

A COMPARISON OF AVALANCHE SURVIVAL PATTERNS IN CANADA AND SWITZERLAND

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EXTENDED ABSTRACT^{\$}

KEYWORDS: Avalanche survival, asphyxia, trauma, snow climate, rescue regime

1. INTRODUCTION

The survival pattern of completely buried individuals in open terrain has been depicted in the avalanche survival curve, which displays probability of survival as a function of burial time (Falk *et al.*, 1994). This curve, which was based solely on data from Switzerland, has a characteristic shape dividing avalanche survival into four distinct phases. This information has provided important conceptual background for the effective medical management of avalanche victims in the field (Brugger *et al.*, 2001, Boyd *et al.*, 2010) and the use of avalanche safety devices (Brugger *et al.*, 2007). However, a recent review of Canadian avalanche fatalities by Boyd *et al.* (2009) has shown that there are considerable differences in the causes of death between Canada and Europe (Hohlrieder *et al.*, 2007), which questions the universal validity of the existing survival curve and the derived recommendations. The purpose of this study was to examine Canadian survival patterns and to compare them with those from Switzerland.

2. METHODS

Relevant data for buried survivors and non-survivors were extracted from the databases of the Canadian Avalanche Centre and the Swiss Feder-

al Institute for Snow and Avalanche Research for the 25 year study period. Survival curves were calculated for Canada with and without trauma fatalities, for different outdoor activities as well as different snow climates and compared to the Swiss survival curve.

3. RESULTS

There were 301 Canadian and 946 Swiss records with overall survival rates of 46% and 47% respectively. The median extrication time in Canada was 18 minutes compared to 35 minutes in Switzerland reflecting the higher Canadian extrication rate within the first 5 minutes of burial (30% versus 14%) but lower extrication rate at burial times beyond 120 minutes (18% versus 25%). While the Swiss survival curve followed the general patterns described in earlier publications (Falk *et al.*, 1994; Brugger *et al.*, 2001), Canadian survival was characterized by a much quicker drop at the early stages of an avalanche burial (<35 min) and a much poorer survival in prolonged burials. Survival fell quicker with trauma and varied with snow climate, while no differences were observed among outdoor activities.

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4. DISCUSSION

Significant differences in survival patterns were observed between Canada and Switzerland. These differences are associated with the higher prevalence of trauma, differences in snow climate and likely characteristics of local rescue regimes. These results provide important background information for the management of avalanche victims in Canada and strongly highlight that, despite advances in avalanche rescue equipment and medical treatment of avalanche victims, the best approach for the prevention of avalanche fatalities remains through the promotion of awareness, education and caution.

REFERENCES

- Boyd J., Brugger H. and Shuster M. (2010). Prognostic factors in avalanche resuscitation: A systematic review. *Resuscitation*, 81(6): 645-652.
- Boyd J., Haegeli P., Abu-Laban R.B., Shuster M. and Butt J.C. (2009). Avalanche fatalities in Western Canada: A 21 year review. *Canadian Medical Association Journal*, 180(5): 507-511.
- Brugger H., Durrer B., Adler-Kastner L., Falk M. and Tschirky F. (2001). Field management of avalanche victims. *Resuscitation*, 51: 7-15.
- Brugger H., Etter, H.-J., Zweifel, B., Mair, P., Hohlrieder, M., Ellerton, J., Elsensohn, F., Boyd, J., Sumann, G. and Falk, M. (2007). The impact of avalanche rescue devices on survival. *Resuscitation*, 75: 476-483.
- Falk M., Brugger H. and Adler-Kastner L. (1994). Avalanche survival chances. *Nature*, 368: 21.
- Hohlrieder M., Brugger, H., Schubert, H. M., Palvic, M., Ellerton, J. and Mair, P. (2007). Pattern and severity of injury in avalanche victims. *High Altitude Medicine and Biology*, 8(1): 56-61.