



Recreational avalanche accidents in Switzerland

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Avalanche accidents

Since the winter 1936/37

- 1884 people died in 1194 avalanches (annual mean 24.5, 1.6 p. per aval., Fig. 1)
- 8356 people were caught in 3540 avalanches (2.4 people per avalanche)
- before 1970's: 30% of fatalities occurred in or around buildings, while travelling or working on roads, railways or on groomed ski runs
- since 1970's: 90% of fatalities during recreational activities in uncontrolled terrain

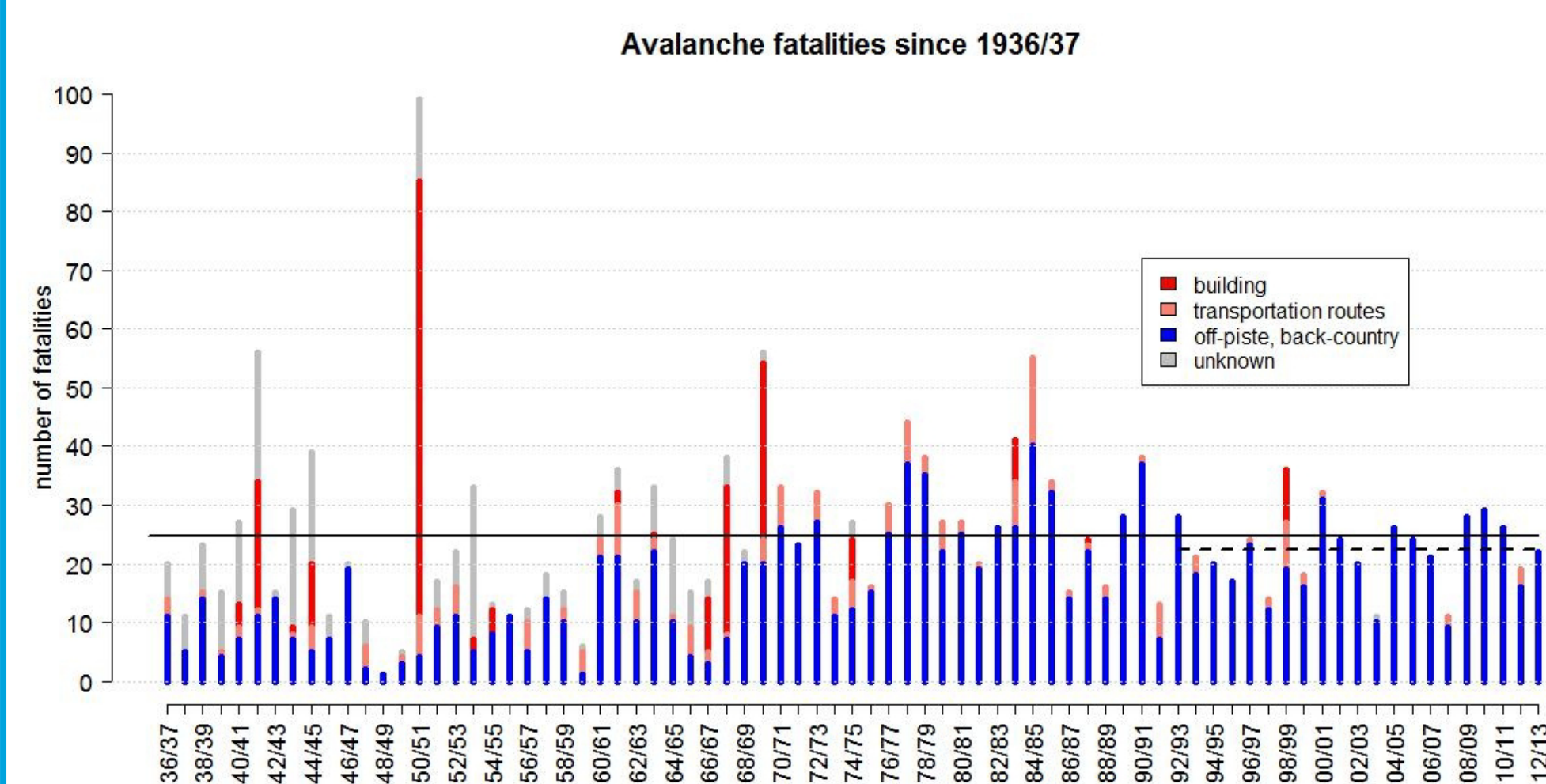


Fig. 1: Number of avalanche fatalities in Switzerland since 1936/37 according to location. Annual mean number of fatalities: 77 years: 24.5 (black line), last 20 years: 22.4 (black dotted line)

20-year period 1992/93 until 2011/12

- 3519 people caught in 1902 avalanches
- 50% of reported avalanches with severe consequences (fatality, injury, full burial, Fig. 2)
- 90% in uncontrolled terrain:
 - 417 died
 - 805 full burials (head in snow)
 - off-piste 33% / backcountry touring 67%
 - 90% during months Dec-Apr
 - 55% on weekends
 - 95% dry slab avalanches

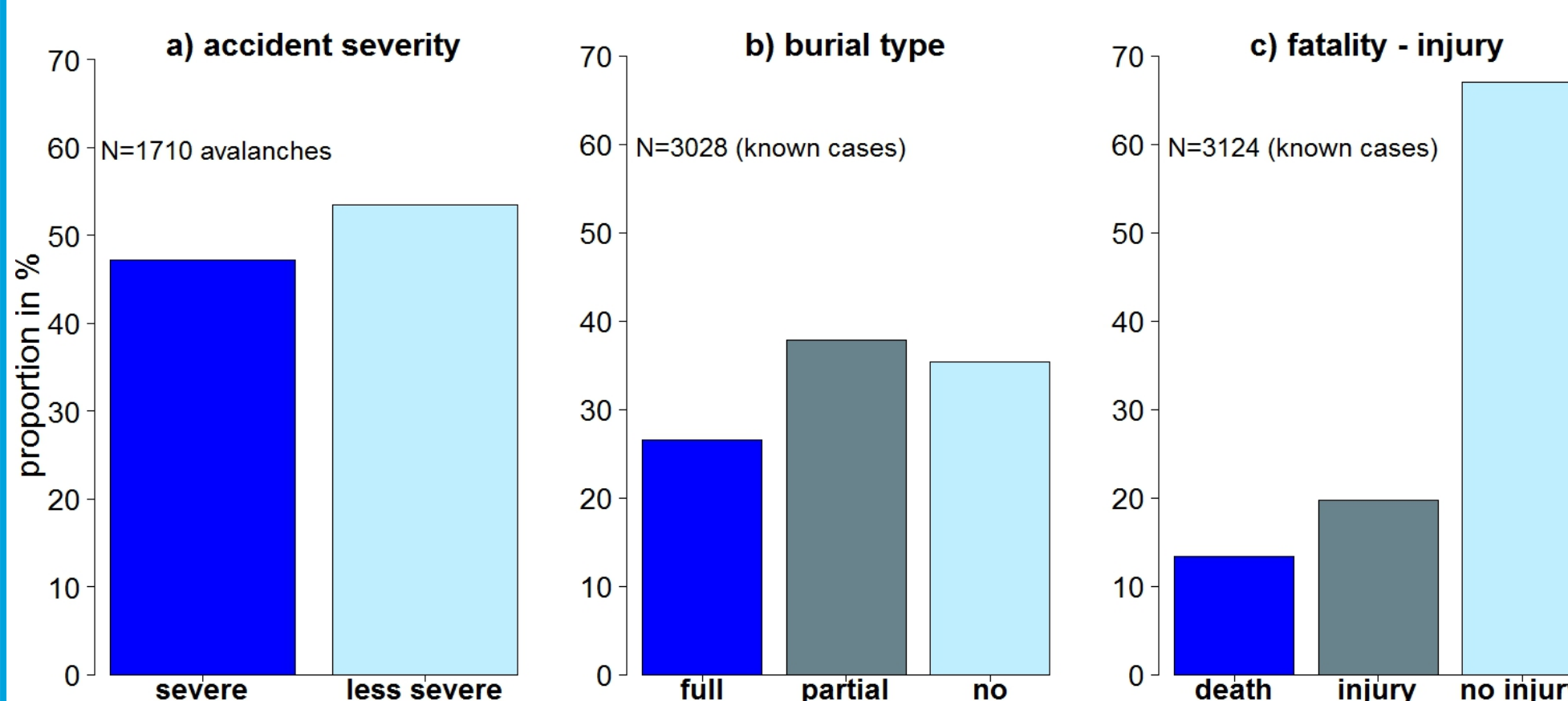


Fig. 2: Avalanche accidents in uncontrolled terrain by severity of consequences (a; severe = death, injury, full burial) and proportion of people caught by burial type (b) and consequence (c).

The number of unreported accidents



Fig. 3: Skier-triggered avalanche. One person was caught, but neither buried nor injured. How many of these avalanche incidents go unreported?

Photo: Marty, 2011

- avalanches resulting in fatalities – probably all are recorded
- avalanches without severe consequences – at least 20% go unreported (see Fig. 3+4)

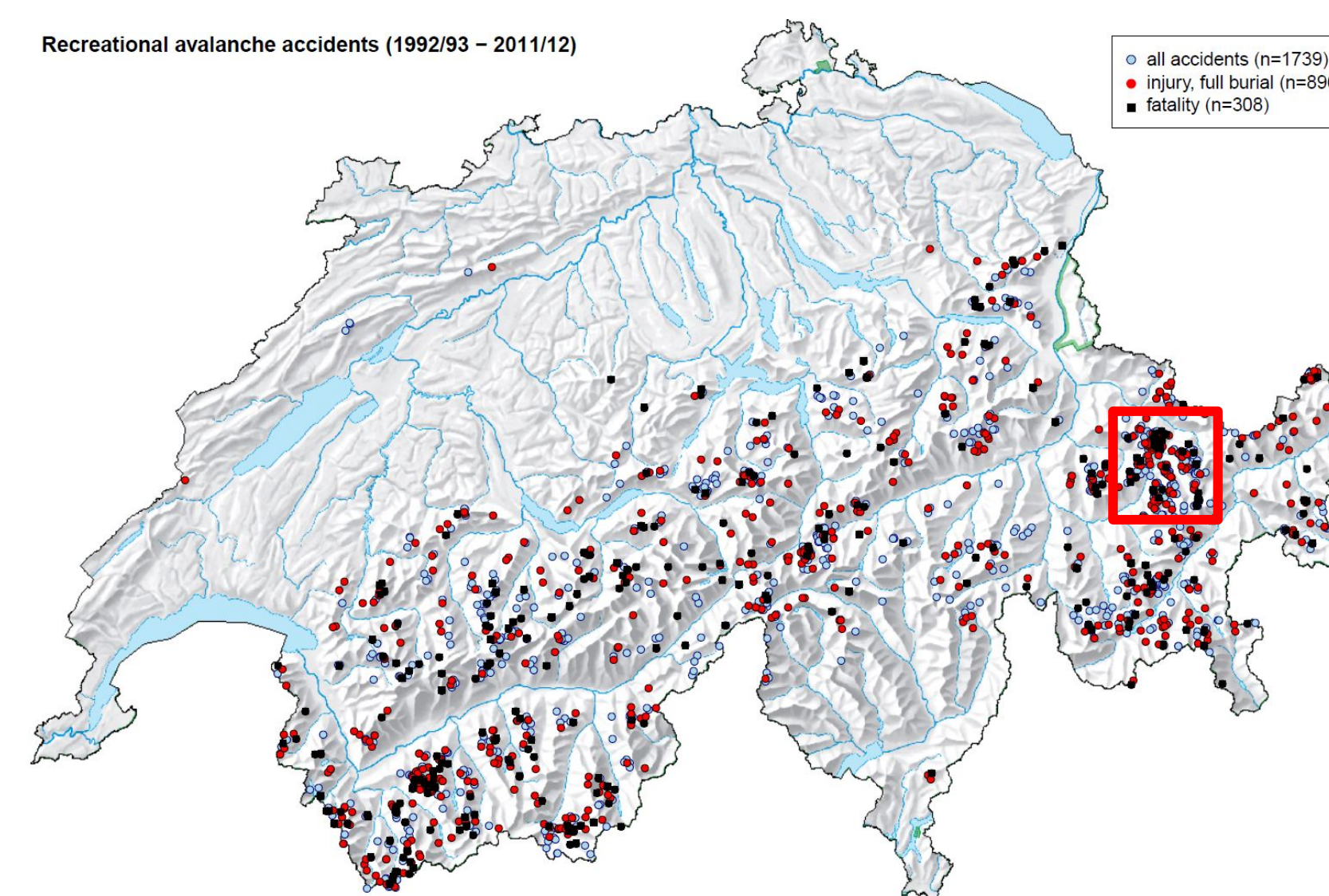


Fig. 4: Recreational avalanche accidents in Switzerland (1992/93 – 2011/12) with known location. About 50% of reported accidents were severe accidents resulting in full burial, injury or death of at least one person. Proportionally less severe accidents were reported in the well-observed region of Davos (33%, red box) than in the remainder of Switzerland (53%). Thus, we estimate that during this time period at least 20% of avalanche accidents went unreported.

Avalanche size and terrain characteristics

Tab. 1: Avalanche characteristics by accident severity (median values)

Consequence	Less severe*	Severe**
Fracture depth (cm)	40	50
Width (cm)	50	50
Vertical drop / length (m)	90 / 150	150 / 250
Unfavourable terrain***	27%	57%

* no injury, no fatality, no full burial

** injury, fatality or full burial

*** in avalanche path (rocks, rock cliffs, single trees, forest, gullies)

Burial and rescue

During the 20-year period 1992/93 until 2011/12

- 805 people were fully buried (median burial depth of 80 cm; median burial duration 30 min; Fig. 5+6)
- burial duration decreased significantly during recent decade (Fig. 5)
- burial duration was lowest and hence survival rate highest when visible clues indicated burial location (Fig. 7)

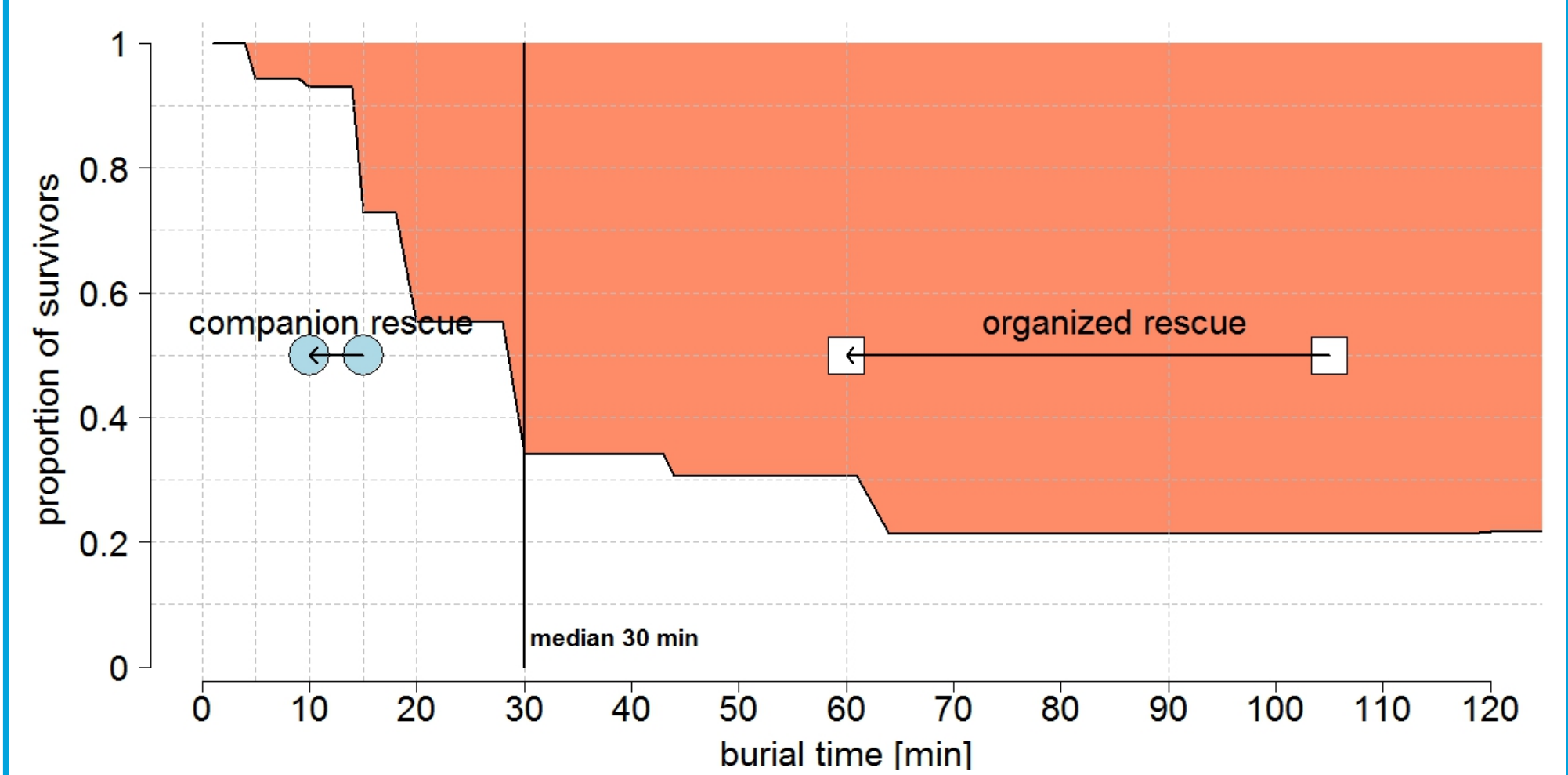


Fig. 5: Burial time and proportion of people who survived in uncontrolled terrain for 582 full burials with known burial duration (20 years 1992/93 – 2011/12, reliable data only, excluding 44 cases where cause of death was trauma). The curve was calculated by splitting the dataset into ten groups with equal number of persons. The decrease in the median burial time is shown for companion rescue (light-blue points) and organized rescue (white squares) for the two decades 1992/93 – 2001/02 and 2002/03 – 2011/12. The curve does not represent a survival curve.

Fig. 6: Burial depth and proportion of people who survived in uncontrolled terrain (20 years 1992/93 – 2011/12, n = 603). Median burial depth:

- companion rescue 50 cm
- rescue teams 100 cm

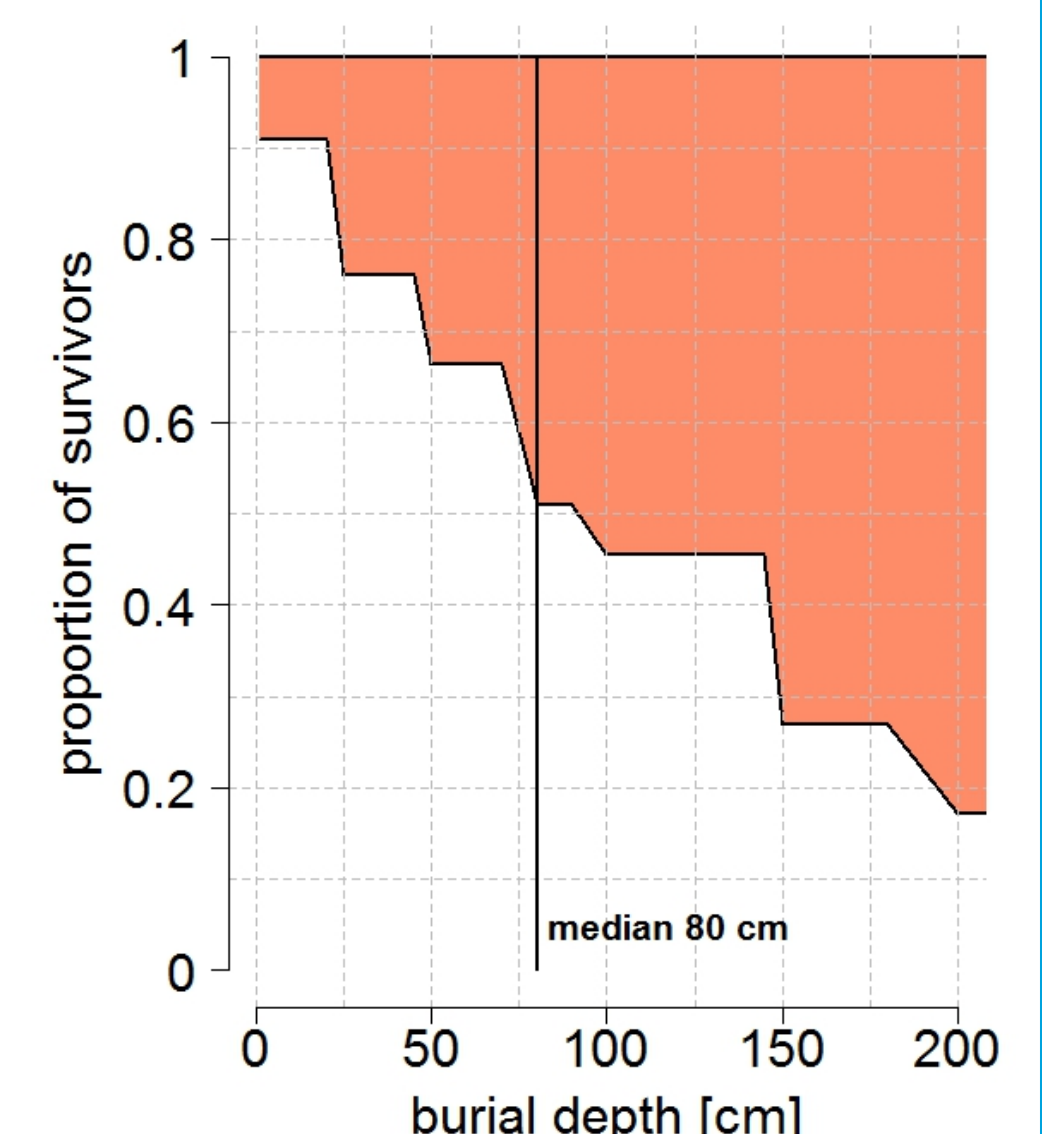
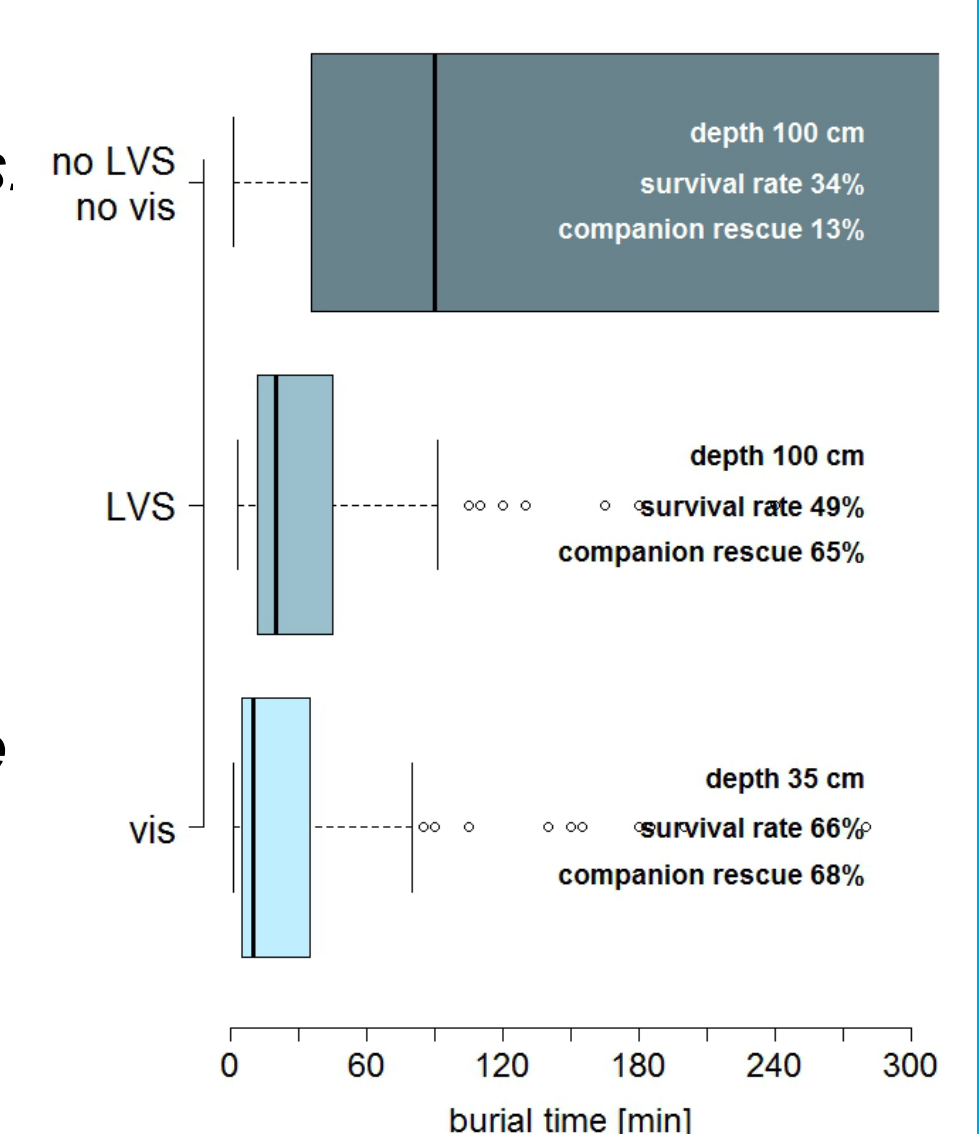


Fig. 7: Burial time by search method for fully buried persons visible parts (vis), with LVS (LVS; no visible parts, but maybe not exclusively with LVS) and neither LVS nor visible parts. Additionally, the median burial depth, the survival rate and the proportion of persons located by companions is given for each search method.



Avalanche danger

In uncontrolled terrain during the 20-year period 1992/93 until 2011/12:

- **reported accidents / fatalities**
 - 59% at danger level 3 (Fig. 8a)
 - 35% at danger level 2
- **off-piste accidents / fatalities**
 - 4 times more often at danger level 3 than 2
- **backcountry touring**
 - equally often at danger level 2 and 3 (44%)
 - more fatalities at danger level 3 than 2 (51% vs. 44%)
- **danger level 1**
 - avalanche accidents with severe consequences are rare (Fig. 8b)

- if severe avalanche accidents occur at danger level 1, avalanches are characterized by a larger length and vertical drop than at other danger levels

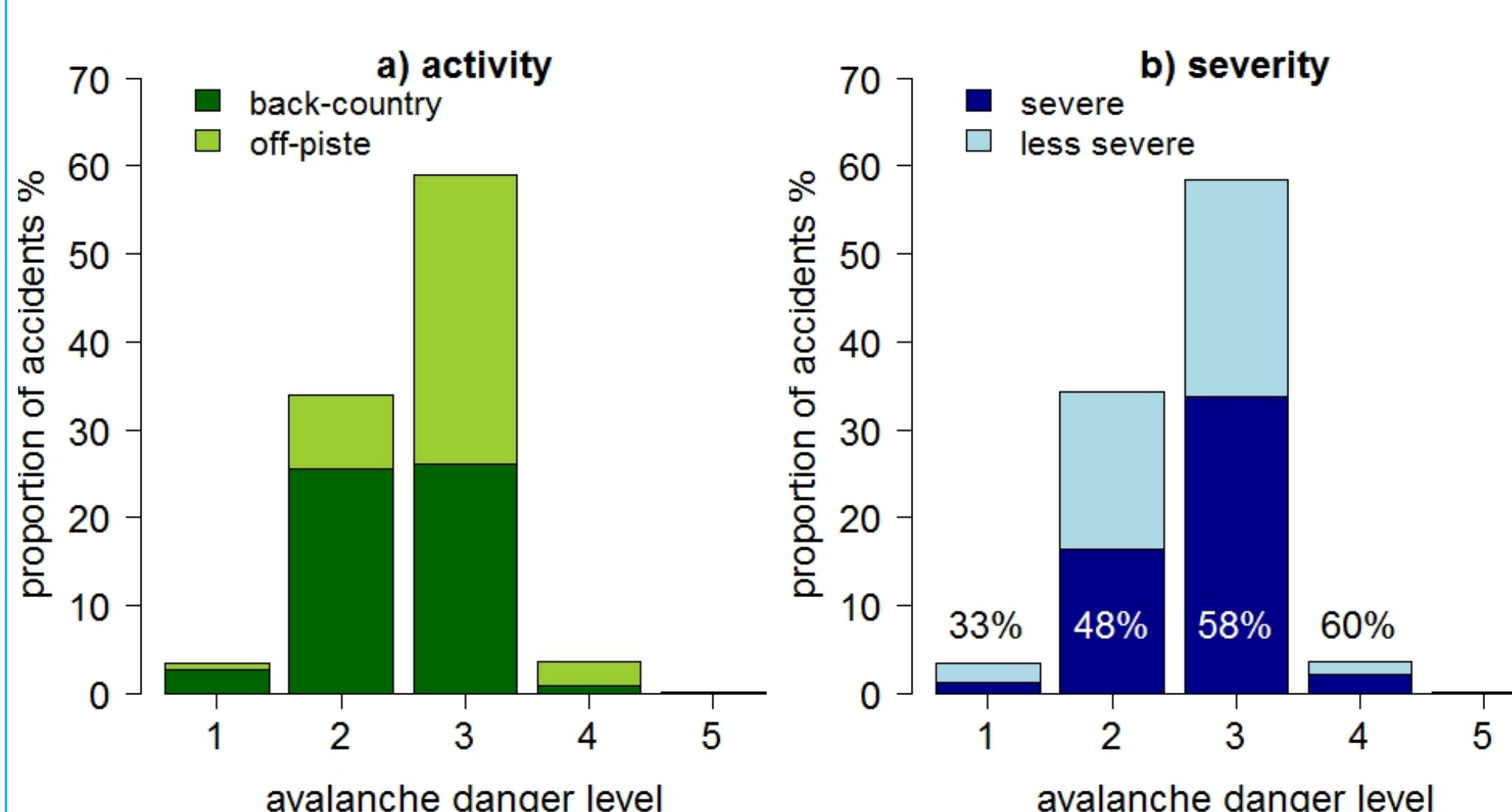


Fig. 8: Frequency of avalanche accidents by forecasted avalanche danger level in uncontrolled terrain – by activity (a) and accident severity (b; resulting in death, injury or full burial). The proportion of severe accidents is given for each danger level.

Conclusions

- In Switzerland, at least 20% of avalanche accidents go unreported (particularly those with less severe consequences).
- Almost all avalanche accidents involving people occur in uncontrolled terrain during recreational activities.
- Number of fatalities during last 20 years lower (22) than long-term mean (77 years: 24.5)
- Burial times have been reduced and hence survival rate has increased.
- Despite positive trends: an avalanche involvement remains potentially life-threatening!