ORIGINAL ARTICLE

Risk factors for childhood drowning in rural regions of a developing country: a case–control study

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Background: Descriptive epidemiological studies have shown that childhood drowning rates are higher in developing countries, with an increasing trend in rural areas.
Aim: To examine risk factors associated with childhood drowning in rural China.
Methods: Participants included parents of all children aged 1–14 years who died of drowning between 2002 and 2004 in 20 districts in GuangXi Province, and two age- and gender-matched controls each. Behavioral characteristics of the child and the children's caregivers were collected using a questionnaire and analyzed using logistic regression.
Results: Boys (60%) and children aged 1–4 years (48%) were over-represented among the cases; 62% occurred within 500 m of the school or home. Protective fencing or warning signs were found at only two sites. None of the children's caregivers knew how to perform cardiopulmonary resuscitation. For children aged 1–4 years significant risk factors included poor health of the caregiver (OR 3.1; 95% CI 1.9 to 5.8), not using flotation devices (OR 2.3; 95% CI 1.4 to 4.5) and no proper swimming lessons (OR 1.8; 95% CI 1.1 to 5.5). For children aged 5–14 years, the main risk factors were that the child did not have the experience of playing near or in water regularly (OR 2.7; 95% CI 1.8 to 7.4) and lack of close supervision (OR 1.9; 95% CI 1.3 to 5.6).
Conclusion: Risk factors identified in this study suggest that childhood drowning in rural areas in developing countries could be prevented by providing safety educational programs, which should focus on constant adult supervision and the use of flotation devices when children play in and near water.

Childhood drowning is a leading cause of mortality from injury.[1] In 2000, nearly 450 000 people drowned worldwide, accounting for 9% of the global injury-related deaths, with over half of them being children aged 0–14 years.[2] In the US, this is the second leading cause of unintentional deaths from injury among children and adolescents aged 1–19 years.[3] It is also the leading cause of death among children aged 1–4 years in several European countries.[4] A majority of drownings occurred in low- and middle-income countries; the death rate was 13.1 per 100 000 population in Africa[2] and 7.6 in Mexico.[5] In Vietnam, seven of nine drowning cases were of children <15 years,[6] and in Thailand, 35% of deaths from injury among school children were due to drowning,[7]which was 13.1/100 000.

In China, drowning is the leading cause of death from injury for children aged <14 years,[8] and accounted for 40% of all deaths from injury.[9] The incidence rate per 100 000 population varied from 1.86 in JiangXu, to 10.2 in GuangXi and 13.4 in XianMen.[9–11] Drowning occurred more often in rural areas than in cities. For children aged 1–4 years, the mortality due to drowning was as high as 21.1/100 000 population in rural China.[12]

Many survivors of near-drowning have permanent neurological disabilities. For each death from drowning, an estimated 1–4 non-fatal submersions were serious enough to result in hospitalization.[13] Children who still required cardiopulmonary resuscitation (CPR) at the time they arrived at emergency departments had a poor prognosis, with at least half of the survivors having significant neurological impairment.[14] This again was more serious in rural areas as immersions in swimming pools and domestic bathtubs have a 60% survival rate compared with a 5% survival rate for similar immersions in creeks and rivers.[2]

Many epidemiological studies have shown that isolation fencing, which separates a swimming pool from a house and yard, is effective.[15] However, there are few private swimming pools in the rural regions of developing countries. Almost all research on drowning in low-income countries to date consists of descriptive studies aimed at determining incidence and trends.[16] Like many injuries, childhood drowning is preventable; any modifiable risk factors identified could point to prevention strategies. As a majority of drownings occurred in underdeveloped or developing countries,[5] we initiated this study to examine risk factors associated with childhood drowning in rural areas of a developing country.

METHODS

Study design and subjects

Drowning is defined as the process of experiencing respiratory impairment from submersion/immersion in a liquid medium. Although the definition includes both fatal and non-fatal cases, we referred only to deaths related to these impairments in this study.

This was a case–control study. Using a stratified approach, 11 districts in a costal township and 9 districts in an inland township in the GuangXi Province were randomly selected. This province has a total population of approximately 48 million, with about 2.5 million residents in the selected districts. Randomization was carried out by listing all townships and districts in an SPSS file, using the ''random cases'' command to select a sample. We attempted to find drowning cases by searching the database of the registry of deaths held by the local Birth Planning Committee, the function and operation of which is similar to the Births and Deaths General Register

Abbreviation: CPR, cardiopulmonary resuscitation

Office. All cases registered between January 2002 and December 2004 were identified. When identifying drowning victims, death and health status were categorized using the *International Classification of Diseases*, 10th revision, codes W65–W74. For a case to be included victims were required to be aged 1–14 years when the incident took place. Controls were recruited by randomly selecting households in the districts adjacent to where each case lived, until two children from different households had been identified. Randomization was performed by selecting first the street, and then dwellings in the street, from the list provided by local councils. Adjacent districts were chosen because the same interviewers could be employed to minimize inter-interviewer variability. Controls were matched precisely for age and gender, and did not have any drowning or near-drowning history in the previous 36 months. Ethical approval was granted by GuangXi Medical University and informed consent was obtained from all parents before data collection. Particular care was taken to minimize the discomfort experienced by parents of the victims. This was achieved by providing training workshops, conducted by clinical psychologists experienced in interviewing vulnerable populations, for the research fellows who conducted the interviews.

Interviews

A semistructured questionnaire was used to collect information related to the death of the cases: when, where and how it took place. On the basis of the literature review, a 36-item questionnaire was developed by a group of local researchers (healthcare professionals and pediatricians) experienced in childhood injuries, all of whom had at least 5 years of relevant experience. The questionnaire, which mainly consisted of multiple-choice questions, took approximately 20 min to administer. Expert validity was carried out by an independent group of specialists with similar backgrounds. The questions included sociodemographic and behavioral profiles of the cases and controls, health status of the child and the main caregiver, and other potential risk factors such as access to healthcare facilities in the district and environment adjacent to the dwellings.[13 17–20]

We interviewed the parents of all but 11 controls. The grandparents of the 11 controls were interviewed because the parents were unavailable. The parents of all the victims were interviewed. However, with respect to questions relating to how the drowning occurred, if the parent was not present at the scene, the children's caregivers (n = 78) or eyewitnesses (n = 15 adult neighbors) were interviewed. As the education level of the participants was generally low, the questionnaire was filled in by the researcher conducting the interview; they would articulate on any item only when requested.

Pilot study

A pilot study was carried out in one district selected from the coastal township of HePu; with 6 cases and 12 controls. The aim was to test and refine the questionnaire and recruitment process, and to standardize the interviewing procedures. No items were added after the pilot study, and none of the 36 items were removed, but minor changes were made to several questions when the participants expressed difficulty in understanding or responding to those items. Inter-rater reliability was tested using the following procedures: for half of the sample one researcher asked all the questions; the researcher and an observer from the research team filled in the questionnaire independently; they switched their roles for the rest of the sample. Reliability was judged acceptable as the κ statistic for 27 of the 36 items was one, and none was below 0.65. For six items where κ could not be computed (eg, number between-subject variations), percentage agreement was used and it was 100% for five of the items. For ethical reasons, test–retest reliability which was carried out 2 weeks apart was only conducted on controls. Similar κ statistics and percentage agreement results were obtained.

Data analysis

Pearson's χ^2 was used to test the differences between cases and controls. Multivariate logistic regression was used to identify factors associated with drowning. We considered conditional logistic regression inappropriate because matching was carries out mainly to control for the potential confounding effects of age and gender; cases and controls were still unmatched on many variables. All analyses were performed using SPSS V.12.0.

RESULTS

A total of 133 cases were found. Accordingly, 266 controls were recruited. Table 1 shows drowning was more common among boys and among children aged 1–4 years. Cases and controls were similar with respect to sociodemographic characteristics. The only variable that was significantly different between the two groups was whether the child had severe disease, but the number was too small to be practically significant. We also noticed that the education level of the parents, whether they

Table 1 Differences in sociodemographic characteristics between cases and controls

	Cases (n = 133), n (%)	Controls (n = 266), n (%)	p Value
Age group (years)			NA
1–4	64 (48.1)	128 (48.1)	
5–9	40 (30.1)	80 (30.1)	
10–14	29 (21.8)	58 (21.8)	
Sex			N/A
Male	80 (60.2)	160 (60.2)	
Female	53 (39.8)	106 (39.8)	
Does the child attend school / kindergarten?			0.076
Yes	72 (54.1)	119 (44.7)	
No	61 (45.9)	147 (55.3)	
Did the child have severe disease (eg, high blood pressure)			0.036
Yes	3 (2.3)	0 (0)	
No	130 (97.7)	266 (100)	
Father's occupation			0.847
Farmer	121 (91.0)	243 (91.4)	
White-collar worker	7 (5.3)	14 (5.3)	
Other	5 (3.8)	9 (3.4)	
Father's education level			0.927
Senior high school or above	12 (9.0)	27 (10.2)	
Junior high school	38 (28.6)	77 (28.9)	
Primary school or lower	83 (62.4)	162 (60.9)	
Mother's education level			0.496
Senior high school or above	9 (6.8)	21 (7.9)	
Junior high school	33 (24.8)	79 (29.7)	
Primary school or lower	91 (68.4)	166 (62.4)	
Annual household income (RMB)			0.650
⩽3000	71 (53.4)	129 (48.5)	
3001–5000	39 (29.3)	85 (32.0)	
>5000	23 (17.3)	52 (19.5)	

NA, not applicable; RMB, RenMinBi.

Table 2 Differences in health behaviors between cases and controls and their caregivers (whole group)

	Cases (n = 133), n (%)	Controls (n = 266), n (%)	p Value
How often does the child play near water?			0.064
Regularly (more than once a day)	118 (88.7)	250 (94.0)	
Not often	15 (11.3)	16 (6.0)	
Did the child have proper swimming lessons?			0.103
No	124 (93.2)	234 (88.0)	
Yes	9 (6.8)	32 (12.0)	
Did the child wear a life-jacket when swimming/ playing near water?		0.056	
No	122 (91.7)	226 (85.0)	
Yes	11 (8.3)	40 (15.0)	
Child's personal character			0.040
Active	12 (9.0)	48 (18.0)	
Inactive	48 (36.1)	97 (36.5)	
In between	73 (54.9)	121 (45.5)	
Child's main caregiver			0.072
Mother	45 (33.8)	121 (45.5)	
Grandparents	74 (55.6)	118 (44.4)	
Others	14 (10.5)	27 (10.2)	
General health of child's caregiver			0.030
Good	113 (90.4)	239 (96.0)	
Poor	12 (9.6)	10 (4.0)	
Can the child's caregiver swim?			0.608
No	96 (72.2)	197 (74.1)	
Yes	37 (27.8)	69 (25.9)	
Was there close and constant supervision by the child's caregiver?			<0.001
No	56 (42.1)	57 (21.4)	
Yes	77 (57.9)	209 (78.6)	
Does the child's caregiver know how to perform CPR?*			n/a
No	133 (100)	266 (100)	
Yes	0 (0%)	0 (0)	
Can someone in the village perform CPR?*			0.197
No	83 (62.4)	148 (55.6)	
Yes	50 (37.6)	118 (44.4)	

*CPR, cardiopulmonary resuscitation.

Table 3 Differences in health behaviors between cases and controls and their caregivers by age group*

	Cases (n = 64), n (%)	Controls (n = 128), n (%)	p Value
Aged 1–4 years			
Did the child have proper swimming lessons?			0.079
No	63 (98.4)	118 (92.2)	
Yes	1 (1.6)	10 (7.8)	
Did the child wear a life jacket when swimming/ playing around water?		0.048	
No	62 (96.9)	113 (88.3)	
Yes	2 (3.1)	15 (11.7)	
General health of the child's caregiver			0.004
Good	55 (85.9)	124 (96.9)	
Poor	9 (14.1)	4 (3.1)	
Aged 5–14 years	(n = 69) n(%)	(n = 138) n(%)	
How often did the child play near water?			0.015
Regularly (more than once a day)	57 (82.6)	129 (93.5)	
Not often	12 (17.4)	9 (6.5)	
Child's personal character			0.035
Inactive	26 (37.7)	60 (43.5)	
Active	4 (5.8)	22 (15.9)	
In between	39 (56.5)	56 (40.6)	
Was there close and constant supervision by the child's caregiver?			<0.001
No	42 (60.9)	35 (25.4)	
Yes	27 (39.1)	103 (74.6)	

*Only significant or near significant differences are reported in this table.

belonged to the ''case'' or ''control'' group, was generally low, with >60% having only primary education.

A majority of the cases (n = 85; 64%) simply lost their footing and fell into the water, and a further 29% (n = 38) drowned while swimming. None of the deaths by drowning were intentional. Nearly two-thirds (n = 82) of the incidents occurred within 500 m of the home or school. Most cases (n = 109; 82%) died at the scene, and a further 7% (n = 9) died on the way to hospitals or healthcare facilities. The incidents occurred mainly in the summer months (July–September; n = 61; 46%) and warmer months (April–June; n = 44; 33%), and during daytime (11:00 to 15:00 h; n = 86; 65%). Nearly 75% (n = 99) of the incidents occurred in ponds (34%), rivers (26%) or lakes (14%). No cases occurred in a swimming pool. Children aged <4 years were over-represented in drowning in ponds (n = 37; 58%), whereas older children drowned more frequently in rivers (n = 26; 38%). Fences were found at only two of the places, and only two places had warning signs erected.

Table 2 shows the differences in health behaviors between cases and controls, as well as between their main caregivers. A slightly higher proportion of children in the case group were looked after by their grandparents (56% vs 44%), although the difference was marginally non-significant. It was therefore not surprising that more caregivers of children in the case group had poor health (10% vs 4%). More children's caregivers in the control group reported that they had provided constant and close supervision of the child when the child was playing in or near water (79% vs 58%, p<0.001). The use of a lifebuoy or any form of floatation devices when swimming (15% vs 8%, p = 0.056) seemed to provide some protective effect. None of the main caregivers knew how to perform CPR.

We performed the analyses presented in table 2 separately for the two age groups. Table 3 shows the significant or near significant results. The most noticeable difference was that the risk factors were completely different between the two age groups. For the age group of 1–4 years, constant and close supervision was reported by 78% of the case group and 83% of the controls (p = 0.433), whereas the proportion was significantly lower for cases (39% vs 75%; p<0.001) in the age group of 5–14 years. More control children aged 1–4 years wore a life jacket when swimming; however, the percentage (11.7%) was still low.

Multivariate logistic regressions, stratified by age groups, were fitted to examine factors associated with drowning (table 4). Risk factors identified were consistent with univariate

Table 4 Multivariate logistic regression results showing factors associated with rural drowning

Factor	OR (95% CI)	p Value
Age Group 1–4 years		
Poor health of the child's caregiver	3.1 (1.9 to 5.8)	0.016
Child not using flotation devices when swimming	2.3 (1.4 to 4.5)	0.027
Child did not receive proper swimming lessons	1.8 (1.1 to 5.5)	0.039
Age Group 5–14 years		
Child did not often play beside the water	2.7 (1.8 to 7.4)	0.026
Lack of constant supervision when the child swims	1.9 (1.3 to 5.6)	0.033

results. For children aged 1–4 years, they were (1) poor health of the caregiver, (2) not using flotation devices in or near water and (3) no proper swimming lessons. For children aged 5–14 years, significant risk factors included (1) the child did not have a habit of playing near water regularly; and (2) lack of close and constant supervision.

DISCUSSION

Previous studies indicate research on childhood drowning has been descriptive in nature, reporting the trends or incidence rates with relatively few studies investigating risk factors.[21–24] This is the first study examining risk factors associated with childhood drowning in rural areas in a developing country. Not only was the incidence rate in rural China higher than that in cities,[12] this trend was also observed in Western countries. An Australian study found that the incidence rate among children aged 0–4 years increased by 0.4% annually in the Northern Territory whereas the rate decreased by 5% in other states between 1983 and 1998.[25] Drowning of toddlers in swimming pools was uncommon in Tasmania; however, there were relatively more drownings in dams and ponds, a hazard associated with rural living.[26] Higher incidence was found in coastal regions, and in inland provinces. The KweiZhou province of China has few water networks, but drowning was the second leading cause of injury-related mortality for children aged <5 years. Incidents occurred in open spaces, such as public septic tanks in remote villages and farms or drinking-water wells in private dwellings.[27]

This study found that children aged 1–4 years were at higher risk. In developed countries, drowning among children aged 1–4 years occurred most often in residential swimming pools.[1 24 28] However, none of the incidents in this study occurred in a swimming pool. In fact, almost no families in rural China had a swimming pool at home. Most drownings occurred in rivers, ponds or lakes close to schools or homes. This proves to be a major health risk to rural populations. Boys have consistently been found to be at higher risk, [2 5 13 23 28] with the relative risk reported to be approximately 1.6 in China.[8 12] Our study also had more boys than girls among the cases. Previous research reported that children, especially boys, who are more active and bold are at higher risk of injury-related mortality and morbidity.[29] However, in this study, more active children and those who often played near water networks were found to have a lower risk. This could imply that as long as precautionary measures, such as using a lifebuoy, are taken, a more active person might be able to react to sudden changes of water and other conditions in a timely manner. It could also imply that swimming lessons might be protective even for younger children. As the number of cases was small (table 2), more data are required to test both hypotheses. On the other hand, because of the outdoor nature of the activities and the fact that bath tubs are rarely available to rural families in China, it was not surprising to have observed more drowning cases in warmer months. This is consistent with results found in other studies.[29]

Childhood drowning is preventable. Previous studies found that the lack of effective barriers between the dam and children was a risk factor,[17] and that installation of fences around swimming pools could help reduce the incidence rate.[30] In the present study, fencing or warning signs were found at only two places. There are hardly any fences next to rivers, ponds or lakes in rural China. Empirical data from this study and previous research confirmed that drowning occurred mostly within a few hundred meters of the home or school.[17] Hence, installation of barriers next to water networks near residential areas should be seriously considered by regional governments in rural areas.

A study found that providing an educational program on drowning to parents could help to reduce the childhood drowning rate by 40%, as compared to an increase of 26% in the control group.[31] Most young children who drowned in pools had been out of sight for only a few minutes.[4 22] Our study showed that lack of close and constant supervision by the caregiver was associated with an increased risk for children aged >5 years. Strict supervision at all times when the child is playing in or near water should therefore be an effective preventive measure. Parents and children's caregivers could be educated through special educational programs.

Many victims in this study died before they arrived at hospitals. This could be because GuangXi, which is in south-western China, is economically less advanced and because there are few hospitals in small villages. It may therefore be important to provide first-aid training in drowning to clinicians in health clinics in the villages. As none of the children's caregivers knew how to perform CPR, teaching local residents how to perform CPR as well as how to react appropriately under those circumstances could also be included in the training. More studies are needed on practical issues related to the implementation of such training, perhaps including economic research to study the cost-utility of providing lifebuoys.

Smoking and alcohol consumption by parents, which could be related to the parents' education level, have been shown to be associated with childhood injury.[18] Most residents in rural China are farmers and have a relatively low education level. In this study, many participants had only primary education; this sample was, therefore, not ideal for the investigation of the association between childhood drowning and parents' educational level.

This study has several limitations. An inherent problem with case–control studies is that recall bias could potentially be present as a consequence of the event experienced by the participants. Bereaved parents might report a higher frequency of lack of supervision, or health impairment as a consequence of the event. They might report a lower frequency of prior playing near water by the child to reduce their guilt or blame. In addition to the issues of self-report and social desirability, generalizability of the findings may be questionable as the study regions cover only a small part of China. Moreover, because controls were recruited from townships next to where cases lived, the two groups had a similar living environment. Further studies would need to be undertaken to identify more precisely other environmental risk factors.

Implications for prevention

Providing first-aid training courses in CPR in remote villages, and the installation of safety barriers such as fences next to water networks in close proximity of residential areas are potentially useful for the prevention of childhood drowning in

Key points

- Similar to other research on childhood drowning, boys and younger children are over-represented in rural areas in developing countries.
- Incidents occurred mostly in ponds, lakes and rivers, but not in swimming pools.
- Prevention strategies should include educational programs focusing on ''touch'' supervision and the use of flotation devices by infants and toddlers.
- Rural regions are relatively poor, with fewer hospitals, so prehospital care and community training programs could be more important.

rural areas. An investigation into the effectiveness of these strategies may be worth pursuing. For drowning prevention and control programs, the focus should be on ''close and constant'' supervision and safety education including the use of buoyancy vests.

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REFERENCES

1 **Brenner BA**. Childhood drowning is a global concern. *BMJ* 2002;**324**:1049–50.
2 **Peden MM**, McGee K. The epidemiology of drowning worldwide. *Injury Control Saf Promot* 2003;**10**:195–99.
3 **Brenner RA**, Trumble AC, Smith GS, *et al*. Where children drown, United States, 1995. *Pediatrics* 2001;**108**:85–9.
4 **Ellsasser G**, Berfenstam R. International comparisons of child injuries and prevention programs: recommendations for an improved prevention program in Germany. *Inj Prev* 2000;**6**:41–5.
5 **Celis A**. Home drowning among preschool age Mexican children. *Inj Prev* 1997;**3**:252–6.
6 **Huong DL**, Minh HV. Applying verbal autopsy to determine cause of death in rural Vietnam. *Scand J Public Health Suppl* 2003;**62**:19–25.
7 **Kozik CA**, Suntayakorn S, Vaughn DW, *et al*. Causes of death and unintentional injury among schoolchildren in Thailand. *SE Asian J Tropical Med Public Health* 1999;**30**:129–35.
8 **Yang KH**, Huang JJ, Chen AP. Injury rates and trends in China. *Chi J Epidemiol* 1997;**18**:142–5.
9 **Shen T**, Hsu CL. An analysis of injury related mortality among adolescent aged 20 in HsuZhou city 1997–2001. *China School Med* 2002;**16**:526.
10 **Yang L**, Liu Y, Liu DC. A survey of injury death in three cities in GuangXi. *Chi J Public Health* 2004;**20**:580–1.
11 **Chen MJ**, Rong Y, Wu KL, *et al*. Analysis of injury death among adolescents in XiaMen city 1987–1998. *China School Mede* 2001;**22**:568–9.
12 **Lin ML**, Liu YL, Mi J, *et al*. Injury mortality trend of children aged 5 or below in China. *Chinese J Child Health* 2000;**8**:28–31.
13 **American Academy of Pediatrics**. Prevention of drowning in infants, children, and adolescents. *Pediatrics* 2003;**112**:437–9.
14 **Pearn J**. Survival rates after serious immersion accidents in childhood. *Resuscitation* 1978;**6**:271–8.
15 **Harbor View Injury Prevention & Research Center website Best Practices Section on drowning**. http://depts.washington.edu/hiprc/practices/topic/drowning/index.html (accessed 20 Mar 2007).
16 **Unicef**. *A league table of child deaths by injury in rich nations*. Florence: Unicef Innocenti Research Centre, 2001.
17 **Bugeja L**, Franklin R. Drowning deaths of zero- to five-year-old children in Victorian dams, 1989–2001. *Aust J Rural Health* 2005;**13**:300–8.
18 **Li LP**, Huang G. Childhood unintentional injury: personal characteristics of parents of the victims. *J Disease Control* 1999;**3**:256–7.
19 **Liller KD**, Kent EB, Arcari C, *et al*. Risk factors for drowning and near-drowning among children in Hillsborough County, Florida. *Public Health Rep* 1993;**108**:346–53.
20 **Washington State Department of Health**. *Child Drowning Prevention*. Washington: Washington State Department of Health, 2004.
21 **Scheidt PC**, Overpeck MD, Trifiletti LB, *et al*. Child and adolescent injury research in 1998: a summary of abstracts submitted to the Ambulatory Pediatrics Association and the American Public Health Association. *Arch Pediatr Adolesc Med* 2000;**154**:442–5.
22 **Present P**. *Child drowning study: a report on the epidemiology of drowning in residential pools to children under age five*. Washington, DC: US Consumer Product Safety Commission, 1987.
23 **Smith G**, Brenner RA. The changing risks of drowning for adolescents in the US and effective control strategies. *Adolesc Med* 1995;**6**:153–70.
24 **Dowd MD**, Keenan HT, Bratton SL. Epidemiology and prevention of childhood injuries. *Crit Care Med* 2002;**30**:385–92.
25 **Edmond KM**, Attia JR, D'Este CA, *et al*. Drowning and near-drowning in Northern Territory children. *Med J Aust* 2001;**175**:605–8.
26 **Riley MD**, Larson A, Langford J. Drowning fatalities of children in Tasmania: differences from national data. *Aust NZ J Public Health* 1996;**20**:547–9.
27 **Yu KC**, Yang JH. Factors associated with 540 injury deaths in children under 5 years of age. *Chin J Child Health* 2000;**8**:366–7.
28 **Sibert JR**, Lyons RA, Smith BA, *et al*. Preventing deaths by drowning in children in the United Kingdom: have we made progress in 10 years? *BMJ* 2002;**324**:1070–2.
29 **Won KC**, Mok RM, Kuo RS, *et al*. The distribution of injury mortality of children aged 1 to 14 in GeeChen County. *Chin J Prev Med* 1995;**29**:58–60.
30 **Pitt WR**, Balanda KP. Childhood drowning and near-drowning in Brisbane: the contribution of domestic pools. *Med J Aust* 1991;**154**:661–5.
31 **Zhang PB**, Chen RH, Cheng JY, *et al*. An evaluation of the effectiveness of health education on drowning among children aged 0–4 in rural regions. *Chin J Paediatr* 2003;**41**:498–500.