

Injuries and deaths due to victim-activated improvised explosive devices, landmines and other explosive remnants of war in Nepal

Oleg O Bilukha,¹ Hugues Laurence,² Luhar Danee,² Krishna P Subedi,³
Kristin Becknell¹

¹International Emergency and Refugee Health Branch, Center for Global Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

²United Nations Children's Fund, Kathmandu, Nepal

³Informal Sector Service Center, Kathmandu, Nepal

Correspondence to

Dr Oleg O Bilukha, International Emergency and Refugee Health Branch, Center for Global Health, CDC 4770 Buford Hwy, MS F-60, Atlanta, GA 30341, USA; obilukha1@cdc.gov

Accepted 23 December 2010

ABSTRACT

Background Following more than a decade of civil conflict, Nepal is among the countries affected by landmines, victim-activated improvised explosive devices (IED) and other explosive remnants of war (ERW).

Objectives To assess the magnitude of injuries due to landmines, victim-activated IED and other ERW in Nepal and to describe epidemiological patterns and risk factors for these events.

Methods Analysis of surveillance data on civilian injuries due to landmines, victim-activated IED and other ERW between July 2006 and June 2010. Data were collected through active community-based prospective surveillance.

Results Of 307 total casualties, 94 (31%) were female and 169 (55%) were children under 18 years of age. The case–fatality ratio was 14%. The highest number of casualties was in the age group 10–14 years. 233 (76%) injuries were caused by victim-activated IED, 13 (4%) by landmines and 44 (14%) by other ERW. Two types of IED, sutali and socket bombs, caused the majority of injuries (28% and 31%, respectively). 117 (38%) of all injuries occurred in victims' homes and 152 (50%) occurred while victims were tampering with explosive devices.

Conclusions Substantial numbers of civilians, including women and children, were injured and killed following implementation of the Comprehensive Peace Agreement in 2006. The government of Nepal and humanitarian organisations should continue their efforts to reach communities at highest risk through targeted interventions and nationwide media campaigns to convey the risks of tampering with explosive devices or suspicious objects.

Landmines, victim-activated improvised explosive devices (IED), and other explosive remnants of war (ERW) continue to pose a significant threat to lives and livelihoods in many conflict and post-conflict settings.^{1–5} Landmine Monitor has identified over 73 000 reported casualties caused by landmines, ERW and victim-activated IED in 119 countries during the past decade (1999–2008).² This number probably represents only a fraction of all injuries and deaths because of incomplete detection and reporting and lack of data collection systems in many affected countries. The total number of casualties worldwide in the past decade is not known, but is estimated to be 'in the hundreds of thousands'.² The annual number of injuries, however, has been declining over the past decade. It

decreased from over 8000 per year in 1999–2003 to fewer than 5500 per year during 2007–8.²

Nepal is highly affected by landmines, IED and other ERW due to the armed conflict between the government of Nepal and the Communist Party of Nepal (Maoist) (CPN/M) that started in February 1996. An estimated 12 000 persons were killed and over 100 000 were displaced during the conflict, which formally ended with the signing of the Comprehensive Peace Agreement (CPA) in November 2006.⁶ CPN/M has since entered the parliamentary process and intermittently joined the government, and its People's Liberation Army (PLA) is undergoing demobilisation.² However, political tensions remain high; dozens of armed groups have emerged following the signing of the CPA and are active in certain regions of the country. The proliferation of armed groups since 2007, especially in the southern region of Nepal (Terai belt), has led to ongoing contamination with unexploded or abandoned IED.²

Both government security forces and the PLA used antipersonnel landmines and IED during the decade of internal armed conflict (1996–2006).⁷ Government security forces primarily used landmines and command-detonated IED to create defensive perimeters around army installations, police posts, government offices and other key infrastructure.⁷ PLA forces predominantly used home-made IED, including booby traps. Socket bombs (improvised hand grenades made of galvanised pipe sockets; figure 1) and sutali bombs (also used as improvised hand grenades; figure 2) have been reported as key explosives causing contamination in the areas of military corridors and engagements and presenting risk to civilians, especially to children.⁷

The 2006 CPA brought significant progress to mine action efforts. As of July 2009, the Nepali army had cleared 17 of 53 known minefields and 90 of approximately 300 'IED fields' laid by government security forces.² The destruction of IED stored at the seven PLA cantonment sites was completed in 2009. There have been no reports of the use of landmines or victim-activated IED by the PLA since the May 2006 cease fire.² However, a number of armed rebel groups are reported still to use IED, and explosive devices stored in civilian homes or abandoned near villages still pose a threat to civilians.² We undertook this study to assess the magnitude, time trends and risk factors of injuries and deaths due to landmines, victim-activated IED and other ERW in Nepal during 2006–10.



Figure 1 Socket bomb.

METHODS

Data on injuries caused by victim-activated IED, landmines and other ERW in Nepal were obtained from the United Nations Children's Fund (Unicef) and Informal Sector Service Center (INSEC). INSEC is a Nepali non-governmental organisation (NGO) with the primary mission of promoting policies, institutions and capacity that contribute to the protection and promotion of human rights. INSEC staff collects injury surveillance data and manages the casualty database. The database included injuries that occurred over a 4-year period, between 1 July 2006 and 30 June 2010.

INSEC implemented a nationwide active prospective surveillance for these injuries in July 2006 in collaboration with Unicef and with initial support from the international NGO Handicap International. INSEC supported staff members called 'district representatives' in each of the 75 districts in Nepal. District representatives were trained in casualty data collection and continuously monitored local and national media (both in Nepali and English languages) and community networks (eg, local police, district administrations, village-level authorities, partner NGO) to identify incidents as soon as they occurred. Initial incident reports came from a variety of sources, including injured individuals and their families, witnesses and other community members, police officers, teachers, health workers, community-based organisation personnel and newspapers and other media.



Figure 2 Sutali bomb.

After obtaining an initial incident report, the respective district representatives visited the site and interviewed the victim, family member of the victim or an eyewitness using a standardised data collection form that conforms to a standard questionnaire of the WHO recommended for use in the surveillance of landmine and unexploded ordnance injuries worldwide.⁸ Information collected included the date and location of the incident, victim demographics, circumstances of the incident (eg, victim's activity at the time of incident, type of explosive device that caused the incident) and type of injuries sustained by the victim. Verbal informed consent was obtained before the interview.

Only data on civilian non-combatants injured by landmines, victim-activated IED and other ERW were included in the database. The case definition used by the surveillance system included casualties injured or killed by explosive devices activated unknowingly or without the intention to harm, hurt or terrorise. Excluded were those involved in military or guerilla activity at the time of the incident, victims of command-detonated explosive devices and victims injured directly during active fighting (eg, those injured by bullets, artillery or rocket projectiles, aerial bombing, hurled IED or hand grenades). Victim-activated IED were defined as home made (as opposed to industrially manufactured) explosives (such as sutali or socket bombs) that were not command detonated. Other ERW were defined as industrially manufactured explosive devices or their parts, such as detonators, grenades, bombs or mortar shells, which were deployed or scattered during military activities but failed to detonate. 'Incident' was defined as an explosion of landmine, victim-activated IED or other ERW resulting in one or more casualties as defined above.

The database was checked for duplicate entries by the trained data manager by comparing victim demographics and the time and location of the incident. Statistical analyses were performed using JMP software (release 8.0). Differences in proportions were assessed with Pearson χ^2 tests. The significance of the time trends was examined using Poisson regression. *p* Values less than 0.05 were considered statistically significant. The Institutional Review Board of the Centers for Disease Control and Prevention exempted this study from review. Personal identifiers were not included in the final dataset used for analyses.

RESULTS

Analysis included 307 Nepali civilians injured or killed in 138 incidents caused by landmines, victim-activated IED and other ERW from July 2006 to June 2010. Seventy-four (54.3%) incidents involved one casualty, 45 (32.6%) involved two to three casualties, 15 (10.9%) involved four to six casualties and three incidents involved more than six (nine, 11 and 32) casualties (table 1). The time trends show a significant decrease both in the number of incidents ($p < 0.001$) and in the total number of injuries ($p < 0.0001$) during the study period (figure 3). Overall, 213 (69%) injuries were among men and 169 (55%) were among children younger than 18 years of age (table 2). The distribution of injuries by age group and sex is presented in figure 4. The highest number of injuries occurred in the age group 10–14 years, followed by age groups 5–9 years and 15–19 years. The proportion of females was higher among adults than among children (38% vs 24%, $p < 0.01$). The highest number of female injuries was in the age group 5–9 years (figure 4).

More than three-quarters of all incidents (77%) were caused by IED including socket bombs and sutali bombs (causing 40.6% and 19.6% of all incidents, respectively). Other ERW and

Table 1 Distribution of incidents due to landmines, victim-activated IED and other ERW, Nepal, July 2006 to June 2010 (N=138)

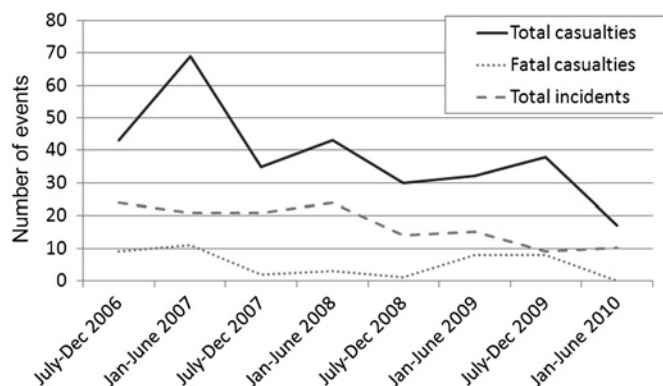
	Incidents, N (% total)
Type of explosive device	
Socket bomb	56 (40.6)
Sutali bomb	27 (19.6)
Other IED	23 (16.7)
Landmine	9 (6.5)
Detonator	9 (6.5)
Hand grenade	2 (1.4)
Other ERW*	5 (3.6)
Unknown	7 (5.1)
Place of incident	
Home	55 (39.9)
Road or path	23 (16.7)
Forest or grassland	19 (13.8)
Agricultural land	14 (10.1)
Village or town	12 (8.7)
Other	15 (11.5)
No of persons injured or killed per incident	
One	75 (54.3)
Two to three	45 (32.6)
Four to six	15 (10.9)
More than six	3 (2.2)

*Industrially manufactured explosive devices or their parts, such as bombs, rockets or mortar shells, which were deployed or scattered during military activities but failed to detonate (excluding detonators and hand grenades, which are listed separately in the table). ERW, explosive remnants of war; IED, improvised explosive devices.

landmines caused 11.5% and 6.5% of all incidents, respectively; the type of explosive device was unknown for 5.1% of incidents (table 1). Similarly, 75.8% of all injuries were caused by IED (including 30.9% by socket bombs and 28.0% by sutali bombs), 14.3% by other ERW and 4.2% by landmines (table 2).

Overall, 55 (39.9%) incidents and 117 (38.1%) injuries occurred in victims' homes. Forty-one per cent of incidents caused by IED and 56% of incidents caused by other ERW occurred in homes. Other common places where incidents occurred were roads or paths (16.7% of all incidents), forest or grassland (13.8%) and agricultural land (10.1%) (table 1).

Approximately 50% of all injuries were sustained when victims were handling or otherwise tampering with (eg, burning, hitting, throwing) the explosive device (table 2). Children were more likely than adults to be injured while engaged in

**Figure 3** Time trends in number of casualties and incidents due to landmines, victim-activated improvised explosive devices and other explosive remnants of war in Nepal, July 2006–June 2010.

these activities (62.1% of children vs 35% of adults, $p<0.0001$). On the other hand, injured adults were more likely to be bystanders in situations when someone else activated the explosive device (37.0% of bystanders among adults vs 21.3% among children, $p<0.01$). None of the 307 injured individuals reported receiving mine risk education (MRE) before the incident. Of those injured while handling or otherwise tampering with the explosive devices, only one individual reported to be aware that this activity was dangerous.

The overall case–fatality ratio was 13.7%. Of 42 fatal casualties, 35 (83.3%) died at the scene, two (4.8%) on the way to the health facility and four (9.5%) at the health facility; the place of one death was unknown. The case–fatality ratio for injuries caused by landmines and other ERW (24.6%) was higher than for injuries caused by IED (9.4%, $p<0.01$). In survivors, upper body injuries were more common than lower body injuries (34.9% vs 16.6%); 25.7% of casualties had both upper and lower body injuries. The case–fatality ratio and distribution of injury locations were similar among children and adults (table 2).

DISCUSSION

This study demonstrates that substantial numbers of civilians have continued to be injured and killed in Nepal following implementation of the ceasefire and CPA in 2006. Although the time trends show a decrease in the number of injuries and incidents during July 2006–June 2010, the situation remains fragile. The high proportion of children among the injured and the high proportion of injuries sustained while playing or tampering with explosive devices are particularly troubling.

Children and adolescents under 18 years of age constituted a high proportion (55%) of all casualties in Nepal. Similarly high proportions of children among casualties (but still lower than those observed in Nepal) were found in Afghanistan (47% of all casualties <18 years of age),⁹ Laos (46% <15 years of age)¹⁰ and Eritrea (41% <15 years of age).¹¹ The proportions of children among casualties in Chechnya (26% <18 years of age),¹² Bosnia and Herzegovina (14% <18 years of age),¹³ Mozambique (7% <15 years of age)¹⁴ and Iran (23% <17 years of age)¹⁵ were much lower. This finding suggests that children in Nepal are at high risk of injury and should remain a priority target for MRE and other risk-reduction interventions.

Another interesting observation was the high proportion of females (31%) among the casualties. It was much higher than observed in previous studies from Chechnya (19% females among casualties),¹² Afghanistan (8% females),^{16 17} Eritrea, and Bosnia and Herzegovina (both 10% females).^{11 13} The proportion of females in our study was especially high among adult casualties (38%). This may suggest that a high proportion of Nepali women are mobile and engage in daily activities that put them at risk of injury along with males. Therefore, risk reduction interventions among adults should equally target males and females.

A very high proportion of injuries in Nepal (76%) was caused by home-made IED, which is a unique finding not documented in published studies from other affected countries. Only 14% of injuries were caused by other ERW and 4% by landmines. Furthermore, among home-made IED the two by far most common explosives causing injuries were sutali and socket bombs (28% and 31% of all injuries, respectively). These are relatively small explosive devices that have been produced in large quantities and were most commonly used as home-made hand grenades hurled at the enemy during combat.⁷ The high

Table 2 Distribution of casualties due to landmines, victim-activated IED and other ERW by age group, Nepal, July 2006 through June 2010 (N=307)*

	Children (0–17 years) N (%)	Adults (18 years and older), N (%)	p Value*	Total N (%)
Total casualties (% of total)	169 (55.0)	138 (45.0)	0.008	307 (100.0)
Sex				
Male	128 (75.7)	85 (61.6)		213 (69.4)
Female	41 (24.3)	53 (38.4)		94 (30.6)
Type of explosive device				
Sutali bomb	51 (30.2)	35 (25.4)	0.17	86 (28.0)
Socket bomb	58 (34.3)	37 (26.8)		95 (30.9)
Other IED	23 (13.6)	29 (21.0)		52 (16.9)
Hand grenade	8 (4.7)	5 (3.6)		13 (4.2)
Detonator	10 (5.9)	7 (5.1)		17 (5.5)
Other ERW†	7 (4.1)	7 (5.1)		14 (4.6)
Landmine	3 (1.8)	10 (7.3)		13 (4.2)
Unknown	9 (5.3)	8 (5.8)		17 (5.5)
Activity at the time of injury				
Handling explosive, playing/curiosity	73 (43.2)	25 (18.1)	<0.001	98 (31.9)
Handling explosive, unspecified reasons	11 (6.5)	9 (6.5)		20 (6.5)
Burning, throwing, or hitting explosive	21 (12.4)	13 (9.4)		34 (11.1)
Standing nearby and/or watching	36 (21.3)	51 (37.0)		87 (28.3)
Collecting wood/food/water	3 (1.8)	11 (8.0)		14 (4.6)
Travelling	3 (1.8)	8 (5.8)		11 (3.6)
Other/unknown	22 (13.0)	21 (15.2)		43 (14.0)
Place of incident				
Home	63 (37.3)	54 (39.1)	0.008	117 (38.1)
Village or town	24 (14.2)	7 (5.1)		31 (10.1)
Agricultural land	25 (14.8)	32 (23.2)		57 (18.6)
Forest or grassland	15 (8.9)	12 (8.7)		27 (8.8)
Road or path	30 (17.8)	14 (10.1)		44 (14.3)
Other	12 (7.1)	19 (13.8)		31 (10.1)
Injury type				
Death	25 (14.8)	17 (12.3)	0.96	42 (13.7)
Upper body injury	61 (36.1)	46 (33.3)		107 (34.9)
Lower body injury	27 (16.0)	24 (17.4)		51 (16.6)
Upper and lower body injury	43 (25.4)	36 (26.1)		79 (25.7)
Unknown	13 (7.7)	15 (10.9)		28 (9.1)

*Pearson χ^2 test, association between age group and respective variable.

†Industrially manufactured explosive devices or their parts, such as bombs, rockets or mortar shells, which were deployed or scattered during military activities but failed to detonate (excluding detonators and hand grenades which are listed separately in the table).

ERW, explosive remnants of war; IED, improvised explosive devices.

number of incidents caused by these devices may be partly due to failure of the devices to explode during combat and subsequently causing contamination in areas of previous military engagements. Some of the incidents may also be caused by unused devices stored in or near settlements. Another reason is that in Nepal, home-made IED often do not look like explosives. A socket bomb, for example, may look like a piece of an iron pipe or a part of a motor engine (figure 1), whereas a sutali bomb often resembles a small home-made ball or a valuable object packed with rope or string (figure 2).

A high proportion of injuries (50%) were sustained when victims were handling or otherwise tampering with (throwing, hitting, or burning) explosive devices. These high-risk activities were especially common among children, with three out of five injured children tampering with explosives at the time of the incidents. Among adults this proportion was lower (35%), but many adults (37%) were injured or killed while standing nearby when the explosions occurred. It is possible that in some of these situations an adult saw others manipulating the explosive but did nothing to prevent the incident. Surprisingly, only one of the

casualties injured while handling an explosive reported knowing that this activity was dangerous. These data suggest that child and adult casualties in Nepal generally did not realise the dangers of touching, playing with, hitting or burning explosive devices.

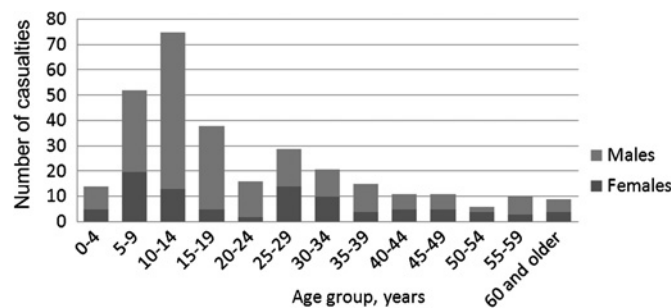


Figure 4 Age and sex distribution of injuries and deaths caused by landmines, victim-activated improvised explosive devices and other explosive remnants of war in Nepal, July 2006–June 2010.

Forty per cent of explosions causing injury occurred in victims' homes. This suggests that many of those injured were not only unafraid to handle explosives, but were also willing to bring them to or store them in their homes, putting other family members at serious risk. Therefore, it is critical that MRE activities supported by the Nepalese Ministry of Peace and Reconstruction, Unicef, International Committee of the Red Cross, Nepal Red Cross Society, Nepalese Ministry of Education and other organisations continue and are targeted to communities at highest risk. More qualitative research may be needed to understand better the reasons why people handle explosives or do not deter others from doing so, and why they bring or keep explosives at home.

Strengths and limitations of the study

Data presented in this paper were collected through active, community-based prospective surveillance in which information about incidents and casualties was obtained from a variety of sources, including governmental and non-governmental structures, the media and community members. Active community-based data collection systems are likely to have higher sensitivity (ie, register more events under surveillance) than systems collecting data solely through health facilities.^{11 16 18} Also, all casualty data in this study were collected prospectively, shortly after the incident. This is in contrast to recent studies from Bosnia and Herzegovina¹³ and Chechnya,¹² where some surveillance data were collected retrospectively and thus were more likely to have had lower sensitivity in detecting casualties and higher susceptibility to recall bias.

Our study is subject to several limitations. First, self-reported data are subject to reporting bias. This bias may be especially problematical when the victim is killed and the information on the incident is collected from eyewitnesses or family members. Second, because of security concerns, data collection included only civilian non-combatants and excluded members of the military, armed police force, PLA and other insurgent groups. This may have underestimated the magnitude of the problem and limited interpretation of the epidemiological patterns and risk factors for injury. Third, in spite of efforts to collect data on all civilian casualties, it is unlikely that all eligible casualties were detected by surveillance, which would also somewhat underestimate the magnitude of the problem. Finally, active prospective surveillance was instituted in July 2006, following the May 2006 ceasefire and shortly before the November 2006 signing of the CPA. Therefore, the surveillance system did not capture most of those injured and killed by landmines, victim-activated IED and other ERW during the decade of active military conflict (1996–2006).

CONCLUSIONS

Although the number of incidents and casualties due to landmines, victim-activated IED and other ERW has decreased over the past 4 years, the threat to civilians remains. Most of the injuries are caused by home-made explosive devices, and many incidents occur in victims' homes and in situations in which casualties tamper with explosives. Unicef, Nepal Red Cross Society and other humanitarian organisations collaborating with the government of Nepal should continue their efforts to reach communities at highest risk through targeted interventions and nationwide media campaigns to convey the risks of tampering with known explosive devices or suspicious objects. Timely, coordinated and sustained efforts of all stakeholders will be critical in preventing further injuries and deaths from victim-activated IED and other ERW in Nepal.

What is already known on the subject

- ▶ Landmines, victim-activated IED and other ERW (such as unexploded or abandoned munitions) continue to pose a significant threat to civilians (including women and children) in many conflict and post-conflict settings.
- ▶ In many affected countries, unexploded or abandoned ordnance cause more injuries than landmines. These explosives are more visible than landmines, and areas contaminated with these devices are easier and cheaper to clear than minefields.

What this study adds

- ▶ In some affected countries the main cause of injuries due to landmines and ERW is shifting from industrially manufactured to home-made explosive devices. In Nepal, victim-activated IED caused three of every four injuries, whereas landmines caused only 4% of injuries.
- ▶ Because victim-activated IED are usually visible, but often do not look like military objects posing danger, a very high percentage of injuries are sustained when the casualties, especially children, tamper with these devices.

Acknowledgements The authors would like to thank the Informal Sector Service Center and the United Nations Children's Fund for providing the data on victims of victim-activated IED, landmines and other ERW in Nepal.

Competing interests None.

Ethics approval Exempted from review by the Institutional Review Board of the Centers for Disease Control and Prevention as the primary intent of surveillance was determined to be non-research. The study constitutes a secondary analysis of surveillance data routinely collected for programmatic purposes.

Contributors OOB and HL designed the study; HL, LD and KPS collected the data; OOB and KB analysed the data; OOB and HL interpreted the data; OOB drafted the manuscript; HL, LD, KPS and KB critically revised the manuscript for important intellectual content. OOB is a guarantor. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention and the United Nations Children's Fund.

Provenance and peer review Not commissioned; externally peer reviewed.

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Inj Prev published online February 4, 2011

doi: 10.1136/ip.2010.030312

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