Children's understanding of natural hazards in Christchurch, New Zealand

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Abstract

Children need to understand and be prepared for natural hazard events as much as adults. Children are vectors of hazard education, having the ability to educate those around them. This study investigated natural hazard risk perceptions, levels of preparedness and participation in education programmes of children from a school in Christchurch, New Zealand. Although hazard education programmes had been attended by a majority of the children hazard awareness was only fair and reported levels of household preparedness were low. Continuing hazards education is needed to increase understanding of hazards and to improve household preparation in the Christchurch community.

Introduction

This is a study of children's natural hazard risk perceptions, levels of preparedness and participation in education programmes. Children have influence on their community and their communities have influence on them. Children can educate those around them about civil defence preparedness through involving them with homework exercises or assignments, or general discussion. Studies evaluating the effectiveness of using student-to-parent communication of school curriculum to increase awareness and/or promote behavioural change among both the students and their families (Crawford et al., 1990; McDevitt and Chaffee, 2000; Ronan and Johnston, 2001b; Saphir and Chaffee, 2002) have proven this method to be successful. The community's influence on children may primarily come from their parents and the media. Children's level of fear towards a natural hazard can be biased by their parents' fear. Muris et al. (1996) found that children of mothers who often express their fears exhibit high fear levels, children of mothers who never express their fears have low fear levels, while children of mothers who sometimes express their fears fall in between. Following a disaster, children look to their parents' reactions to determine its seriousness and by witnessing a parent distressed by the situation the child will likely become fearful (Deering, 2000). Fearful children following a disaster have parents who tend also to report (Allen & Rosse 1998, Ronan et al. 2000) and be perceived by children (Ronan, 1997) as more fearful.

Educating children on civil defence matters through hazard education programmes is intended to decrease the child's vulnerability and promote personal, family and community resilience. Knowing the types of hazards, their recurrence intervals and appropriate protective behaviour should help mentally prepare a child for a hazard event, helping them understand what happens and that they have the power to help themselves. Knowledge of protective behaviour will decrease a child's vulnerability if alone or unsupervised and will decrease a family's vulnerability as the child can act independently and, depending on age, can help others who are unaware of the correct actions to take. Some protective behaviours will increase resilience, such as closing doors in a fire and shutting windows in a volcanic eruption, as they are intended to prevent damage to a house, reducing loss and destruction and enabling faster rehabitation. Not only does this facilitate resilience in a child and their family, as they can more easily return to a familiar lifestyle, but it also increases the resilience of their community by reducing the drainage of resources and helping the community to return to its prior level of functioning more quickly.

This study supplements other investigations recently undertaken in New Zealand and Washington State that have measured community risk perceptions, hazard awareness and preparedness and identified factors contributing to vulnerability in communities (Johnston and Benton, 1998; Johnston et al., 2001; Johnston and Houghton, 1995; Ronan and Johnston, 2001b; Ronan and Johnston, 2003)

Method

Participants and setting

The 102 participating students were from Cobham Intermediate School in Christchurch (54 boys, 47 girls, and one did not report gender). The ages of the children ranged from 10 to 12 years (Mean age = 10.9; SD = 0.4; Modal age = 11). Rather than 'ethnicity', the children were asked if they had always lived in Christchurch; a majority (n=54) of the children have always lived in Christchurch, where as other children have lived in other parts of New Zealand (n=15), Asia (n=14), North America (n=5), Europe (n=5), Australia (n=3), other places (n=5) and 1 did not report.

Survey

The questionnaire, based on one developed for an Auckland study (Ronan and Johnston, 2001a) was designed to assess children's level of awareness, risk perceptions, factual knowledge and physical preparedness for hazards and mass emergencies (i.e. floods, storms with high winds, fires, earthquakes, volcanic eruptions, tsunami, heavy snow storms and tsunami). It also assessed children's prior exposure to a) specific hazards and b) education programmes designed to increase awareness, knowledge and preparedness that were provided either by Emergency Management or by school teachers.

Procedure

The survey was administered within four classes by their teachers between the 18th and 21st June, 2003. Children were encouraged to ask questions if they did not understand a particular item. Questionnaires were returned to the teachers and forwarded to the researchers.

Results

Hazard awareness and risk perceptions

The children were asked to identify the two most likely hazards that could affect them in Christchurch. Table 1 shows that the hazards children felt most likely to affect them were storms with high winds, and earthquakes; these were followed in order of decreasing likelihood by grass or forest fires then floods. Perceived as least likely were volcanic eruptions, tsunami, tornadoes and heavy snow storms by less than 7% of respondents. In a report on the affects of hazards in Christchurch (Christchurch Engineering Lifelines Group, 1997), heavy snow storms were reported to have the lowest return period, followed equally by tsunami, storms with high winds, and destructive earthquakes (Modified Mercalli Intensities (MM) VII to MMVIII), with floods having the highest return period. Volcanic activity was not considered to be a hazard in Canterbury and tornadoes and forest fires were not discussed. The last large snowstorm to affect Christchurch was in 1992, the year most of these children were born.

Table 1. Rank order of the two hazards perceived to be the most likely in Christchurch

Hazard	% (n = 102)
Storm with high winds	54.4
Earthquake	53.4
Grass or forest fires	37.9
Flood	27.2
Volcanic eruption	6.8
Large sea wave (tsunami)	2.9
Tornado	1.0
Heavy snow storm	1.0

Children ranked the likelihood of future hazard occurrence and perceived physical risk in the event of each hazard on a 3-point scale (likely = 1, a chance = 2, unlikely = 3). The ranked order of hazards most likely to occur in the future reflected that of the hazards most likely to affect Christchurch with the exceptions of a) heavy snow storms endorsed as more likely to occur than volcanic eruptions, and b) tornadoes endorsed more than tsunami (both incorrect). The hazards perceived as most likely to cause injury were tornadoes, by over half the children, followed by earthquakes and volcanic eruptions. Most of the hazards were perceived as having better than 'a chance' (mean < 2.0) of causing injury except for floods and heavy snow storms.

A significant majority of children correctly identified that the Christchurch area does not have any active volcanoes (Table 3). However 11% of the children did perceive there to be active volcanoes in the area which accounts for volcanic eruptions not being the hazard least considered likely to affect Christchurch. Less than a quarter of the children know what the Alpine Fault is, but of those who do two-thirds are aware that Christchurch could be affect by an earthquake caused by the fault. Large earthquakes (~ Magnitude 8) occur on the central Alpine Fault at roughly on average 500 year intervals with the last event approximately 550 years ago. Shaking intensities in Christchurch generated by a central Alpine Fault event would be MMVII to MMVIII. Not only would there be direct damage caused by the event, but the activity of the nearby active faults in the Canterbury foothills and mountain areas may be increased in the following years (Christchurch Engineering Lifelines Group, 1997).

Table 2. Hazards perceived as likely to occur and likely to cause injury (likely = 1, a chance = 2, unlikely = 3)

(n = 102)	% endorsing likely to occur in future	Mean	SD	% endorsing likely to cause injury	Mean	SD
Storm with high winds	54.4	1.5	0.6	28.2	1.9	0.7
Earthquake	48.5	1.6	0.6	46.6	1.6	1.0
Grass or forest fires	48.5	1.6	0.7	33.0	1.9	0.8
Flood	19.4	2.0	0.7	24.3	2.0	0.7
Heavy snow storm	9.7	2.4	0.7	19.4	2.1	0.7
Volcanic eruption	6.8	2.7	0.6	44.7	1.8	0.8
Tornado	5.8	2.6	0.6	51.5	1.7	0.8
Large sea wave (tsunami)	5.8	2.6	0.6	37.9	1.8	0.8

Table 3. Volcano and Alpine Fault awareness

	n	% endorsing "Yes"	% endorsing "No"
Does the Christchurch area have any active volcanoes?	102	11	84
Do you know what the Alpine Fault is?	102	20	75
If yes, would an earthquake caused by the Alpine Fault affect Christchurch?	21	67	33

Hazard exposure and factual knowledge of risk mitigation and safety behaviours

Earthquakes are the hazard reported to have been experienced by the most children (Table 4). A majority also report to having been in a storm with high winds, seen a volcanic eruption on television or seen a house or building on fire. Fortunately, only a minority (<20%) have had first hand experience with a fire in their home or had their house flooded.

Table 4. Hazard exposure

Have you ever…	% endorsing "Yes"(n=102)
Had your house flooded	15
Seen a volcanic eruption – On TV	67
Seen a volcanic eruption – Live	1
Had a fire in your home	19
Seen a house or building on fire	61
Felt an earthquake	76
Been in a storm with high winds	52
Been in a storm with heavy snow falls	26

Tables 5 through 11 present the children's reported knowledge of risk mitigation and safety behaviours for floods, volcanic eruptions, earthquakes, storms with high winds, storms with heavy snowfalls and house fires. The items highlighted in dark yellow are the safety-related responses encouraged by Civil Defence and the items highlighted in light yellow are the other responses considered correct. For all hazards asked nearly three-quarters of the children knew at least one safety-related response encouraged by Civil Defence for each hazard. For volcanic eruptions and earthquakes there is a second encouraged response; these were known by 44% and 66% of children respectively. Other actions considered correct were not as well known, ranging between 20%–55% of the children choosing the action. Incorrect actions were chosen by less than 20% of the children with the exceptions of closing all windows in storms with high winds, which was selected by 71%, and finding something to hold on to when outside during an earthquake, selected by 32%. Table 12 shows that tsunami and storms with heavy snowfalls were the hazards that had a majority of the children choosing only the correct actions for (i.e. knew what to do and what not to do). A third of the children selected only the correct responses for earthquakes and house fires. Correct actions for volcanic eruptions, floods and storms with high winds were poorly known (by 17% of children or less). Only one child consistently chose the correct actions for all the hazards.

Table 5. Correct actions knowledge for floods (dark yellow are the safety-related responses encouraged by Civil Defence, light yellow are the other responses considered correct)

FLOODS	% endorsed (n=102)
Move to area higher than flood level	85
Listen to the radio	53
Stay inside and wait to be told what to do	26
Go outside and look at the rising water	0

Table 6. Correct actions knowledge for volcanic eruptions

VOLCANIC ERUPTION	% endorsed (n=102)
If building is in immediate danger, evacuate at once	83
If building is not in immediate danger, stay inside	44
Close all the windows and doors	54
Listen to the radio	55
Open all windows and doors	6
Go outside and look at the eruption	1

Table 7. Correct actions knowledge for house fires

HOUSE FIRE	% endorsed (n=102)
Leave by the shortest route	95
Close any doors that you pass through	41
Listen to the radio	12
Open all doors and windows	8
Stay inside and wait to be told what to do	3

Table 8. Correct actions knowledge for earthquakes

EARTHQUAKE	% endorsed (n=102)
Stay inside and take cover in a doorway, under beds or tables	89
Curl into a turtle shape and protect your head (Duck, cover, hold)	66
If you are outside, find a tree or something sturdy to grab on to	32
Stay right where you are and wait for it to be over	3
Run outside	1

Table 9. Correct actions knowledge for storms with high winds

STORM WITH HIGH WINDS	% endorsed (n=102)
Stay inside	79
Open window on side of house away from the wind (sheltered side)	20
Close all windows	71
Do nothing, just wait for it to be over	11
Run outside and take cover	6
Open window on side of house closest to wind (unsheltered side)	3

Table 10. Correct actions knowledge for tsunami

TSUNAMI	% endorsed (n=102)
Go at least 1km inland or 35m above sea level	92
Stay inside	18
Run outside and take cover	7
Watch for the sea wave to come	1
Go to the beach to inspect the effects of the tsunami	0

Table 11. Correct actions knowledge for storm with heavy snowfalls

STORM WITH HEAVY SNOWFALLS	% endorsed (n=102)
Stay inside and listen to the radio	74
Prepare for electrical failures	74
Run outside and play in the snow	15
Encourage your family to go driving in the snow to see how bad it is	1

Table 12. Percentages of children who chose only correct actions

HAZARD	% children choosing completely correct actions (n=102)
Tsunami	70
Storm with heavy snowfall	53
House fire	34
Earthquake	33
Volcanic eruption	17
Flood	15
Storm with high winds	9

Hazard education

Table 13 presents information on the proportions of children who participated in education programmes aimed at hazard awareness and preparedness, and follow-up behaviours of these programmes. Approximately three-quarters of the children reported participating in a hazard education programme. These programmes were generally carried out in school by Civil Defence personnel or a teacher. The majority of children reported participating in a programme before 2001 and in 2002 and with just over a quarter participating in a programme in 2003. The mean number of hazard education programmes participated in was 2.9 (SD 1.4). The majority of children have been encouraged to discuss hazards/emergencies with their parents and virtually the same proportion have discussed what they learned in the programme with their parents. Following these discussions nearly two-thirds of the parents wanted to discuss further how to be prepared.

Table 13. Information on hazard education programme participation

	% endorsed (n=102)
Participated in hazard education	75
In School	95
Outside School	22
Education by teacher	53
Education by civil defence	71
Education by other	19
Participated in education in 2003	30
Participated in education in 2002	52
Participated in education in 2001	47
Participated in education before 2001	55
Encouraged to discuss hazards with parents	59
Discussed education programme with parents	58
Parents want to discuss how to be prepared	63

Preparedness

Unsurprisingly, most of the children have participated in emergency practices at school (Table 14), as fire drills are compulsory in schools. In general, less than a third of the children have participated in emergency practices at home and know of emergency plans. Table 15 lists preparedness measures and hazard adjustment adoptions recommended by Civil Defence and the Fire Service. A majority of the children reported having key items such as torches, first aid kits, smoke detectors, a store of emergency equipment, radio and spare batteries and someone who knows how to provide first aid. Key earthquake hazard adjustments such as strapping water heaters, latching cabinet doors, adding lips to shelves etc. are reported by the children to be less adopted (35% or less). This may be a reflection of the children's age and knowledge/awareness of such items in the home, but does reflect a trend found in surveys of older children and adults (e.g.(Johnston et al., 2001; Mileti and Darlington, 1995; Russell et al., 1995). The essential emergency kit Civil Defence encourages all households to have consists of a torch, food and water for three days, transistor radio and batteries, and a first-aid kit all stored together ready for an emergency. Less that 15% of children reported having all the requirements for an emergency kit.

Table 14. Information on preparedness plans and practices

Preparedness plans and practices	% yes responses (n=102)
Family emergency plan	37
Practice for an emergency at home	30
Practice for an emergency at school	86
Plan showing exits, assembly areas, utility switches	16
Plan where to meet or leave a message in an emergency	23
Plan for collection from school in an emergency	32

Nearly three-quarters of the children knew at least one safety-related response encouraged by Civil Defence

Table 15. Preparedness measures and hazard adjustment adoptions

PREPAREDNESS MEASURES	% endorsed (n=102)
Have a torch	85
Have a first aid kit	80
Have a smoke detector	78
Someone in family has learned to provide first aid	68
Store emergency equipment (e.g. torches, fire extinguisher, first-aid kit)	57
Have a transistor radio and spare batteries	55
Someone in family has learned how to put out fires	49
Store hazardous materials safely	44
Stockpile water and food for three days	36
Strap water heater	35
Find out if you are in an area particularly vulnerable to a natural or other kind of hazard (e.g. earthquake, flood)	34
Put strong latches on cabinet doors	31
Pick an emergency contact person outside your area	31
Have a fire extinguisher	27
Rearrange breakable household items	20
Bolt house to foundation	20
Install flexible piping to gas appliances	16
Brace house walls	13
Put spanner or wrench by gas turn-off valve	12
Add lips to shelves to keep things from sliding off	12
Arranged bracing for pile foundation	5
Have "Emergency Kit"	15

Schools Comparison

Schools in Auckland and Washington State, USA have participated in similar studies (Johnston et al., 2001; Ronan and Johnston, 2001a). Following is a comparison of the results of the three regions (Tables 16 through 24) to see how Christchurch children's awareness, preparedness and education compare to the other regions' children. Only correlated questions have been included as the survey questions varied due to the regions' different hazard environments.

Hazard exposure and factual knowledge of risk mitigation and safety behaviours

The Christchurch children generally have better knowledge of vital safety behaviours (dark yellow) than the children from the other regions. Auckland children had better knowledge of the other safety behaviours (light yellow) compared with Christchurch and Washington children. Christchurch children, however, consistently chose fewer incorrect responses than the other children.

Table 16. Correct actions knowledge for floods (dark yellow are the safety-related responses encouraged by Civil Defence, light yellow are the other responses considered correct)

FLOODS	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Move to area higher than flood level	85	75	83
Listen to the radio	53	61	41
Stay inside and wait to be told what to do	26	39	18
Go outside and look at the rising water	0	10	21

Table 17. Correct actions knowledge for volcanic eruptions

VOLCANIC ERUPTION	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
If building is in immediate danger, evacuate at once	83	62	79
If building is not in immediate danger, stay inside	44	56	54
Close all the windows and doors	54	75	56
Listen to the radio	55	68	51
Open all windows and doors	6	5	0
Go outside and look at the eruption	1	8	29

Table 18. Correct actions knowledge for house fires

HOUSE FIRE	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Leave by the shortest route	95	79	93
Close any doors that you pass through	41	50	32
Open all doors and windows	8	29	14
Stay inside and wait to be told what to do	3	12	4

Table 19. Correct actions knowledge for earthquakes

EARTHQUAKE	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Stay inside and take cover in a doorway, under beds or tables	89	86	64
Curl into a turtle shape and protect your head (Duck, cover, hold)	66	58	67
Stay right where you are and wait for it to be over	3	12	20
Run outside	1	5	13

Table 20. Correct actions knowledge for storms with high winds

STORM WITH HIGH WINDS	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Stay inside	79	78	78
Open window on side of house away from the wind (sheltered side)	19	37	9
Close all windows	71	58	50
Do nothing, just wait for it to be over	11	21	30
Run outside and take cover	6	7	2
Open window on side of house closest to wind (unsheltered side)	3	10	6

Table 21. Correct actions knowledge for tsunami

TSUNAMI	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Go at least 1km inland or 35m above sea level	92	76	88
Stay inside	18	29	14
Run outside and take cover	7	11	0
Watch for the sea wave to come	1	5	14

Hazard education

A higher percentage of Christchurch children have participated in hazard education programmes than children from the other regions (Table 22). The majority of this education was provided by civil defence personnel, compared to a nearly equal share of CD and teachers in Auckland and primarily teachers in Washington State. More Christchurch children were encouraged to discuss hazards with their parents, and did so, compared to those from Auckland, but less than the children from Washington State. Less Christchurch parents were reported to want to discuss further how to be prepared than Washington State parents.

Table 22. Information on hazard education programme participation across the three regions

	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Participated in hazard education	75	70	65
In School	95	n/a	97
Outside School	22	n/a	21
Education by teacher	53	49	93
Education by civil defence	71	47	9
Education by other	20	17	17
Encouraged to discuss hazards with parents	59	43	77
Discussed education programme with parents	58	29	61
Parents want to discuss how to be prepared	63	n/a	82

Preparedness

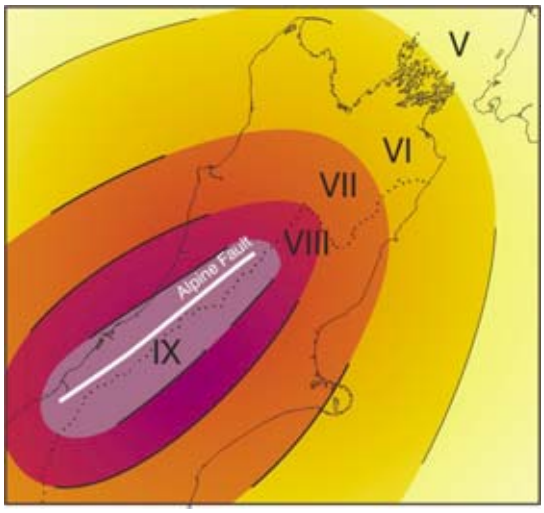
Christchurch children have reported similar to lower numbers of plans and practices than the other children. Preparedness measures could only be compared with those of Washington State Children. For every measure consistently fewer Christchurch children reported having the item.

Table 23. Information on preparedness plans and practices across the three regions

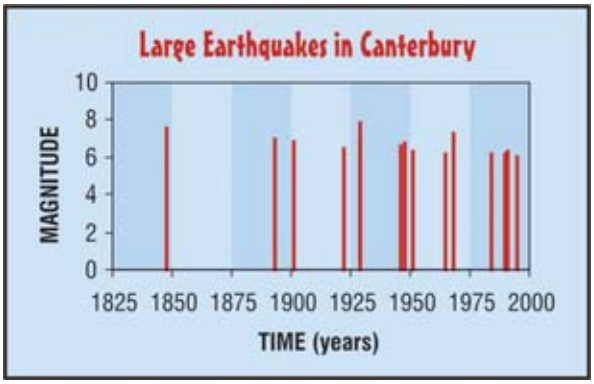
Preparedness plans and practices	Christchurch % (n=102)	Auckland % (n=409)	WA % (n=327)
Family emergency plan	37	29	33
Practice for an emergency at home	30	26	32
Practice for an emergency at school	86	~ 80	93
Plan showing exits, assembly areas, utility switches	16	24	19
Plan where to meet or leave a message in an emergency	23	34	36
Plan for collection from school in an emergency	32	52	55

Table 24. Comparison of preparedness measures and hazard adjustment adoptions

Preparedness measures	Christchurch % (n=102)	WA % (n=327)
Have a torch	85	94
Have a first aid kit	80	88
Have a smoke detector	78	95
Someone in family has learned to provide first aid	68	75
Have a transistor radio and spare batteries	55	73
Someone in family has learned how to put out fires	50	62
Store hazardous materials safely	44	48
Stockpile water and food for three days	36	48
Strap water heater	35	36
Find out if you are in an area particularly vulnerable to a natural or other kind of hazard (e.g. earthquake, flood)	34	46
Put strong latches on cabinet doors	31	19
Pick an emergency contact person outside your area	31	38
Have a fire extinguisher	27	80
Rearrange breakable household items	20	25
Bolt house to foundation	20	33
Install flexible piping to gas appliances	16	20
Put spanner or wrench by gas turn-off valve	12	24
Add lips to shelves to keep things from sliding off	12	13



Source: Geological and Nuclear Sciences New Zealand



Source: Geological and Nuclear Sciences New Zealand

Awareness of the Alpine Fault and the impact of an event greatly needs to be increased

Summary

The findings from this survey highlight the need for continuing hazards education a) to increase understanding of the hazard types and impacts the Christchurch community could face and b) to improve household preparation. The children's awareness of hazards impacting Christchurch was fairly accurate; however, the awareness of the risk from storms with heavy snow falls and tsunami was very poor. Awareness of the Alpine Fault and the impact of an event greatly needs to be increased considering the level of threat posed to Christchurch and the 'overdue' nature of an earthquake generated along the central Alpine Fault. Vital safety behaviours were well known by the children, with other safety behaviours not as well known. However, incorrect behaviours were rarely chosen, indicating that overall the children generally have a good knowledge of safety behaviours. A significant majority of the children have participated in a hazard education programme, generally at school conducted by Civil Defence personnel. Preparedness plans and practices were reported to be poorly adopted by the children's household. Only emergency practices at school had a majority of children participating. Torches, first aid kits and smoke detectors were the principal preparedness measures reported to have been adopted by the children's families. Less than one fifth of children reported having an emergency kit prepared. Compared to children who have participated in similar studies in Auckland and Washington State, Christchurch children generally have better knowledge of safety behaviours and a greater number have participated in education programmes, but fewer children report having preparedness plans, practices and measures.

Improvement in Christchurch might simply involve adjusting the content and delivery of education programmes. It has been found in other research that an emergency management focused programme that emphasises children's interactions with their parents can increase home preparedness (Ronan & Johnston 2001, 2003). For example, providing children with homework to fill out a home preparedness checklist might be one avenue to translate increased knowledge into useful actions.

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