Predisposing factors leading to child trauma

An analysis of specific versus non-specific causes in motor vehicle and drowning fatalities

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SUMMARY In many Western countries, trauma is the chief cause of death in children aged one to 14 years. A large number of these deaths are the result of motor vehicle accidents or drowning. It is postulated that the causes of such trauma can be classified into (a) non-specific, predetermining social factors; (b) specific social factors; and (c) acute triggers. Preventive strategies vary considerably for these three groups. Prevention is most cost-effective when directed against specific social factors. In this paper, data for childhood motor vehicle and drowning fatalities in Australia have been analysed and scored for non-specific social influences on childhood accidents such as overcrowding or poverty. This approach allows the ranking of different communities by risk. Motor vehicle accident ratios have been calculated, and these are sufficiently specific, by age and sex, to enable comparisons to be made in future with other communities.

In Australia, the United States, and many other Western countries, trauma ranks highest of all causes of death in children aged one to 14 years (Lopez and Rennie, 1969; Simpson, 1976).

Detailed analyses of the causes suggest that one or more acute triggers are superimposed on pre-determining social factors. These factors can be resolved into specific and non-specific components. Table 1 illustrates the three causal links in the chain. Any preventive campaign to reduce child trauma must define the causes under each of these three headings, and try to obtain detailed data for each one.

Acute triggers for the various forms of child trauma are reasonably well documented, but data on predisposing social factors are sketchy. No attempt has previously been made to break down such data into specific and non-specific components. This study provides reference data for the two most important causes of fatal child trauma, namely, motor vehicle traffic accidents (MVTA) and drowning accidents (DA).

For deaths from MVTA, the two types of component can easily be identified. Firstly, there are factors specific to motor vehicles and the conditions under which they operate. The numbers of vehicle

Table 1 *Some examples of the three linked causes of child trauma*

<i>Trauma</i>	<i>Non-specific causes</i>	<i>Specific causes</i>	<i>Triggers</i>
Drowning	Hot country Affluent society able to buy home swimming pools	Parental surveillance interrupted by sudden alteration in family routine Unrealistic parental expectations of child's discipline near pool Water hazards unprotected by safety barriers	Toddler attracted into water by floating toy Epileptic fit while in water Disobedient older child swims in creek
Motor vehicle deaths	Reduced public awareness of safety measures for children High level of anti-social indices Poverty, overcrowding	Large no. of vehicle registrations per unit of population, or high vehicle-per-mile figures Large no. of child cyclists Poor street lighting near pedestrian crossings Child never restrained by adequate car seat harness	Drunken driver Child cyclist swerves in path of car Child runs out on road during play into path of oncoming vehicle

registrations, the total annual mileage driven, the attitudes of society to drunken driving, and the way traffic laws are policed are all important here. The second component relates to non-specific but none the less important factors such as the kind of society (with MVTA as indicators of social violence) in which all types of accident rates are high (Jamieson and Tait, 1967; Whitlock, 1971).

When childhood drowning deaths are considered, the two components are not so easy to identify. The physical presence of an exposed water hazard (for example, an unfenced swimming pool) is an obvious specific social threat; but the fact that an unprotected pool is legally permitted reflects society's attitudes to child safety in general. A less equivocal example

of a non-specific social predeterminant of childhood drownings is the striking social class distribution of infant bathtub fatalities (Pearn and Nixon, 1977).

The recent compilation of Australian surveys of childhood drownings (Pearn *et al.*, 1976), and of age-specific MVTA death rates (Pearn, 1978), has yielded data of sufficient detail to permit some resolution of these two categories of causes, and to enable them to be placed in rank order.

Methods

Demographic data on raw accident rates were obtained from publications of the Australian Bureau of Statistics on 'Causes of death' and

Table 2 *Fatal motor vehicle traffic accident ratios by State, age, and sex*

State	Sex	Age group (years)				All ages
		0-4	5-9	10-14	15+	
Queensland	Males	0.15	0.61	0.43	0.57	0.55
	Females	0.41	0.79	0.50	0.47	0.47
	Total	0.28	0.68	0.44	0.55	0.53
New South Wales	Males	0.16	0.53	0.56	0.43	0.42
	Females	0.17	0.72	0.52	0.34	0.34
	Total	0.17	0.60	0.55	0.40	0.38
Victoria	Males	0.34	0.68	0.73	0.63	0.62
	Females	0.43	0.60	0.80	0.40	0.42
	Total	0.38	0.66	0.75	0.55	0.55
Tasmania	Males	0.33	0.75	0.50	0.51	0.51
	Females	0.20	—	0.50	0.52	0.47
	Total	0.29	0.60	0.50	0.51	0.50
South Australia	Males	0.14	0.44	0.80	0.63	0.59
	Females	0.25	0.33	0.87	0.40	0.40
	Total	0.18	0.40	0.85	0.54	0.52
Western Australia	Males	0.07	0.60	0.60	0.53	0.51
	Females	0.41	0.77	0.77	0.42	0.44
	Total	0.20	0.67	0.67	0.50	0.49
Northern Territory	Males	0.13	—	1	0.30	0.54
	Females	0.25	0.5	—	0.85	0.60
	Total	0.17	0.17	0.5	0.64	0.55
Australian Capital Territory	Males	—	—	—	—	0.52
	Females	—	—	—	—	0.40
	Total	—	—	—	—	0.48
AUSTRALIA	Total	0.24	0.61	0.61	0.49	0.47

Table 3 *Fatal drowning accident ratios by State, age, and sex*

State	Sex	Age group (years)				All ages
		0-4	5-9	10-14	15+	
Queensland	Males	0.41	0.26	0.10	0.08	0.10
	Females	0.25	0.07	—*	0.03	0.05
	Total	0.33	0.19	0.08	0.06	0.09
New South Wales	Males	0.29	0.16	0.08	0.04	0.06
	Females	0.15	0.12	0.21	0.01	0.03
	Total	0.24	0.14	0.13	0.03	0.05
Victoria	Males	0.38	0.20	0.03	0.02	0.05
	Females	0.18	0.10	—*	0.01	0.03
	Total	0.29	0.17	0.02	0.01	0.04
Tasmania	Males	—*	—*	0.25	0.05	0.06
	Females	0.50	0.33	—*	—*	0.07
	Total	0.27	0.10	0.25	0.04	0.06
South Australia	Males	0.41	0.22	—*	0.05	0.07
	Females	0.19	0.33	—*	0.03	0.05
	Total	0.31	0.27	—*	0.04	0.06
Western Australia	Males	0.37	0.16	0.16	0.05	0.07
	Females	0.23	0.06	0.06	0.02	0.04
	Total	0.32	0.12	0.12	0.04	0.07
Northern Territory	Males	0.25	0.25	—*	0.03	0.06
	Females	0.50	—	1.0	0.39	0.40
	Total	0.33	0.17	0.50	0.08	0.13
AUSTRALIA	Males	0.34	0.20	0.06	0.05	0.07
	Females	0.19	0.12	0.14	0.02	0.04
	Total	0.28	0.17	0.09	0.04	0.06

*Insufficient data

'Demography' in various States (Australian Bureau of Statistics, 1973a, 1973b).

The simplest measure of the specific threat within a community is to calculate the ratio of the total of MVTA or of DA to the total of fatal accidents in each age group and for both sexes for each State. These data are shown in Table 2 for motor vehicle traffic accidents and in Table 3 for drowning accidents. The striking feature is the similarity of the ratio for MVTA in different State populations (0.38 to 0.55) and also of the ratio for DA (0.04 to 0.13).

In ranking these risks, correction is required for differences in State populations. The most straightforward approach is to correct further the simple age-specific trauma fatality rates per 100 000 at risk, by multiplying them by the MVTA and DA ratios. This gives an index of risk called the trauma specificity index.

if preventive action were strengthened.

For example, it can be seen in Tables 4 and 5 that efforts to prevent drowning in the 0-4 age group and deaths from MVTA in the 5-9 age group would be a logical first priority in any campaign to reduce child trauma.

Discussion

Although the figures given are specifically Australian, the non-specific determinants of child trauma are probably universal. The trauma indices published here will enable further investigation to be made. Such quantitative measures of predetermining social influences are essential if the limited resources set aside for child safety are to be honestly apportioned.

It is generally accepted that preventive measures to reduce non-specific components of child trauma are relatively inefficient, at least in the short term; and that if the specific factors related to specific

Table 4 *Motor vehicle traffic accident specificity indices by State and age*

State	Age group (years)				All ages
	0-4	5-9	10-14	15+	
Queensland	3.63	9.44	3.72	23.28	17.70
New South Wales	1.24	5.67	4.29	13.27	9.99
Victoria	4.42	9.16	8.17	17.93	14.72
Tasmania	2.75	8.12	3.69	17.15	13.04
South Australia	1.07	1.90	7.83	17.87	13.05
Western Australia	1.69	8.90	8.90	21.45	16.51
Northern Territory	3.69	2.35	8.67	46.92	32.58
Australian Capital Territory	—	—	—	—	11.68
AUSTRALIA	2.29	6.81	5.50	17.33	13.23

Table 5 *Drowning accident specificity indices by State and age*

State	Age group (years)				All ages
	0-4	5-9	10-14	15+	
Queensland	5.18	0.74	0.13	0.29	0.49
New South Wales	2.57	0.31	0.23	0.07	0.15
Victoria	2.55	0.61	0.01	0.01	0.08
Tasmania	1.89	0.22	1.20	0.13	0.22
South Australia	3.10	0.86	—	0.10	0.18
Western Australia	4.10	0.29	0.29	0.16	0.31
Northern Territory	14.59	2.40	—	3.60	1.77
AUSTRALIA	3.10	0.54	0.12	0.10	0.20

Results

The results of this exercise are presented in Table 4 (MVTA specificity indices) and in Table 5 (DA specificity indices), by age and by State, with national figures for comparison. Error formulae are not yet available, but specificity indices allow simple ranking of the different forms of trauma, and such a list of priorities would be of help to those charged with the task of reducing child mortality. A consideration of different communities classified by such an index would suggest where short-term improvements could be anticipated in the current child mortality figures

injuries can be identified, measured, and ranked, then priorities for more effective preventive strategies can be planned.

Table I suggests that the type of preventive strategy applied to non-specific social factors is usually unrelated to, and often inappropriate to, preventive campaigns against specific social factors.

Age-specific and sex-specific fatality rates are of considerable value in themselves, but they give only a generalised, overall view of the threat to children. It is usually agreed that prevention is most cost-effective when aimed at specific trauma-producing situations; attempts to reduce trauma by intensive

publicity directed at more broadly based sociological influences have proved disappointing. Road safety campaigns at Easter, and pleas for common-sense driving in motorway fog, are two examples.

There is an urgent need for fresh, innovative approaches to the study of the causes of child trauma. The publication of additional new and experimental trauma indices would help—for example, child trauma statistics corrected for, and made highly specific by, standardised mortality ratios (Scott-Samuel, 1977).

In theory, the chain of causal links leading to a child's traumatic death can be broken at any point. It is unrealistic to hope for great improvement by directing all efforts at the final common point, the trigger. Triggering causes (Table 1) are usually spur-of-the-moment events for which it is difficult to legislate. Public educational campaigns must provide the main preventive thrust, although it is very difficult to measure their usefulness. The major effort should be directed against specific, predisposing social causes. These can be controlled by legislation, with campaigns in the media for support. One advantage of this strategy is that the effects of preventive efforts can be measured (Dickson *et al.*, 1964), as in a study of the results of the mandatory wearing of car seat-belts (Trinca and Dooley, 1975). Compulsory high flags on children's bicycles, enforced accident-proofing of children's swimming pools, and the compulsory use of child-resistant containers for drugs are commonly discussed strategies of this type.

Preventive strategies directed at non-specific social causes must be very broadly based (Table 1). Any approach here will be expensive, and probably inefficient in reducing any particular form of trauma. However, any kind of influence that can be brought to bear on these non-specific causes (for example, poor parental knowledge of accident risks, poverty, and overcrowding) will be beneficial, because all types of child trauma may be affected, not just a particular type such as burns, ingestions, or drownings. A recent study from Newcastle, New South Wales (Vinson and Homel, 1975) and other studies overseas (Syme and Berkman, 1976) suggest that preventive action might be expected to produce good results in specific sub-populations 'who live in a more toxic, hazardous and non-hygienic environment'. The identification of links in the causal chain and their subsequent classification (Baker and Haddon, 1974) is the first step towards the scientific control of this major problem.

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References

- Australian Bureau of Statistics (1973a). *Causes of Death. Bulletin No. 10*. Australian Bureau of Statistics: Canberra.
- Australian Bureau of Statistics (1973b). *Demography 1973*. Australian Bureau of Statistics: Brisbane.
- Baker, S. P., and Haddon, W. (1974). Reducing injuries and their results: the scientific approach. In *Health and Society*, pp. 377-389. Milbank Memorial Fund Quarterly: New York.
- Dickson, D. G., Schlesinger, E. R., Westaby, J. R., and Lowen, L. (1964). Medically attended injuries among young children. Observations in a suburban area. *American Journal of Diseases of Children*, **107**, 618-623.
- Jamieson, K. G., and Tait, I. A. (1967). *Traffic injury in Brisbane*. National Health and Medical Research Council Special Report Series, No. 13. NHMRC: Canberra.
- Lopez, W. A., and Rennie, T. F. (1969). A survey of accidents to children aged under 15 years seen at a district hospital in Sydney in one year. *Medical Journal of Australia*, **1**, 806-809.
- Pearn, J. H. (1978). Fatal motor vehicle accidents involving Australian children. *Australian Paediatric Journal*. In press.
- Pearn, J. H., and Nixon, J. (1977). Bathtub immersion accidents involving children. *Medical Journal of Australia*, **1**, 211-213.
- Pearn, J., Nixon, J., and Wilkey, I. (1976). Freshwater drowning and near-drowning accidents involving children. A five-year total population study. *Medical Journal of Australia*, **2**, 942-946.
- Scott-Samuel, A. (1977). Social area analysis in community medicine. *British Journal of Preventive and Social Medicine*, **31**, 199-204.
- Simpson, J. S. (1976). Trauma: the leading childhood killer in Canada and elsewhere. *Clinical Pediatrics*, **15**, 313-316.
- Syme, S. L., and Berkman, L. F. (1976). Social class, susceptibility and sickness. *American Journal of Epidemiology*, **104**, 1-14.
- Trinca, G. W., and Dooley, B. J. (1975). The effects of mandatory seat belt wearing on the mortality and pattern of injury of car occupants involved in motor vehicle crashes in Victoria. *Medical Journal of Australia*, **1**, 675-678.
- Vinson, T., and Homel, R. (1975). Crime and disadvantage. *British Journal of Criminology*, **15**, 21-28.
- Whitlock, F. A. (1971). *Death on the road. A study in social violence*. Tavistock Publications: London.