over[a] | .15 | .36 | .19 | .39 | $t(380) = -.90$ |
| Tsunami | | | | | |
| Stay inside | .06 | .23 | .17 | .38 | $t(380) = -3.43^{***}$ |
| Run outside and take cover | .09 | .28 | .13 | .34 | $t(380) = -1.28$ |
| Go at least 1 km inland or 35 m above sea level[b] | .94 | .23 | .83 | .37 | $t(380) = 3.60^{***}$ |
| Watch for the sea wave to come | .07 | .26 | .05 | .21 | $t(380) = .92$ |
| The siren | | | | | |
| Awareness | 1.76 | .81 | 1.77 | .76 | $t(369) = -.10$ |
| Do nothing | .13 | .34 | .14 | .35 | $t(380) = -.14$ |

**Table 4** continued

| | Education | | No education | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Go outside | .24 | .43 | .35 | .48 | $t(380) = -2.36$** |
| Seek out a caregiver[a] | .66 | .47 | .49 | .50 | $t(380) = 2.96$*** |
| Listen to the radio[a] | .40 | .49 | .37 | .49 | $t(380) = .40$ |

[a] Correct; [b] vitally correct

† $p < 0.10$ (approaching significance); ** $p < 0.01$; *** $p < 0.001$

**Table 5** Correlations between hazards education and major variables

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Knowledge: total | .11* | .17** | .05 | −.00 | .04 | .09† | .14* | .18*** | .15** | .08 |
| Knowledge: vital | .13* | .19*** | .09 | .00 | .05 | .10 | .16** | .17*** | .13** | .08 |
| Incorrect knowledge | −.10* | .03 | .04 | .04 | .03 | .01 | .04 | −.04 | −.04 | −.00 |
| Family plan | .05 | .02 | .06 | −.01 | .02 | .05 | .08 | .11* | .20*** | .16** |
| Family practice | −.00 | −.03 | .06 | −.03 | .11* | .02 | .10 | .15** | .20*** | .35*** |
| School practice | .18*** | .11* | .09 | −.03 | .14** | .12* | .05 | .15** | .20*** | .07 |
| Hazard adjustment | .12* | .09 | .12* | −.02 | .22*** | .12* | .22*** | .17*** | .24*** | .21*** |

1 = any prior education; 2 = teacher-taught program; 3 = emergency management program; 4 = program in 2005; 5 = program in 2004; 6 = program prior to 2004; 7 = number of programs; 8 = encouraged to discuss with parents; 9 = did discuss with parents; 10 = parents willing to discuss

† $p < 0.10$ (approaching significance); * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

There were a number of significant relationships between increased knowledge and the following education factors: participation in a prior program, participation in a teacher-taught program, participating in a program within the past 2 years, the number of programs participated in, and interaction variables (programs that encouraged discussion of topics with parents, and actual discussion with parents) (see Table 5).

### *3.4.1 Knowledge about responding to the civil defence siren*

When compared to children who had not participated in a hazards education program, children who had participated in a hazards education program endorsed an incorrect answer (go outside) significantly less and a correct answer (seek out a caregiver) significantly more (see Table 4). There was no significant difference in the level of awareness of the alarm or other answers (do nothing and listen to the radio) (see Table 4).

## 3.5 Hypothesis three: readiness behaviors and hazard adjustments

### *3.5.1 Family emergency plans, and home- and school-based practice*

Of a possible 398 children, 103 (25.90%) reported having an established family emergency plan. Of the children who reported participating in a hazards education program, 26.66% ($n = 72/270$) reported having a family emergency plan. In comparison, 20.75%

($n = 22/106$) of children who did not participate in a hazards education program reported having a family emergency plan. This did not represent a significant difference, $\chi^2$ (2) = 1.45, $p > .05$, ns. A total of 129 children (36.90%) indicated having practiced what to do in an emergency at home. Of the children who participated in a hazards education program, 36.71% ($n = 87/237$) reported practicing what to do in an emergency at home. By contrast, 31.91% ($n = 30/94$) of children who did not participate in a hazards education program also reported practicing what to do in an emergency at home. This did not represent a significant difference, $\chi^2$ (1) = .68, $p > .05$, ns. A total of 327 children (90.58%) reported having practiced what to do in an emergency at school. Of the children who reported participating in a hazards education program, 93.23% ($n = 234/251$) reported having practiced what to do in an emergency at school. In comparison, 81.32% ($n = 74/91$) of children who did not participate in a hazards education program reported having practiced what to do in an emergency at school. This represented a significant difference in the expected direction, $\chi^2$ (1) = 10.58, $p = .001$.

There were a number of significant correlations between planning and practice factors and a number of education factors including: participation in a prior program, participation in a teacher-taught program, participating in a program within the past 2 years, the number of programs participated in, and the interaction variables (programs that encouraged discussion of topics with parents, actual discussion with parents, and the parents' willingness to discuss) (see Table 5).

#### *3.5.2 Hazard adjustments*

Table 6 presents a list of hazard adjustments and the number of participants who endorsed each hazard adjustment. The number of participants endorsing each hazard adjustment ranged from 44 (10.81%; arranged bracing for pile foundation) to 342 (84.03%; having a torch). Inspection of the table reveals that more participants endorsed easy adjustments (i.e., low effort, low cost) and fewer participants endorsed more difficult adjustments (i.e., time consuming, expensive).

The possible score on the hazard adjustment index ranged from zero to 23 and had a mean of 9.84 (SD = 5.17). As expected, children who were involved in hazards education programs reported a significantly greater number of hazard adjustments than those children who had not been in a hazards education program (see Table 3).

There were a number of significant correlations between the reported number of hazard adjustments and the following education factors: participation in a prior program, participation in an emergency management program, participating in a program within the past 2 years, the number of programs participated in, and the interaction variables (programs that encouraged discussion of topics with parents, actual discussion with parents, and the parents' willingness to discuss) (see Table 5).

### 3.6 Hypothesis four: risk perceptions

With regard to the likelihood of occurrence, those children who had participated in a hazards education program were significantly more likely to believe that a flood or storm with high winds could occur (see Table 7). As expected, when compared to children who had not participated in a hazards education program, children who had participated in a hazards education program were significantly less likely to believe that a volcanic eruption, chemical spill, tsunami, or tornado could occur (see Table 7). There was no significant difference between those children who had and had not participated in a hazards education

**Table 6** Endorsement of hazard adjustments

| Hazard adjustment | *n* | % |
|---|---|---|
| Torch | 342 | 84.03 |
| First aid kit | 331 | 81.33 |
| Smoke detector | 330 | 81.11 |
| Learned how to provide first aid | 248 | 60.93 |
| Stored emergency equipment (e.g., torches, fires extinguisher, first aid kit) | 229 | 56.26 |
| Learned how to put out fires | 225 | 55.28 |
| Has a transistor radio and spare batteries | 215 | 52.82 |
| Has a fire extinguisher | 207 | 50.86 |
| Brought additional insurance | 197 | 48.40 |
| Stored hazardous material safely | 194 | 47.67 |
| Stockpiled water and food for 3 days | 191 | 46.93 |
| Strapped the water heater | 174 | 42.75 |
| Picked an emergency contact person outside your area | 162 | 39.80 |
| Assessed the vulnerability of natural or other kind of hazards for family's area | 138 | 33.91 |
| Put strong latches on cabinet doors | 137 | 33.66 |
| Rearranged breakable household items | 120 | 29.48 |
| Added lips to shelves to keep things from sliding off | 112 | 27.52 |
| Home inspected for resistance | 107 | 26.29 |
| Has a spanner or wrench by gas turn-off valve | 93 | 22.85 |
| Bolted house to foundation | 89 | 21.87 |
| Braced house walls | 86 | 21.13 |
| Installed flexible piping to gas appliances | 65 | 15.97 |
| Arranged bracing for pile foundation | 44 | 10.81 |

program for their expectations surrounding the likelihood of the occurrence of a fire or an earthquake (see Table 7).

With regard to the likelihood of injury, those children who had participated in a hazards education program were significantly more likely to believe that they could be injured by a fire or a tornado (see Table 7). There were no significant differences between those children who had and had not participated in a hazards education program for their injury expectations surrounding the likelihood of the occurrence of a flood, volcanic eruption, chemical spills, storms with high winds, earthquake, or a tsunami (see Table 7).

### 3.7 Hypothesis five and six: emotional factors

With regard to emotional factors, when compared to children who had participated in a hazards education program, and as expected, children who had not done a hazards education program were significantly more likely to perceive their parents as being upset/fearful when talking about hazards (see Table 7). There were no significant differences between those children who had and had not participated in a hazards education program for their own (a) level of fear or (b) perceived emotional coping ability (see Table 7).

**Table 7** Risk perceptions, emotional factors, and siren knowledge: means and standard deviations

| Hazard | Education | | No education | | |
|---|---|---|---|---|---|
| | *M* | SD | *M* | SD | |
| Risk perceptions: occurrence | | | | | |
| Flood | 2.28 | .62 | 2.07 | .65 | $t(377) = 3.01$** |
| Fire | 2.29 | .65 | 2.24 | .65 | $t(376) = .68$ |
| Volcanic eruption | 1.24 | .49 | 1.48 | .71 | $t(375) = -3.62$*** |
| Chemical spill/gas leak | 1.81 | .63 | 1.93 | .65 | $t(375) = -1.71^{\dagger}$ |
| Storm with high winds | 2.45 | .58 | 2.29 | .69 | $t(376) = 2.15$* |
| Earthquake | 2.55 | .59 | 2.51 | .64 | $t(376) = .46$ |
| Tsunami | 1.58 | .61 | 1.76 | .74 | $t(374) = -2.44$* |
| Tornado | 1.36 | .54 | 1.50 | .67 | $t(375) = -2.10$* |
| Risk perception: injury | | | | | |
| Flood | 1.90 | .69 | 1.98 | .72 | $t(377) = -.95$ |
| Fire | 2.60 | .55 | 2.46 | .67 | $t(374) = 1.98$* |
| Volcanic eruption | 2.11 | .86 | 2.00 | .86 | $t(376) = 1.17$ |
| Chemical spill/gas leak | 2.13 | .68 | 2.12 | .69 | $t(374) = .13$ |
| Storm with high winds | 2.12 | .66 | 2.23 | .71 | $t(370) = -1.44$ |
| Earthquake | 2.40 | .57 | 2.40 | .62 | $t(370) = .00$ |
| Tsunami | 2.31 | .80 | 2.20 | .83 | $t(372) = 1.24$ |
| Tornado | 2.26 | .79 | 2.06 | .82 | $t(369) = 2.18$* |
| Emotional factors | | | | | |
| Hazard-related fear | 1.71 | .64 | 1.71 | .64 | $t(363) = -.03$ |
| Parent fear | 1.79 | .54 | 1.93 | .52 | $t(376) = -2.26$* |
| Emotional coping ability | 4.67 | 1.76 | 4.53 | 2.01 | $t(378) = .64$ |

*M* mean, *SD* standard deviation

$^{\dagger}$ $p < 0.10$ (approaching significance); *$p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$ (one-tailed)

A total number of 37 children (9.54%) reported "often" feeling scared or upset about hazards. Of the children who reported participating in a hazards education program, 10.11% ($n = 27/267$) reported often feeling scared or upset about hazards. Similarly, 10.20% ($n = 10/98$) of children who reported not participating in a hazards education program reported often feeling scared or upset about hazards. This did not represent a significant difference, $\chi^2$ (2) = .00, $p > .10$, ns.

### 3.8 A partial correlation controlling for the effect of age and gender

As the preliminary analyses revealed that age and gender had a significant effect on a number of dependent variables, a partial correlation controlling for the effect of age and gender was conducted. This allowed an exploration of the effect of participation in a hazards education program when these factors were controlled for. This analysis revealed that after age and gender had been controlled for, participation in a hazards education program was associated with a decreased level of parental fear ($r = -.15$, $p < .01$), an increased level of vital knowledge ($r = .13$, $p = .01$), and a decreased level of incorrect knowledge ($r = -.14$, $p = .01$).

### 3.9 Exploratory question one: predictors of hazard adjustments

The overall regression equation accounted for 24.80% of the variance (adjusted $R^2 = .21$) in the reported number of hazard adjustments, $F$ (13, 246) = 5.91, $p < .001$. A number of factors associated with the education programs had a significant unique effect on the reported number of hazard adjustments. The following variables predicted a greater number of hazard adjustments: participation in a greater number of hazards education programs ($\beta = .16$, $p = .01$); more recent program involvement ($\beta = .18$, $p < .01$); an increased risk perception of an injury caused by a hazard ($\beta = .16$, $p = .01$); and encouragement to talk with parents about what they had learned ($\beta = .15$, $p = .01$). Surprisingly, incorrect knowledge was also found to predict a greater number of hazard adjustments ($\beta = .13$, $p < .05$) and teacher-taught programs were found to predict a fewer number of hazard adjustments ($\beta = -.13$, $p < .05$). Additionally, a number of variables approached significance ($p < .10$), including: discussing what was learned in a hazards education program ($\beta = .11$) and the willingness of parents to discuss what the children had learned ($\beta = .12$).

### 3.10 Exploratory question two: the impact of child emotional factors

There was a significant main effect for children's hazard-related fear on the perception of parents' level of fear, $F$ (2, 382) = 14.33, $p < .001$. An LSD post hoc analysis revealed that children who reported not being scared at all ($M = 1.64$, SD = .56) reported that their parents were significantly less scared (upset) of hazards than both children who reported sometimes being scared ($M = 1.93$, SD = .49, $p < .001$) and children who reported often being scared ($M = 1.97$, SD = .55, $p = .001$).

The main effect for children's hazard-related fear on the number of hazard adjustments adopted approached significance, $F$ (2, 387) = 2.83, $p = .06$. An LSD post hoc analysis revealed that children who reported not being scared at all ($M = 9.27$, SD = 5.27) reported significantly fewer hazard adjustments than both children who reported sometimes being scared ($M = 10.32$, SD = 4.76, $p = .05$) and children who reported often being scared ($M = 11.08$, SD = 5.50, $p = .05$).

There was a significant main effect for children's hazard-related fear on their level of correct knowledge, $F$ (2, 387) = 9.54, $p < .001$. An LSD post hoc analysis revealed that children who reported being sometimes scared ($M = 8.57$, SD = 2.51) had significantly more correct responses than both children who reported not being scared at all ($M = 7.44$, SD = 2.39, $p < .001$) and children who reported often being scared ($M = 7.70$, SD = 2.27, $p = .05$).

There was a significant main effect for children's hazard-related fear on their level of vitally correct knowledge, $F$ (2, 387) = 13.98, $p = .02$. An LSD post hoc analysis revealed that children who reported being sometimes scared ($M = 6.56$, SD = 1.94) had significantly more vitally correct responses than both children who reported not being scared at all ($M = 6.05$, SD = 1.92, $p = .01$) and children who reported often being scared ($M = 5.95$, SD = 1.91, $p = .07$).

Analyses revealed that children's hazard-related fear did not have a main effect on their perceived ability to cope, $F$ (2, 384) = 1.79, $p > .05$, ns, or their level of incorrect knowledge, $F$ (2, 387) = 0.79, $p > .05$, ns.

### 3.11 Exploratory question three: hazard adjustment factor structure

In order to identify the factor structure of the hazard adjustments, the 23 statements were subjected to a principal component analysis. Initial statistics indicated that six factors had eigenvalues greater than one. However, an inspection of the scree plot revealed that a four factor solution was more meaningful. These factors accounted for 25.17, 8.65, 6.26, and 5.01% of the variance, respectively, for a combined total of 45.09%. These four factors were then rotated to an oblimin criterion. Of the 23 variables, factor one and two each had five item loadings, and factor three and four each had three item loadings. The remaining variables either did not load on any variable or loaded on multiple factors. Factor one contained statements associated with planning and household adjustments. Factor two contained statements associated with easier and more day to day adjustments. Factor three contained statements associated with more difficult and expensive adjustments. Factor four contained statements associated with specific earthquake responses (see Table 8).

## 4 Discussion

Taken together, the findings of the current study support the value of hazards education programs for youth, replicating as well as extending features of previous research. Youth involved in programs reported a greater number of home-based hazard adjustments, had more correct knowledge of emergency management-related readiness and response behaviors, and lower levels of incorrect knowledge. This latter aspect is important as one of our early studies (Ronan et al. 2001) found indications that educated youth in that study endorsed a greater number of incorrect responses on some items. Along with their higher level of correct knowledge concerning emergency management related behaviors, there was a concern raised based on the findings of that study around the idea of helping children differentiate the most correct responses to hazardous events. In line with this idea, the current study additionally found that educated youth were significantly more knowledgeable about responses considered by emergency management personnel to be "vital" responses compared to those youth who did not participate in a program.

As in previous research, we found some additional benefits of hazards education program involvement, in terms of both emotional factors as well as risk perceptions. However, findings here were not as consistent as they were with the knowledge and adjustment indicators. Nevertheless, that educated children reported seeing their parents as less fearful and that they also reported more realistic risk perceptions in some domains compared to their non-educated counterparts is encouraging. The fact that educated youth did not report any greater levels of fear or lower levels of perceived emotional coping ability is also supportive of the idea that helping children learn about disasters doesn't have to be upsetting (Ronan and Johnston, 2001, 2003, 2005). For example, in this study, despite the fact that educated youth reported perceiving a greater likelihood of being hurt in the event of some hazardous events, the fact that they did not report higher levels of distress or reduced coping is encouraging of the idea that helping children gain knowledge does not have to lead to problems with emotional functioning. One other finding worth taking particular note of has to do with family emergency planning and practice. In this study, while there were expected differences in the overall number of home-based hazard adjustments as a function of education, there were no differences in family planning and practice. Given the vital role of planning and practice to adaptive emergency response

**Table 8** Factor loadings for the four hazard adjustment factors

| Factors | Factor loadings |
|---|---|
| Component one: planning and household adjustments | |
| Has your family rearranged breakable household items? | 0.66 |
| Has your family stored hazardous materials safely? | 0.47 |
| Has your family installed flexible piping to gas appliances? | 0.59 |
| Has your family picked an emergency contact person? | 0.41 |
| Has your family found out if you are in an area particularly vulnerable to hazards? | 0.66 |
| Component two: easier and more day to day | |
| Does your family have a torch? | 0.61 |
| Does your family have a fire extinguisher? | 0.59 |
| Does your family have a smoke detector? | 0.69 |
| Does your family have a first aid kit? | 0.71 |
| Has someone in your family learned how to provide first aid? | 0.57 |
| Component three: more difficult and expensive | |
| Has your family braced house walls? | 0.66 |
| Has your family bolted house to foundations? | 0.72 |
| Has your family arranged bracing for pile foundation? | 0.58 |
| Component four: specific earthquake responses | |
| Has your family put latches on cabinet doors? | 0.67 |
| Has your family added lips to shelves to keep things from sliding off? | 0.77 |
| Has your family had your home inspected for resistance? | 0.56 |
| Unclassified (Did not load on any factor) | |
| Has your family stockpiled water and food for 3 days? | |
| Does your family have a transistor radio and spare batteries? | |
| Has your family stored emergency equipment? | |
| Does your family have a spanner or wrench by gas? | |
| Has someone in your family brought additional insurance? | |
| Has your family strapped the water heater? | |
| Has someone in your family learned how to put out fires? | |

(FEMA 2006; NIMH 2002; Ronan and Johnston 2005), this is one feature of hazards education that we recommend being incorporated quite specifically no matter the specific hazards focus of an education program.

As in previous research, the current study found that when it came to hazard adjustments those that were easier (e.g., owning a torch) were more likely to be endorsed than those that were more difficult (e.g., arranging bracing for pile foundation; Johnston et al. 2005). Adding to this knowledge base, the current study found that the hazard adjustments could be represented by four factors: (1) planning and household adjustments; (2) easier and more day to day adjustments; (3) more difficult/expensive adjustments; and (4) specific earthquake responses. Future studies should attempt to further analyze these hazard adjustments to determine if these factors are transferrable to other regions or if these factors are specific to a certain region and the disasters that each region is more likely to encounter.

In terms of the ingredients that might be incorporated into education programs, the factors here that were found to predict an increased number of home hazard adjustments were (a) program recency, (b) encouragement by the program to talk with parents, (c) participation in a greater number of programs, and (d) an increased perception of an injury occurring due to a hazard. Additionally, as indicated by a trend toward significance, actual discussion with parents and in turn parents' willingness to discuss what was learned marginally predicted adjustments. These findings mirror our previous research (Ronan and Johnston 2001) and indicate that helping children increase knowledge is important but so too is assisting them to go home and talk with their parents about what they learned, all in the context of a spaced interactive learning approach. When helping children learn or when encouraging them to go home and discuss education programs with parents, it does appear that incorporating specific emergency management information and helping guide interactions with parents (e.g., through homework exercises) can increase benefits (Ronan and Johnston 2003). Having said this, the fact that the amount of variance accounted for, as well as the value of many bivariate relationships, in the current study was modest, we have to temper our enthusiasm. One implication here is that if educators do include various evidence-supported features in hazards education programs, we recommend evaluation being done to document their effectiveness.

In the prediction of the adoption of hazard adjustments there were some unexpected findings. For example, teacher-taught programs were found to predict a decreased number of hazard adjustments and incorrect knowledge was found to predict an increased number of hazard adjustments. The latter finding may be related to the nature of children. For example, one of our early studies (see Ronan et al. 2001) found that correct hazards-based knowledge appeared to be related to incorrect hazards-based knowledge. This and the current finding may be related to children having a tendency to be enthusiastic and perhaps over-inclusive. Alternatively, this appears to reflect multicollinearity: these variables (teacher-taught programs, incorrect knowledge) on their own each predicts adjustments in simple correlational analysis as one might expect (i.e., positively and negatively, respectively) whereas each predicts in an unexpected way in the face of a number of other variables (i.e., negatively and positively, respectively). Why this pattern of relationships occurred in the regression analyses is not immediately clear and, while these findings may be anomalous, future research should assess whether similar patterns emerge.

A notable finding within this study was that anxious children were more likely to report hazard adjustment adoption. This may be related to other studies that have found that anxious children generally have anxious parents (e.g., Deering 2000; Huzziff and Ronan 1999; Norris et al. 2002; Ronan 1997b) and being unprepared can heighten parents' anxiety. Furthermore, in terms of correct and vital knowledge, this study provides some support for the notion that moderate levels of anxiety can be functional (Yerkes and Dodson 1908; see also Faupel and Styles 1993). Children who reported moderate levels of anxiety also had greater knowledge of both correct and vitally correct readiness and response behaviors compared to children who reported being often upset and those who reported being not at all upset about hazardous events. On the other hand, while children with moderate levels of anxiety reported the most benefit, children with high anxiety reported a similar level of benefit on home-based hazard adjustments. Thus, this leaves open questions for future research about the role of emotional factors in child and family readiness and in education programs.

Of interest, the current study found differences between younger children and older children as well as girls and boys. For example, younger age was found to correlate significantly with a number of factors, including knowledge, home adjustments, interaction with parents, family planning, and other factors. It may well be that younger children are more prone to be enthusiastic about learning about hazards and their mitigation, and willing to talk with parents, perhaps based on their developmental level. It may also be that younger children may harbor more concern about hazardous events. The fact that younger children tend to have more fears than older children, including fears of hazardous events, may increase their motivation particularly in the face of perceiving potential solutions to some of those fears (Johnston et al. 2005; Ronan and Johnston 2005; see also Kendall and Ronan 1990). Our one earlier study that assessed age effects (Ronan and Johnston 2003) did not find any systematic relationships between age and knowledge, adjustment, or interaction factors. However, that study included a reduced age range; all children were between the ages of 11 and 13, whereas this study included an expanded age range (i.e., 7–18).

Similarly, girls reported higher levels of fear but they also had more knowledge compared to boys. It is worth noting that both girls and younger children's fear scores were at about the midpoint (1.90 and 1.86 on a 1–3 scale). Given other findings in this study that document a relationship between moderate anxiety and increased knowledge, these findings may reflect a similar phenomenon.

The major limitation of the current study was its correlational and cross-sectional methodology. However, given a moderately large sample, and given the fact that the major findings of this research supports previous correlational research (Ronan and Johnston 2001; Ronan et al. 2001) as well as quasi-experimental research (Ronan and Johnston 2003), the current findings should encourage schools, emergency managers, and others to consider the value of offering hazards education programs to children. Given that even a brief reading and discussion program has been shown to have benefits (Ronan and Johnston 2003), those who choose to incorporate additional features linked to increased effectiveness may be able to realize additional benefits in promoting resilience in a population vulnerable to the effects of hazardous events. However, we reiterate that as with any intervention or education program, published research support does not guarantee effectiveness in individual applications. Thus, based on findings to date, we feel comfortable in recommending hazards education programs for youth. Further, research has identified that by adding some ingredients (e.g., providing specific guidance, encouraging guided interaction with parents), programs may have potential to become increasingly effective. However, the arbiter in individual applications needs to be evaluation and documented effectiveness, where children and families are seen to improve on various indicators following involvement in a specific program. Thus, we also strongly recommend that every application of a hazards education program includes an evaluation component to assess its specific level of effectiveness. We also recommend continuing research, including that which is controlled and experimental (e.g., Ronan and Johnston 2003), to continue to shed light on the potential for, and active ingredients in, hazards education programs.

## Appendix

See Table 9.

**Table 9** Zero-order correlation matrix

| | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | $X_8$ | $X_9$ | $X_{10}$ | $X_{11}$ | $X_{12}$ | $X_{13}$ | $X_{14}$ | $X_{15}$ | $X_{16}$ | $X_{17}$ | $X_{18}$ | $X_{19}$ | $X_{20}$ | $X_{21}$ | $X_{22}$ | $X_{23}$ | $X_{24}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $X_1$ | 1.00 | | | | | | | | | | | | | | | | | | | | | | | |
| $X_2$ | −.18$^{c}$ | 1.00 | | | | | | | | | | | | | | | | | | | | | | |
| $X_3$ | −.02 | −.06 | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| $X_4$ | −.05 | −.09$^{\dagger}$ | −.13$^{a}$ | 1.00 | | | | | | | | | | | | | | | | | | | | |
| $X_5$ | −.15$^{b}$ | −.03 | −.12$^{a}$ | −.52$^{c}$ | 1.00 | | | | | | | | | | | | | | | | | | | |
| $X_6$ | .03 | .08$^{\dagger}$ | −.04 | −.29$^{c}$ | .01 | 1.00 | | | | | | | | | | | | | | | | | | |
| $X_7$ | .00 | −.19$^{c}$ | −.04 | −.36$^{c}$ | .30$^{c}$ | .13$^{b}$ | .1.00 | | | | | | | | | | | | | | | | | |
| $X_8$ | −.12$^{a}$ | −.01 | −.02 | −.48$^{c}$ | .28$^{c}$ | .34$^{c}$ | .05 | 1.00 | | | | | | | | | | | | | | | | |
| $X_9$ | −.03 | −.08 | −.03 | −.18$^{c}$ | .12$^{a}$ | .18$^{b}$ | .25$^{c}$ | .23$^{c}$ | 1.00 | | | | | | | | | | | | | | | |
| $X_{10}$ | −.10$^{a}$ | −.16$^{c}$ | −.12$^{a}$ | .13$^{a}$ | .09$^{\dagger}$ | .10$^{\dagger}$ | .07 | .19$^{c}$ | −.10$^{\dagger}$ | 1.00 | | | | | | | | | | | | | | |
| $X_{11}$ | −.07 | −.32$^{c}$ | −.02 | .32$^{c}$ | .24$^{c}$ | .15$^{b}$ | .21$^{c}$ | .18$^{c}$ | .06 | .25$^{c}$ | 1.00 | | | | | | | | | | | | | |
| $X_{12}$ | −.07 | −.17$^{c}$ | −.06 | .12$^{a}$ | .06 | .17$^{b}$ | .15$^{b}$ | .14$^{b}$ | .11$^{\dagger}$ | .25$^{c}$ | .50$^{c}$ | 1.00 | | | | | | | | | | | | |
| $X_{13}$ | .04 | −.29$^{c}$ | −.10$^{a}$ | .06 | .03 | .06 | −.09$^{\dagger}$ | −.02 | −.04 | .19$^{c}$ | .21$^{c}$ | .39$^{c}$ | 1.00 | | | | | | | | | | | |
| $X_{14}$ | .05 | −.26$^{c}$ | −.05 | .04 | −.01 | .04 | .11$^{a}$ | .03 | .06 | .16$^{b}$ | .21$^{c}$ | .30$^{c}$ | .35$^{c}$ | 1.00 | | | | | | | | | | |
| $X_{15}$ | −.10$^{\dagger}$ | .00 | −.03 | .18$^{c}$ | .11$^{a}$ | .09$^{\dagger}$ | .14$^{b}$ | .12$^{a}$ | .05 | .15$^{b}$ | .20$^{c}$ | .07 | .05 | .07 | 1.00 | | | | | | | | | |
| $X_{16}$ | .08 | −.21$^{c}$ | −.04 | −.00 | −.03 | .06 | .11$^{a}$ | .02 | .10$^{\dagger}$ | .15$^{b}$ | .20$^{c}$ | .35$^{c}$ | .33$^{c}$ | .57$^{c}$ | −.00 | 1.00 | | | | | | | | |
| $X_{17}$ | .07 | −.23$^{c}$ | −.01 | .05 | .02 | .06 | .02 | .05 | .08 | .11$^{a}$ | .20$^{c}$ | .16$^{b}$ | .35$^{c}$ | .31$^{c}$ | −.02 | .29$^{c}$ | 1.00 | | | | | | | |
| $X_{18}$ | .15$^{b}$ | −.33$^{c}$ | −.08 | .09$^{\dagger}$ | .04 | .07 | .12$^{a}$ | .08$^{\dagger}$ | .13$^{a}$ | .16$^{b}$ | .17$^{c}$ | .12$^{a}$ | .29$^{c}$ | .21$^{c}$ | .07 | .20$^{c}$ | −.34$^{c}$ | 1.00 | | | | | | |
| $X_{19}$ | −.09$^{\dagger}$ | −.22$^{c}$ | −.01 | .09$^{\dagger}$ | .05 | .03 | .10$^{a}$ | −.04 | .06 | .10$^{\dagger}$ | .25$^{c}$ | .11$^{a}$ | .23$^{c}$ | .19$^{c}$ | .01 | .18$^{c}$ | −.23$^{c}$ | .27$^{a}$ | 1.00 | | | | | |
| $X_{20}$ | −.15$^{c}$ | .13$^{a}$ | .12$^{a}$ | −.00 | .07 | −.03 | −.10$^{a}$ | −.02 | .02 | −.13$^{a}$ | −.09$^{\dagger}$ | −.04 | −.12$^{a}$ | −.14$^{b}$ | −.15$^{b}$ | −.07 | −.17$^{c}$ | −.19$^{c}$ | −.14$^{b}$ | 1.00 | | | | |
| $X_{21}$ | .02 | −.06 | .10$^{\dagger}$ | −.10$^{a}$ | .03 | .04 | .03 | .01 | .04 | −.04 | −.04 | −.00 | −.00 | −.02 | −.21$^{c}$ | .06 | −.02 | −.00 | −.04 | .04 | 1.00 | | | |
| $X_{22}$ | −.18$^{c}$ | −.12$^{b}$ | −.07 | .11$^{a}$ | .17$^{b}$ | .05 | .04 | .09$^{\dagger}$ | .14$^{a}$ | .18$^{c}$ | .15$^{b}$ | .08 | .14$^{b}$ | .03 | .17$^{b}$ | −.04 | .08 | .11$^{a}$ | .10$^{a}$ | −.01 | −.06 | 1.00 | | |
| $X_{23}$ | .06 | −.32$^{c}$ | .00 | .12$^{a}$ | .09$^{\dagger}$ | .12$^{a}$ | .22$^{c}$ | .12$^{a}$ | .22$^{c}$ | .19$^{c}$ | .24$^{c}$ | .21$^{c}$ | .24$^{c}$ | .22$^{c}$ | .11$^{a}$ | .28$^{c}$ | .34$^{c}$ | .29$^{c}$ | .28$^{c}$ | −.21$^{c}$ | .13$^{b}$ | .25$^{c}$ | 1.00 | |
| $X_{24}$ | −.15$^{b}$ | −.04$^{\dagger}$ | −.07 | .13$^{a}$ | .19$^{c}$ | .09 | .05 | .10$^{\dagger}$ | .16$^{b}$ | .17$^{c}$ | .13$^{b}$ | .08 | .13$^{b}$ | .05 | .18$^{c}$ | −.01 | .09$^{\dagger}$ | .11$^{a}$ | .13$^{b}$ | −.05 | −.10$^{a}$ | .91$^{c}$ | .25$^{c}$ | 1.00 |

This correlation matrix reflects the major variables in this study. An expanded zero-order correlation matrix with 49 variables is available from the first author

$X_1$ = Gender; $X_2$ = Age; $X_3$ = Ethnicity; $X_4$ = Prior education; $X_5$ = Teacher taught program; $X_6$ = Civil defense taught program; $X_7$ = Program in the previous year; $X_8$ = Program was more than a year ago; $X_9$ = The number of programs; $X_{10}$ = Encouraged to speak with parents; $X_{11}$ = Talked to parents about education program; $X_{12}$ = Parents willing to discuss; $X_{13}$ = Emergency plan; $X_{14}$ = Home-based practice; $X_{15}$ = School-based practice; $X_{16}$ = Family practice; $X_{17}$ = Family emergency plan; $X_{18}$ = Meet family in an emergency; $X_{19}$ = School pick-up in an emergency; $X_{20}$ = Awareness of siren; $X_{21}$ = Incorrect knowledge; $X_{22}$ = Correct knowledge; $X_{23}$ = Hazards adjustments; $X_{24}$ = Vital knowledge

$^{\dagger}$ $p \leq .10$, * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$ (two-tailed)

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