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Patterns of vulnerability to non-fatal injuries in Sudan: initial evidence from a national cross-sectional survey

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▶ Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/injuryprev-2013-040884).

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Received 12 May 2013
Revised 25 September 2013
Accepted 8 November 2013
Published Online First 10 December 2013

ABSTRACT

Background Successful injury prevention requires identification and targeting of particularly vulnerable groups. Little is known about injury vulnerability patterns in Sudan. This paper aimed to fill this gap using survey data.

Methods Data from the Sudan Household Health Survey were used. This was a national cross-sectional interview survey of 83 510 individuals selected by multistage cluster random sampling. Multivariable Poisson regression was used to investigate the association of cause-specific injury that received care by traditional healers, outpatient care and inpatient care, and those that received only inpatient care, with age, gender, area of residence (urban or rural), socioeconomic status and education. Relevant interactions were tested.

Results Independent of other sociodemographic variables, men were at higher risk of road traffic injury (prevalence ratio (PR): 3.3 95% CI 2.4 to 4.7), falls (PR: 1.5, 95% CI 1.3 to 1.9), assault (PR: 3.0 95% CI 1.8–5) and mechanical injury (PR: 2.0 95% CI 1.2 to 3.1) that received any form of healthcare. Those aged 65 years and over also had the highest risk of those injury causes, while children under 5 years were the most likely to suffer burn injuries. Socioeconomic status was associated with assault (PR for the richest group 0.4 95% CI 0.2 to 0.8). Vulnerability patterns for injury that received inpatient care were fairly similar for some causes.

Conclusions In Sudan, existing disease prevention and health promotion programmes should expand to target men, children under 5 years, elderly people and those of low socioeconomic status with injury prevention interventions. Further research is needed to investigate the context-specific proximal risk factors that shape the various vulnerability patterns observed.

INTRODUCTION

Injuries cause significant mortality and morbidity worldwide, accounting for almost 10% of world deaths, and are the leading cause of death among men aged 15–49 years.[1] Injuries carry considerable social and economic ramification, particularly in low and middle income countries.[2–4] This makes them highly relevant to the development agenda and to poverty-related issues such as maternal mortality and childhood illnesses that for long have been the focus of public health initiatives in those countries.

Effective injury prevention requires the identification of vulnerable groups and specific settings where maximum benefit can be reaped of targeted prevention interventions, healthcare provision and research. Non-fatal injury patterns in particular point to groups that are at higher risk of spending time with disability, with all the ensuing social and economic consequences. Injury prevention principles are universal, and the effectiveness of many interventions has been established.[5–8] However interventions are delivered at national and subnational level, and cross-country as well as within-country variations in vulnerability to injury are expected. For example, while road injuries in Tanzania were more common in urban areas,[9] there was no evidence of urban-rural differences in Nigeria after accounting for other sociodemographic variables.[10] Methodological differences could partly account for cross-country differences. However, genuine differences in social and environmental conditions that largely determine the risk of injury are expected to contribute considerably to such variation, which warrants investigating country-specific patterns.

Sudan is a middle income African country where population-based epidemiological injury research is scarce. A study in Khartoum state, which hosts the capital city and the major urban centre of Sudan, revealed gender, socioeconomic and educational differentials in non-fatal all-cause injury,[11] yet, little is known about cause-specific injury patterns. These are critical because vulnerability patterns are expected to vary by injury cause. Thus, this study sought to identify the broad population groups that are vulnerable to non-fatal injury in Sudan by exploring the association between key sociodemographic variables with injury from various causes using national survey data.

METHODS

Design

This is secondary exploratory analysis of existing data from the Sudan Household Health Survey 2010, a national cross-sectional survey.

Settings

Sudan is a middle income African country with a population of more than 30 million, with 70% living in rural areas. Of the population 43% is aged less than 15 years and only 5% is aged 60 years or more; 46.5% of the population are under the national poverty line.[12] Overall, men have higher labour force participation than women across all ages.[13] The main occupations (based on the International Standard Classification of Occupations[14]) in urban areas are professional and managerial occupations (23%), elementary occupations; for example, street vendors

To cite: Abdalla S, on behalf of the Sudan Household Health Survey 2010 National Management Team. *Inj Prev* 2014;**20**:310–316.

Table 1 Sociodemographic characteristics of survey respondents, Sudan Household Health Survey 2010

Subgroup	Number	(%)
Sex		
Male	40 821	49
Female	42 689	51
Age (years)		
0–4	13 587	16
5–14	24 291	29
15–44	32 388	39
45–64	9925	12
65+	3264	4
Missing	55	0
Area		
Urban	26 976	32
Rural	56 534	68
Wealth index tertiles		
Poorest	27 831	33
Middle	27 842	33
Richest	27 837	33
Highest education attained		
None	36 175	43
Primary	31 400	38
Secondary+	15 818	19
Missing	117	0
Total	83 510	100

and cleaners (20%), and crafts and related trades; for example, construction workers and mechanics (17%). In rural areas, 40% of the economically active population are agricultural, forestry or fishery workers, two-thirds of whom are men and a third are women.[15] Political and tribal conflict had plagued Sudan for decades, with relatively recent unrest in the west and south.

Data

Sudan Household Health Survey 2010 had a sample size of 83 510 respondents, drawn from the 15 states of Sudan using a two stage cluster sampling design. In each state, 40 clusters (Census Enumeration Areas) were randomly selected with probability proportionate to size and 25 households were randomly selected from each cluster.[16] We developed a short injury module with four questions administered in Arabic to the main household respondent, asking whether an injury was experienced over the 12 months preceding the survey, and for the most recent injury, the time, cause, type of healthcare received in the 1st week (none, outpatient care in hospital, outpatient care in non-hospital health facility, inpatient care or traditional healer) and whether injury resulted in disability. Causes were mutually exclusive categories defined according to the tenth revision of the International Classification of Diseases and Related Health Problems (ICD-10).[17] (see online supplementary table S1). The study was approved by the Federal Ministry of Health Research Ethics Committee and informed consent was obtained from the respondents. Field work took place from March to May 2010, with a response rate of 99% of households.

Variables

Independent variables used to define sociodemographic groups were age, gender, area of residence at time of interview, socioeconomic status (wealth index score) and highest education attained. Age was aggregated into five groups (0–4 years, 5–14 years, 15–44 years, 45–64 years, 65 years and over), with potentially varying risks of the different causes of injury.[1] Further age aggregation for injury by fire or hot substance, poisoning and mechanical causes was necessary. Socioeconomic status was represented by the wealth index score based on household assets and characteristics at the time of the interview. It was classified into tertiles separately for urban and rural areas to ensure that poverty was defined relative to the local context and to avoid misclassification of some households in rural areas as poor, the potential of which was indicated by different wealth score distributions in the two areas.[18] Highest education attained was aggregated into none, primary and secondary or higher, for those aged 15 years and over. To ensure that the construct of inappropriately low educational achievement was properly captured, the mother's highest education level, a known determinant of injury,[7] was assigned to those aged less than 15 years, as their low education levels would be appropriate for their age. The highest education of the head of the household was used where the mother was absent. Dichotomous indicator variables for the cause of the most recent injury; RTC, poisoning, fall, mechanical (non-transport), fire or hot substance (non-transport), animal bite or venom and assault were used as dependent variables. Causes with small numbers; electric shock (10 cases), near-drowning (5 cases) and intentional self-harm (2 cases), as well as injury from unspecified cause (103 cases), were not considered. Complications of medical or surgical care (58 cases) were also excluded due to uncertainty in the performance of self-reports in this category.

Analysis

Frequencies and percentages were used to describe the sociodemographic characteristics of the survey respondents and the injury cause distribution. The independent association of sociodemographic variables with each cause of injury was examined by multivariable Poisson regression analyses with robust variance, which estimates the directly interpretable prevalence ratio (PR). This method was recommended for the analysis of cross-sectional surveys as an alternative to the estimation of the OR with logistic regression.[19] One set of models included injuries that resulted in any form of healthcare (defined as care by traditional healer, outpatient care in hospital or other health facility or inpatient care) in the 1st week. Presumptively non-significant injuries that did not lead to healthcare utilisation in the 1st week were excluded. There are considerable urban-rural differences in the social and physical environment, and urban-rural differences in injury vulnerability have been previously reported.[9 11 20–22] Thus, interactions between the area of residence and each independent variable in the model were tested. As socioeconomic differentials in childhood injury are well documented,[23] interaction between age group and socioeconomic status was also tested. Statistically significant interactions (cut-off p=0.05) were retained. Another set of main effects multivariable models was limited to injuries that resulted in hospitalisation (presumptively more severe/disruptive injuries). For the latter, two age groups (0–44 years and 45 years and over) were used because of the smaller numbers of injured people at that level. All analyses excluded records with missing values for at least one variable. PR was statistically significant at the 0.05 level if its 95% CI excluded one. The analyses being exploratory rather than confirmatory, adjusting the cut-off p value for multiple hypotheses was not attempted. The data were prepared in PASW V.18 and analysed in R.2.15.2.[24]

Table 2 Distribution of causes of injury that received any form of healthcare (inpatient, outpatient, traditional healer) and injury that received inpatient care in the 1st week, Sudan Household Health Survey 2010

Cause	Any healthcare	Inpatient care
Road traffic crash	207 (17%)	68 (33%)
Fall	445 (36%)	56 (27%)
Animal bite/venom	276 (23%)	21 (10%)
Poisoning	60 (5%)	14 (7%)
Mechanical (non-transport)	88 (7%)	11 (5%)
Fire/Hot substance (non-transport)	60 (5%)	16 (8%)
Assault	84 (7%)	18 (9%)
Total	1220 (100%)	204 (100%)

RESULTS

Table 1 shows the socio-demographic characteristics of the survey sample. Out of 83 482 who responded to the injury question, 1626 respondents had an injury over the 12 months preceding the survey. A total of 1444 were injured from the causes included in the analysis; 1220 received any form of healthcare, 204 of whom received inpatient care. Table 2 displays the distribution of injury causes in the survey population. Falls were the most common cause of injury that received any form of healthcare (36%), followed by animal bite or venom (23%) and RTC (17%). RTC was the most common cause of injury that received inpatient care (33%) followed by falls (27%). The sociodemographic distribution of injuries that received any form of healthcare varied by cause of injury (table 3).

Adjusted PR, with 95% CIs for each cause leading to any form of healthcare, are displayed in table 4. Falls were more likely to affect men (PR 1.5 95% CI (1.3 to 1.9)) and those aged 5–14 years, 45–54 years and 65 years and over than children under 5 years, with the highest PR among those aged 65 years and over (6.3 95% CI 4.1 to 9.8)). Falls were associated with socioeconomic status in rural areas (PR for highest wealth tertile=0.6 95% CI 0.4 to 0.8) but not in urban areas.

Animal bite or venom injuries were more likely to be reported in rural areas than in urban areas (PR 3.2 95% CI 2.3 to 4.6), and in all other age groups than in children under 5 years.

Men and urban residents were more likely to report road traffic injuries (RTIs) than women and rural residents respectively. People aged 15–44 years, 45–64 years and 65 years were at higher risk than children under 5 years, as were those from households in the middle wealth tertile than those in the poorest tertile (PR 1.9 95% CI 1.3 to 2.7).

Men were three times as likely as women to suffer injury from assault, while the richest third of the population were about 60% less likely to experience such injury. Assault was also associated with age, with PR up to 11 (95% CI 2.2 to 56.2) in those aged 65 years and over compared with children under 5 years. Men were also more likely to have injury from mechanical forces (PR 2 95% CI 1.2 to 3.1) which were also independently associated with age and highest education attained. Risk of injury by fire or hot substance was 70–80% lower in older age groups than children under 5 years. Poisoning was more likely to be reported in people with primary education compared with those with no education.

There were no statistically significant interactions between age and socioeconomic status for any of the injury causes considered.

Table 5 shows adjusted PR with 95% CIs for each cause of injury that received inpatient care in the 1st week. Those due to RTC were associated with gender (male PR 3.0 95%CI 1.7 to 5.3), area of residence (rural PR 0.4 95% CI 0.3 to 0.6) and age

Table 3 Distribution of causes of injury that received any form of healthcare (outpatient, inpatient, traditional healer) in the first week, Sudan Household Health Survey 2010

Subgroup	Road traffic injury	Falls	Animal bite/venom	Assault	Mechanical	Fire/hot substance	Poisoning
Sex							
Male	159 (77%)	270 (61%)	124 (45%)	62 (74%)	59 (67%)	32 (53%)	31 (52%)
Female	48 (23%)	175 (39%)	152 (55%)	22 (26%)	29 (33%)	28 (47%)	29 (48%)
Age group (years)							
0–4	10 (5%)	34 (8%)	13 (5%)	2 (2%)	3 (3%)	30 (50%)	7 (12%)
5–14	12 (6%)	147 (33%)	54 (20%)	31 (37%)	14 (16%)	14 (23%)	14 (23%)
15–44	124 (60%)	127 (29%)	151 (55%)	34 (40%)	46 (52%)	13 (22%)	26 (43%)
45–64	44 (21%)	85 (19%)	49 (18%)	11 (13%)	19 (22%)	3 (5%)	12 (20%)
65+	16 (8%)	51 (11%)	9 (3%)	5 (6%)	6 (7%)	0 (0%)	1 (2%)
Missing	1 (0%)	1 (0%)	(0%)	1 (1%)	(0%)	(0%)	(0%)
Area							
Urban	114 (55%)	138 (31%)	37 (13%)	35 (42%)	25 (28%)	22 (37%)	23 (38%)
Rural	93 (45%)	307 (69%)	239 (87%)	49 (58%)	63 (72%)	38 (63%)	37 (62%)
Wealth index tertiles							
Poorest	43 (21%)	165 (37%)	84 (30%)	40 (48%)	26 (30%)	19 (32%)	15 (25%)
Middle	88 (43%)	148 (33%)	94 (34%)	25 (30%)	34 (39%)	23 (38%)	20 (33%)
Richest	76 (37%)	132 (30%)	98 (36%)	19 (23%)	28 (32%)	18 (30%)	25 (42%)
Highest education attained							
None	51 (25%)	206 (46%)	114 (41%)	33 (39%)	27 (31%)	24 (40%)	29 (48%)
Primary	97 (47%)	172 (39%)	122 (44%)	37 (44%)	45 (51%)	25 (42%)	13 (22%)
Secondary+	58 (28%)	66 (15%)	40 (14%)	14 (17%)	15 (17%)	11 (18%)	18 (30%)
Missing	1 (0%)	1 (0%)	(0%)	(0%)	1 (1%)	(0%)	(0%)
Total	207 (100%)	445 (100%)	276 (100%)	84 (100%)	88 (100%)	60 (100%)	60 (100%)

Table 4 Adjusted prevalence ratio (PR) (95% CIs) by age, gender, area of residence, socioeconomic status (wealth index tertiles) and highest education attained for injury that received any form of healthcare (outpatient, inpatient, traditional healer) in the 1st week, Sudan Household Health Survey 2010

	RTC	Falls	Animal bite/venom	Assault
Gender (ref=females)	p<0.001	p=0.02	p=0.26	p<0.001
Males	3.3 (2.4 to 4.7)*	1.5 (1.3 to 1.9)*	0.9 (0.7 to 1.1)	3.0 (1.8 to 5)*
Area (ref=urban)	p<0.001	p<0.001	p<0.001	p=0.22
Rural	0.4 (0.3 to 0.6)*	1.5 (1.1 to 2.2)†	3.2 (2.3 to 4.6)*	0.7 (0.5 to 1.2)
Age group in years (ref=0–5)	p<0.001	p<0.001	p<0.001	p=0.04
65+	6.1 (2.8 to 13.4)*	6.3 (4.1 to 9.8)*	3.1 (1.3 to 7.2)*	11 (2.2 to 56.2)*
45–64	5.6 (2.8 to 11.1)*	3.6 (2.4 to 5.3)*	5.5 (3 to 10.1)*	8.0 (1.8 to 36.2)*
15–44	4.8 (2.5 to 9.3)*	1.6 (1.1 to 2.4)*	5.1 (2.9 to 9.1)*	7.4 (1.7 to 32.3)*
5–14	0.7 (0.3 to 1.6)	2.4 (1.7 to 3.6)*	2.4 (1.3 to 4.3)*	9.0 (2.2 to 37.3)*
Wealth index tertiles (ref=poorest)	p=0.01	p=0.46	p=0.94	p=0.02
Richest	1.5 (0.9 to 2.2)	1.3 (0.8 to 1.9)†	1 (0.8 to 1.4)	0.4 (0.2 to 0.8)*
Middle	1.9 (1.3 to 2.7)*	1.0 (0.7 to 1.6)	1.1 (0.8 to 1.4)	0.6 (0.3 to 1)
Education (ref=none)	P=0.41	p=0.33	p=0.10	p=0.49
Secondary+	1.1 (0.7 to 1.8)	1 (0.7 to 1.5)	0.9 (0.6 to 1.4)	1.2 (0.5 to 2.9)
Primary	1.3 (0.9 to 1.9)	1.2 (0.9 to 1.5)	1.2 (0.9 to 1.6)	1.4 (0.8 to 2.4)
Interactions		p=0.01		
Rural : Middle wealth tertile		0.8 (0.5 to 1.3)		
Rural: Richest wealth tertile		0.5 (0.3 to 0.8)*		

	Mechanical	Fire/hot substance		Poisoning	
Gender (ref=females)	p=0.004		p=0.61		p=0.47
Males	2.0 (1.2 to 3.1)*	Males	1.1 (0.7 to 1.9)	Males	1.2 (0.7 to 2)
Area (ref=urban)	p=0.22		p=0.37		p=0.35
Rural	7 (1 to 51.9)	Rural	0.8 (0.5 to 1.3)	Rural	0.8 (0.5 to 1.3)
Age group in years (ref=0–14)	p<0.001	Age group (ref=0–4)	p<0.001	Age group (ref=0–4)	p=0.51
65+	4.4 (1.7 to 10.9)*	15+	0.2 (0.1 to 0.3)*	45+	1.7 (0.7 to 4.3)
45–64	4.3 (2.3 to 8.5)*	5–14	0.3 (0.1 to 0.5)*	15–44	1.5 (0.6 to 3.7)
15–44	3.0 (1.6 to 5.6)*			5–14	1.1 (0.4 to 2.7)
Wealth index tertiles (ref=poorest)	p=0.56		p=0.76		p=0.40
Richest	0.9 (0.5 to 1.5)	Richest	1.1 (0.5 to 2)	Richest	1.7 (0.8 to 3.7)
Middle	1.1 (0.6 to 1.9)	Middle	1.2 (0.7 to 2.2)	Middle	1.4 (0.7 to 2.8)
Education (ref=none)	p=0.11		p=0.77		p=0.03
Secondary+	7.2 (0.9 to 59.7)	Secondary+	1.2 (0.6 to 2.5)	Secondary+	0.9 (0.4 to 2.1)
Primary	8.3 (1.1 to 63.8)*	Primary	1.2 (0.7 to 2.1)	Primary	0.4 (0.2 to 0.8)*

197 records were excluded due to missing values.
*Statistically significant at 0.05 level.
†Because interactions between wealth index tertiles and area of residence were statistically significant they were kept in the falls regression model. Thus the coefficients for these main effects represent the coefficients in the reference group of the interacting variable; the coefficient for area is that of the group in the poorest wealth tertile in rural areas, while those for wealth index tertile represent those in urban areas. In a subgroup analysis, prevalence ratio (PR) for the richest tertile of the population in rural areas was 0.6 95% CI 0.4 to 0.8, while there were no statistically significant differences between wealth tertiles in urban areas.

(PR in 45 years and over 2.5 95% CI 1.5 to 4.2). Those due to falls were also associated with gender (PR in men 2.1 95% CI 1.2 to 3.8) and age (PR in 45 years and over 3.2 95% CI 1.8 to 5.7). People with secondary education were more likely to report injury due to animal bite or venom requiring hospitalisation than those with no education. Men and those in the poorest wealth index quintile were more likely to have hospitalised for injury due to assault.

DISCUSSION

Summary of findings

There were discernible vulnerability patterns of non-fatal injury, fairly generalisable to the national level in Sudan, given the high household response rate. Men and elderly people were the most vulnerable to injury from RTCs, falls, assault and mechanical forces. Children under 5 years were the most likely to suffer injury due to fire or hot substance. Assault was concentrated in people of low socioeconomic status. RTCs and falls affected urban residents more than rural residents, while the latter were more affected by injury from animal bites or venom. Socioeconomic status was associated with falls in rural areas only. Most of the differentials in RTIs, falls and assault persisted at the level of injuries that required hospitalisation.

Limitations of the study

The study used self-reported data which are subject to reporting errors. Another major limitation of self-reported injury data is recall bias. An in-depth analysis of recall bias (personal communication, Abdalla S, publication forthcoming) showed injury among children under 5 years to be particularly under-represented. Thus, lower risk in children under 5 years should be interpreted cautiously. The area of residence (urban and rural) was at the time of interview and could be different from that at the time of occurrence of the injury. This is particularly relevant to RTIs, as

Table 5 Adjusted prevalence ratio (PR) (95% CIs) by age, gender, area of residence, socioeconomic status (wealth index tertiles) and highest education attained for injury that led to hospitalisation in the 1st week, Sudan Household Health Survey 2010

	RTC	Falls	Poisoning	Mechanical	Fire/hot substance	Animal bite/venom	Assault
Gender (ref=females)	p<0.001	p=0.01	p=0.83	p=0.17	p=0.63	p=0.90	p=0.04
Males	3.0 (1.7–5.3)*	2.1 (1.2–3.8)*	1.1 (0.4–3.2)	2.6 (0.7–10)	0.8 (0.3–2.1)	1.1 (0.4–2.5)	3.3 (1.1–9.8)*
Area (ref=urban)	p<0.001	p=0.42	p=0.31	p=0.22	p=0.10	p=0.13	p=0.64
Rural	0.4 (0.3–0.7)*	0.8 (0.5–1.4)	0.6 (0.2–1.6)	2.3 (0.6–9.1)	0.4 (0.1–1.2)	2.1 (0.8–5.6)	0.8 (0.3–2.3)
Age group (ref=0–44)	p<0.001	p<0.001	p=0.31	p=0.81	p=0.39	p=0.86	p=0.72
45+	2.5 (1.5–4.2)*	3.2 (1.8–5.7)*	0.4 (0.1–2.7)	1.2 (0.2–6.1)	0.4 (0.05–3.3)	1.1 (0.3–3.7)	1.3 (0.4–4.3)
Wealth index tertiles (ref=poorest)	p=0.57	p=0.44	p=0.26	p=0.85	p=0.29	p=0.11	p=0.03
Richest	1.2 (0.6–2.6)	0.7 (0.3–1.5)	2.9 (0.4–20.9)	1.3 (0.3–5.4)	0.5 (0.2–1.3)	1.4 (0.3–5.7)	0.2 (0–0.8)*
Middle	1.4 (0.7–2.7)	1.2 (0.7–2.3)	3.9 (0.7–21.1)	0.9 (0.2–4.3)	1.1 (0.4–2.9)	3.1 (0.9–11.1)	0.3 (0.1–0.9)
Education (ref=none)	p=0.42	p=0.33	p=0.17	p=0.58	p=0.63	p=0.09	p=0.31
Secondary+	1.6 (0.7–3.7)	1.4 (0.6–3.3)	0.9 (0.3–3.3)	1.5 (0.3–7.5)	1.3 (0.4–4.5)	3.6 (1.1–11.4)*	3.4 (0.6–19.5)
Primary	1.5 (0.8–2.9)	1.5 (0.8–2.7)	0.2 (0.1–1.1)	2.1 (0.5–9)	1.7 (0.6–5.1)	1.6 (0.6–4.4)	2.5 (0.7–8.9)

197 records were excluded due to missing values.
*Statistically significant at 0.05 level.

they are linked to mobility, and people are more likely to have been injured far from their area of residence than for other injury causes. Nevertheless, the finding of higher vulnerability in urban settings concurs with well-documented link between road injury and urbanisation.[5] Wealth index was measured after occurrence of the injury, which should be considered when interpreting socioeconomic associations. Using hospitalisation as a proxy for the severity or impact of injury may limit the conclusions drawn for some of the associations due to differences in healthcare access and healthcare seeking behaviour.

DISCUSSION OF FINDINGS

Road traffic crashes

RTCs were the leading cause of injury resulting in hospital admission, and similar to findings in Tanzania and Nigeria, men and urban residents were more vulnerable.[9 10] Age differentials were also similar in Nigeria, but the socioeconomic differentials observed here were not evident in the other countries. The findings for RTIs mirror what is expected from their known risk factors.[5] Men in Sudan are more economically active than women.[15] Their higher mobility therefore makes them at higher risk of RTIs. Men are also more likely to drive and to engage in risky driving and pedestrian behaviour.[25] Higher mobility could also explain the higher vulnerability of those aged more than 15 years. The higher risk among higher socioeconomic group, diminishing at hospitalised injury level, conflicts with the suggested link between poverty and RTI mortality and morbidity.[26] Whether a poverty-mortality link exists in Sudan, generating this cross-sectionally observed finding through selective survival of those of higher socioeconomic status, remains to be confirmed.

Falls

Age differentials in falls risk are not surprising; older people are more prone to falls due to biological factors and chronic conditions,[27 28] and similar age and gender patterns were observed in Tanzania.[9] A survey with similar methodology in Mongolia revealed similar predominance of falls among school aged children (2–14 years) as observed here.[29] Urban-rural variations in fall circumstances were reported in other low and middle income countries where falling from trees or in farms and roads was more common in rural areas.[9 22] In the rural outskirts of Khartoum state, the majority of non-fatal falls were from the same level or heights lower than 2 m.[11] Whether this is also the case in other rural parts of Sudan and whether a link with agricultural activities may explain the association of falls with poverty only in rural areas needs to be investigated.

Animal bites and venom

The link of snake bites with agricultural activities and with rural areas in developing countries has been previously highlighted.[30 31] Thus, predominance of agricultural activities in rural areas and the different natural and built environment compared with urban areas may explain the higher risk of injury by this group of causes there. Differentials in care-seeking behaviour may explain the higher risk of hospitalised injury from that cause among those with higher education achievement.

Assault

Assault is more subject to under-reporting than other injury causes, particularly among women,[32 33] which could partly explain the observed gender difference. The study revealed a socioeconomic differential that concurs with the well-documented violence-poverty link attributable to a range of factors such as income inequality, unemployment and material deprivation, operating at individual and contextual levels.[6 34 35] The situation in Sudan is complicated by continuing conflict, with substantial internal displacement that perpetuates poverty.[36] It also tops a pattern of inequitable spending on healthcare where low income families spend the same proportion of their income on healthcare as higher income families.[37]

Mechanical injuries

Unintentional injury from mechanical forces may include a considerable proportion of occupational injuries. For example, data from Tanzania suggests that workplace is one of the most common place of mechanical injury in urban areas, while farms were the most common place in rural areas.[9] There are no similar details for this group of injuries in Sudan, and an investigation of the place of such injuries is required to confirm if occupational risk could explain why men and adolescents/adults of working age were particularly vulnerable.

Poisoning

Acute poisoning is more likely to have been captured by the survey, being more recognisable than chronic poisoning. Heterogeneity in the range of possible causative agents, such as household cleaners, agricultural chemicals and hair dye (commonly used by women for body decoration) hinders the

interpretation of the observed educational differential, but could also explain the lack of association with the other sociodemographic variables. Clearer vulnerability patterns may exist at causative agent level, and could be revealed in a study that identifies those agents.

Fire or hot substance

Similar to the situation in other parts of the world,[7] children under 5 years in Sudan were the most likely to suffer burns with fire or hot substance. This may point to lack of child-proofing of cooking amenities or of the handling of hot or flammable material in the home, where the majority of childhood burns occur.[38 39] For example, in rural Bangladesh, housing with easy access to cooking areas and use of the traditional kerosene lamp was associated with childhood burns.[40] Evidence from Sudan suggests that hot liquid or steam is the main cause of burns, which were also a major form of home injuries.[11] An investigation to confirm if a similar association with housing conditions exists in Sudan is thus warranted.

CONCLUSIONS

Men in Sudan were vulnerable to more than one injury cause, requiring special consideration in a country where they contribute the most to families' financial stability but where their health receives little attention. Elderly people, children under 5 years and people of low socioeconomic status are universally vulnerable groups that are already affected by communicable and non-communicable diseases but were also differentially affected by injury from various causes. Thus, existing disease prevention and health promotion programmes in Sudan should expand to include safety elements targeting those groups, within an overarching multisectoral injury prevention policy. Longitudinal studies are needed in Sudan to confirm the vulnerability patterns observed and whether they also apply to fatal injury, and to investigate the context-specific behavioural, social, environmental and occupational risk factors and injury circumstances that shape them.

What is already known on the subject

- Various patterns of sociodemographic differentials in injury morbidity were reported from low and middle income countries.
- Limited research from Sudan revealed gender and socioeconomic differentials in all-cause non-fatal injury.

What this study adds

- In Sudan, men and elderly people were at higher risk of a multitude of injury causes including road traffic injuries and falls which were major causes of non-fatal injury.
- Children under 5 years were at higher risk of non-fatal injury due to fire or hot substance and interpersonal violence was concentrated in people of low socioeconomic status. Urban residence was associated with road traffic crashes and falls, while rural residence was associated with injury from animal bites or venom.
- Heterogeneity in vulnerability at subnational level was evidenced by an association of falls with socioeconomic status that was limited to rural areas.

Acknowledgements The Sudan Household Health Survey 2010 was carried out by the Federal Ministry of Health and the Central Bureau of Statistics of the Republic of Sudan, in collaboration with the Ministry of International Cooperation, Ministry of Education, Ministry of Social Welfare and Women and Child Affairs, National Population Council, National Council for Child Welfare and National Water Corporation. Financial and technical support were provided by United Nations Children's Fund, United Nations Population Fund, WHO, United Nations Development Programme (UNDP), World Food Programme (WFP), the UNAIDS, Pan Arab Project for Family Health, USA Agency for International Development and the Japan International Cooperation Agency. Data entry and cleaning was carried out by the Central Bureau of Statistics of Sudan. The efforts of the state management teams (listed in the supplementary file), data collectors and the survey respondents and of Dr Saeid Shahraz in helping with injury module design, Ms Nahid Abdelgadir in facilitating data access and Dr Abdel Moneim Mukhtar in reviewing an early draft of this manuscript are deeply acknowledged.

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Funding This work was supported by a grant for further analysis of the Sudan Household Health Survey 2010 data from United Nations Children's Fund, Sudan.

Competing interests None.

Ethics approval Federal Ministry of Health Research Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The Sudan Household Health Survey 2010 data will be deposited by the National Management Team at the Sudan Central Bureau of Statistics from where it can be requested.

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Women win in UN negotiations on guns

The 5th Meeting on States on Small Arms (BMS5) has committed all UN members to promote the participation of women in policy, planning and other projects related to guns. (Ammunition was not covered in the agreement because some countries, including the US and Egypt, blocked doing so.) Source: Rebecca Peters, The International Action Network on Small Arms, 20 June 2014 (noted by IBP).