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ACCIDENT LIABILITY IN THE NATIONAL CHILD DEVELOPMENT STUDY

David R Jones[1] and Philip Sedgwick[2]

Department of Public Health Sciences
St George's Hospital Medical School
Cranmer Terrace
LONDON
SW17 0RE

Note: This paper is presented unchanged from the draft prepared at St. George's Hospital Medical School in 1990/91, to provide a starting point for analyses of further data on accidents, collected in the 5th sweep of the NCDS, which is now available for analysis and interpretation.

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Present address: [1]Department of Epidemiology & Public Health, University of Leicester.
[2]Department of Mental Health Sciences, St. George's Hospital Medical School

Summary

A very wide range of environmental, family, social physiological and psychological factors have been linked with the risk of occurrence of accidents in children and young adults. Few studies have, however, been able to collect measures of such a wide range of these factors, together with relatively reliable accident incidence and repetition data, as the National Child Development Study (NCDS), in which more than 12500 out of 17000 subjects have been followed from birth in 1958 to age 23. Interview and questionnaire data relating to the subjects at birth and ages 7, 11, 16 and 23 cover environmental, social, educational and behavioural factors and medical history. The analyses reported here investigate evidence of patterns of repetition of accidents in certain individuals.

Those who had been reported to suffer frequent accidents between the ages of 11 and 15 were also at greatly raised risk of accidents in the later age range between 16 and 23. The continued patterns of elevated accident risk were not fully explained by socioeconomic circumstances of the respondents. Although the data in this multi-purpose study are inevitably limited, the results of the analyses reported begin to help to place accident risks in their broad social context and to identify subgroups of the young adult population at high risk of accidents for targeting of preventive action.

Background

Accidents are an important cause of death in childhood (Macfarlane and Fox, 1978), adolescence and early adulthood (Bewley, 1986). Consequently, many studies have sought to describe patterns of accidents and to explore their aetiology. Many of these studies have considered childhood accidents, or accident types such as road traffic accidents, particularly relevant in the younger age groups. A large variety of factors have been shown to be associated with raised risks of accidents (Bull, 1961); the categorisation of such factors proposed (Hale and Hale, 1972) in the context of industrial accidents is more broadly applicable. The four categories proposed are i) physical or environmental factors, ii) physiological factors, including age, sex, vision and hearing disabilities, coordination, alcohol consumption, and conditions such as epilepsy, iii) psychological factors, which may include personality characteristics and reactions to stressful events or circumstances, and iv) social factors. There are of course many interactions and interrelationships between factors in the various categories. However, few studies (Langley *et al* 1979) have been able to collect information on a wide range of these factors in conjunction with detailed data on the occurrence of accidents. The National Child Development Study (NCDS) on which this paper is based is to some extent able to meet these data requirements. Here we shall concentrate on exploration of one aspect of accident epidemiology - evidence for believing certain individuals to have a liability to repeat accidents - while adjusting for the influence of other risk factors.

Many studies have sought to contribute to knowledge of the aetiology of accidents by describing the psychological and social background of those involved in accidents. Some of the sociodemographic characteristics of individuals with high accident rates have been noted above. Others, such as a correlation with measures of social status (Brown and Davidson, 1978; Wadsworth *et al.*1983)are unsurprising. The main emphasis of traditional accounts (Farmer and Chambers, 1929) was, however, on the assumption that certain personality traits were associated with proneness to accidents (or at very least with a proneness to report accidents). Subsequently, there has been much critical appraisal (Arbous and Kerrich, 1951; Froggatt and Smiley, 1964; Husband, 1973; Langley, 1982) of the basic concept of accident proneness, leading to a widespread preference for the more complex notion of accident liability.

Whereas accident proneness denotes more or less stable personality characteristics predisposing an individual to have accidents, accident liability also includes a central role for environmental factors, including degree of exposure to hazards, and social and familial characteristics and stressors. The patterns of accidents observed in a population if the hypothesis of accident proneness is correct would be differentiated from that under the null hypothesis of 'pure chance' by the existence of subgroups with (consistently) raised accident rates. Two developments of this basic model have received attention (Greenwood and Yule, 1920). In the first, membership of the accident prone subgroup is assumed to remain stable but the accident potential of the members to vary over time (for example depending on the number of accidents already experienced). More fundamentally, in the second development, membership of the 'accident prone' group varies with time, so allowing a role for psychosocial state rather than trait variables and hence retrieving the above notion of accident liability.
Analysis of patterns of accident occurrence, and particularly of accident repetition by

individuals, are thus crucial in attempts to identify the correct model of accident aetiology. Unfortunately, it is methodologically difficult (and sometimes logically impossible) to differentiate between the competing models of accident incidence on the basis of statistical models of available data alone (Mackenzie, 1986). Some of the classical statistical models follow from more than one conceptual model of accident incidence and hence data which fit such a model are open to more than one interpretation.

The limitations of available data sets, as well as those of potential models, are of course also important. The adopted definition of an accident may be crucial (Stewart-Brown *et al.* 1986); in particular to study only accidents resulting in hospitalisation (Eminson *et al.* 1986) may confound risks of accident incidence and of subsequent hospitalisation. Reporting biases are always a potential problem. This is particularly the case if there is 'effort after meaning' - an attempt to provide an explanation for an adverse experience. Furthermore, few studies have been able to collect accident data from individuals over a long period, for example, from childhood to adulthood, so as to be able to address the question of whether childhood accident repeaters are likely to become accident repeaters in adulthood. However, to some extent this is possible with the accident data from the NCDS analysed here.

Methods

The cohort of seventeen thousand children born in England, Scotland and Wales in the week of 3-9 March 1958 forms the basis of the National Child Development Study. Data describing 98% of cohort members are available from the birth survey and, for those successfully traced at ages 7, 11, 16 and 23. The birth survey includes socio-demographic and obstetric data on each study member obtained from his or her mother and from medical records. At ages 7, 11 and 16 physical, educational and social development data were obtained from interviews with their parents, questionnaires completed by their teachers, medical examinations by the school health service, and tests and questionnaires completed by the cohort members themselves (Davie *et al.* 1972; Fogelman, 1983). Most of the data analysed here were, however, obtained by interview with the cohort members at age 23, once again covering a wide range of socio-demographic, educational, and health characteristics of the 12532 (76%) still traceable. Members of some disadvantaged groups are somewhat over-represented amongst those who drop out, but differences between those successfully followed up and those lost to follow up are generally small (Fogelman, 1983).

Amongst the health related questions in the interview at age 23 were questions on the accident history of the respondent since age 16. Information was sought only about accidents which resulted in a hospital attendance (either in- or out-patient). Some details of the nature and timing of the first eight such accidents were recorded. An ambiguity in the method of administration of the questionnaire yielded lists of accidents in chronological order for some respondents and reverse chronological order for the majority of the remainder, with a small residue of cases with apparently unordered or incomplete data. The 5 cases with missing data are omitted from the analyses presented below; the remaining accident sequences have been sorted in chronological order (by year of age) where necessary. Data for the other variables utilised in the analyses were also collected at, or derived from data collected at, the interview at age 23. These data include measures of health related behaviour such as alcohol

consumption habits, and measures of socioeconomic position, including occupation-based social class. Information on the accident history of the cohort members between the ages of 11 and 15 was obtained from the questionnaire administered to parents of cohort members when the latter were aged 16. Where response to questionnaire items or other assessments from which the risk factor measures were derived are incomplete, risk ratios in the non-response groups have been examined, but are omitted from the Tables for clarity, since they were close to unity.

Eighty accidental deaths were numbered among the 282 deaths (including perinatal deaths) of sample members known to have occurred by age 23. Forty six of the 80 accidental deaths occurred between the ages of 16 to 23. In all of the analyses reported here, accidents requiring hospitalisation as reported by survivors have been used as the outcome measure. Incorporation into the analyses of death from accidental causes in combination with reported non-fatal accidents, had negligible influence on the results.

Results

Eleven thousand and nine accidents leading to hospitalisation between ages 16 and 23 were reported at age 23. As Table 1 shows, overall fewer than half (43.9%) reported an accident leading to hospital attendance between ages 16 and 23. The difference between sexes is very marked, almost twice as many females (73.6%) as males (38.5%) reporting no such accident and fewer than ten percent of those reporting 5 or more accidents in the period being female. Only 44 respondents (0.3%) reported 10 or more such accidents; amongst them 5 reported 20 accidents and one 27 accidents. Failure to recall and report the number of accidents suffered was very surprisingly rare. Substantial numbers of accidents of each type, except road accidents to pedestrians, occur in both sexes. Accidents at work and sports accidents are more common in males, and accidents at home in females.

In the light of the distribution of numbers of accidents noted above, two categorisations of the number of accidents reported between the ages of 16 and 23 were employed: none/1 or more, and none/1-4/5 or more. Most results are presented separately for males and females, in view of the strong differences which are apparent in distribution of the number of accidents which would lead to confounding by sex of relationships between several risk factors and accidents.

Table 2 shows the principal analyses of evidence concerning the relationship between the propensity to suffer accidents between the ages of 16 and 23 and the corresponding risk in the earlier age range 11 to 15. In males there is strong evidence that those reported to have suffered many accidents between the ages of 11 and 15 are more likely also to report many accidents between the ages of 16 and 23. This is strikingly so for the extremely high accident rate reporters, and there is hence some evidence of a 'dose-response' relationship. For females the evidence is less extensive and the effect less marked, but nonetheless clearly still in the same direction.

Before concluding that this constitutes evidence for accident proneness or liability hypotheses, however, we need to consider evidence for alternative explanations of these results. Paramount among the many possibilities provided by the breadth of the NCDS dataset are those stemming from a hypothesis that a subgroup of the cohort suffers from continuing

socioeconomic disadvantage through childhood and early adulthood, which continues to elevate their accident risk throughout. As Table 3 shows, there is evidence of a gradient in accident risk with occupation-based social class (as there is with other measures not reported here).

The combined effects of variables considered in the univariate analyses presented above may be explored by means of logistic regression models for the odds ratio (McCullagh and Nelder, 1989) of accident risk. This allows investigation of both the relative importance of and interrelations between the various factors vis a vis accident risk. In Table 4, both (grouped) social class and number of accidents in the earlier period have strong explanatory effects (models 2 and 3) but they are largely independent. The estimates of odds ratios in model 3 are reduced by less than 5% by addition of the class variables in model 4. The pattern of accident repetition (in males) in Table 2 is thus largely unaffected by controlling for social class (at age 23), and the potential explanation of this pattern in terms of continuing disadvantage throughout teenage and early adulthood is not a powerful one in practice.

Discussion

The NCDS offers a very wide set of data on socio-economic, health, educational and behavioural characteristics of a large, representative cohort followed up from birth to young adulthood. The possibilities for analysis of relations between data on accidents and other characteristics of cohort members are consequently manifold; only a small selection of initially informative analyses have been presented here. Another consequence of use of data from a large multi-purpose study, which of course was not primarily or exclusively designed for investigations of accident aetiology, is that neither the measures of accident experience nor those of risk factors are as comprehensive as is desirable. Nonetheless, despite acknowledged limitations of data items in the NCDS, its broad base and representative nature make it almost uniquely valuable for the present purpose.

The principal measure of accident occurrence available in the NCDS is derived from reports by the respondent, or at earlier ages by the respondent's parent, of any accident during the past few years which led to outpatient or inpatient attendance at a hospital. This confounds measures of propensity to report, recall biases, and variability of both perception of an event as an accident and of the need for hospitalisation. In later papers we propose to analyse subsidiary measures of accident severity and outcome available in the NCDS data set, namely whether in- or out-patient care was needed, and whether disability resulted from the accident, to help separate the risks of occurrence of and severity of consequences arising from accidents. More extensive analyses of the type (road, work, sports, etc), number and timing of accidents reported is also in progress. Ultimately, however, the utility of increased complexity and sophistication of analyses will be constrained by the data limitations noted above.

Those on whose behalf several accidents between the ages of 11 and 15 were reported by their parents seems to be at clearly higher risk of reporting several accidents in the age range 16 to 23. This does not, however, necessarily constitute evidence for the accident proneness hypothesis, although the influence of reporting biases may here be reduced somewhat by the differing sources of reports in the two age ranges. It is also quite possible that such an association results from exogenous variations of risk factors between individuals, for example

from differential use of modes of transport. Although further analyses by accident type may be of some use and interest here, the absence of much specific data on the extent to which respondents are at risk is a fundamental weakness. Analyses of the influence of broader indicators such as social class provide some reassurance about the validity of the basic result, which complement other analyses of cohort study data describing relations between childhood morbidity and later health (Power and Peckham, 1990) and other outcomes (Wadsworth, 1986).

Assignment of causality and estimation of the size of associations are both similarly constrained by the wide range of possible confounding factors which have been measured in the NCDS and the even wider range which could in principle be important. The results of a key analysis adjusting for a measure of socioeconomic status has been reported, but in view of the complexity of the NCDS database, a large number of other possibilities remain.

What are the implications of these initial findings from the NCDS for accident prevention programmes? If the evidence of accident repetition patterns in some individuals is upheld by further investigation of this data set, it will be of some use in identifying subgroups of the population of young adults who are at high risk of suffering accidents. This will help to target preventive campaigns. We should, however, not be too sanguine; there are major limitations of the data set analysed and hence of the inferences available therefrom. Moreover, the attributable risks in the case of some of these relationships are, unlike the relative risks, small. For example, the attributable risk fraction corresponding to the relative risk of almost 10 for high accident frequency at ages 16-23 if similarly high frequencies were experienced at ages 11-15 is only about 8%. Much more hence remains to be investigated in the aetiology of accidents; collection of further accident data in the forthcoming fifth sweep of the NCDS should at least allow continuation of investigation of continued accident propensity until cohort members are in their early thirties.

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Table 1

Distribution of numbers of accidents per respondent. between ages 16 and 23, by sex.

Number of Accidents	Males	%	Females	%	Persons	%
0	2410	(38.5)	4615	(73.6)	7025	(56.1)
1	1716	(27.4)	1185	(18.9)	2901	(23.2)
2	949	(15.2)	294	(4.7)	1243	(9.9)
3	517	(8.3)	111	(1.8)	628	(5.0)
4	293	(4.7)	34	(0.5)	327	(2.6)
5	151	(2.4)	11	(0.2)	162	(1.3)
6	87	(1.4)	7	(0.1)	94	(0.8)
7	29	(0.5)	5	(0.1)	34	(0.3)
8	24	(0.4)	2	(0.0)	26	(0.2)
9	25	(0.1)	0	(0.0)	5	(0.0)
10 or more	43	(0.7)	1	(0.0)	44	(0.3)
Not known	38	(0.6)	5	(0.1)	43	(0.3)
TOTAL	6262	(100)	6270	(100)	12532	(100)

Table 2

Accidents at ages 16-23 (reported at age 23)
by accidents at ages 11-15 (reported at 16)

	Accidents at 11-15		
	0	1-4	5+
Accidents at 16-23			
Males			
0	971	748	21
1-4	1180	1383	47
Odds ratio	**[1]**	**1.52**	**1.84**
(95% ci)		**(1.34,1.72)**	**(1.06,3.21)**
5+	90	154	19
Odds ratio	**[1]**	**2.22**	**9.76**
(95% ci)		**(1.67,2.96)**	**(4.82,19.7)**

95% ci = 95% confidence interval for the odds ratio

Table 2 ctd

Accidents at 16-23	Accidents at 11-15: 0	Accidents at 11-15: 1+
Females		
0	2209	1187
1+	726	508
Odds ratio	**[1]**	**1.30**
(95% ci)		**(1.14,1.49)**

Table 3

Accident frequency at ages 16 - 23 in males
by grouped social class (based on last job) reported at age 23

	Grouped Social Class		
			Odds Ratio
No of Accidents	Non-Manual	Manual	**(95% ci)**
0	775	1014	**[1]**
1-4	956	1825	**1.46**
			(1.29,1.65)
5+	81	210	**1.98**
			(1.50,2.63)

Table 4

Logistic models of proportion of males experiencing 1 or more accidents at ages 16-23, as function of number of accidents at ages 11-15 and social class.

Model		Deviance	df
1.	Null	146.1	11
2.	Class[a]	68.2	9
3.	Accs1115[b]	77.1	8
4.	Accs1115 + Class	3.0	6

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[a] social class as a 3 level factor: non manual/manual/other

[b] number of accidents at ages 11-15, as a 4 level factor; none/1-4/5 or more/not known.

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