

Brief communication: Keeping pace with human factors in avalanche decision-making—an update to the NHESS scoping review (2023–2026)

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Abstract. We update our NHESS scoping review of human factors in avalanche decision-making to include 35 peer-reviewed studies published 1 Jan 2023– 13 May 2026. The new studies concentrates in Decision-making strategies (9/35), with additions to Willingness to take risk (5/35), Population characteristics (4/35), Theory and Methods (5/35), Risk communication (3/35), Social factors and group decision-making (3/35), Risk perception (2/35), and Avalanche accidents (1/35), Motivation (1/35);
15 Avalanche education (1/35), Experience (1/35), none in Biases. Methods and sampling resemble the baseline. We recommend causal identification, behavioral linkage, and group-level designs. Data and scripts are openly provided; this is a time-bounded snapshot with a defined cut-off.

1 Introduction

20 Human exposure and choices remain central to avalanche risk. Our recent NHESS scoping review synthesized 70 peer-reviewed studies published by 31 Dec 2022, organizing a heterogeneous literature into 12 themes with a common codebook and open data. To maintain that reference as a living resource, we provide a time-bounded update through 13 May 2026, applying the identical protocol. The goals are to (i) report where growth occurred since 2022, (ii) flag where gaps persist, and (iii) suggest practical priorities for research, education, and operations.

25 2 Methods and data

Eligibility and scope followed the NHESS review: peer-reviewed English-language studies where human factors are central to risk assessment and/or decisions by individuals personally exposed in avalanche terrain (recreationists, guides, educators, patrollers, forecasters). We excluded rescue/medical-only, purely technical snow/terrain/forecasting, and operational risk management where the decision-maker is not personally exposed. ‘Ahead-of-print’ items were included if DOI-assigned by
30 the cut-off.

Information sources and search replicated the original multi-database strategy (Web of Science, Scopus, PsycInfo, Hospitality & Tourism Complete, ProQuest, ISSW proceedings; Google Scholar for scoping) using the unchanged two-bin Boolean logic

35 (“human factor” × “avalanche”) on titles/abstracts/keywords. Deduplication, dual screening, and dual extraction followed the published protocol; studies were assigned up to three of the 12 themes and coded for methods, population, risk target, focus, and explanatory factors. The cut-off is 13 May 2026.

3 Results and discussion

We identified 35 eligible peer-reviewed studies: 2023: 7, 2024: 3, 2025: 17, 2026: 8. Most additions appeared in 2025. Theme distribution (primary, TAG 1). Dominant: Decision-making strategies (9/35; 25.7%). Additional primary themes: Theory and Methods (5/35; 14.3%), Willingness to take risk (5/35; 14.3%), Population characteristics (4/35; 11.4%), Risk communication (3/35; 8.6%), Social factors & group decision-making (3/35; 8.6%), Risk perception (2/35; 5.7%), and single instances of Avalanche accidents (1/35; 2.9%), Avalanche education (1/35; 2.9%), Experience (1/35; 2.9%), and Motivation (1/35; 2.9%). No papers were identified under Biases. Methods and sampling resemble the baseline. We recommend causal identification, behavioural linkage, and group-level designs. Data and scripts are openly provided; this is a time-bounded snapshot with a defined cut-off. A full overview of the papers including tags and codes can be found and downloaded through this link: <https://osf.io/u9ydm/files/wrcj7>. The list of all the 105 papers from the initial review and the current update can be found through this link: <https://osf.io/u9ydm/files/4t9w3>

Table 1
Primary Theme Distribution Across 35 Eligible Studies

Theme	n	%
Decision-making strategies	9	25.7
Theory and Methods	5	14.3
Willingness to take risk	5	14.3
Population characteristics	4	11.4
Risk communication	3	8.6
Social factors and group decision-making	3	8.6
Risk perception	2	5.7
Avalanche accidents	1	2.9
Avalanche education	1	2.9
Experience	1	2.9
Motivation	1	2.9
Biases and decision-making errors	0	0.0
Total	35	100.0

50 **Note.** n = number of studies assigned primary theme tag. Percentages are based on total eligible studies (N = 35).

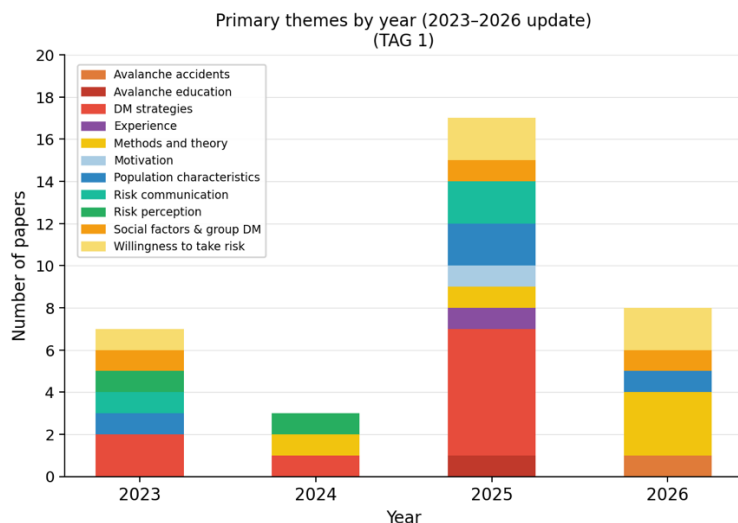


Figure 1: Primary themes spread by year of publication.

55 4 Conclusion

Since 2022, human-factors papers in avalanche terrain have grown mainly in decision-process/strategy work and user characterization; biases and accident-centric analyses did not expand in this window. The methodological and sampling profile appears unchanged. Priorities are clear: causal designs, behavioral linkage, and group-level studies within a standardized measurement framework.

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Data availability

All extraction sheets (themes, methods, populations, risk targets, focus), figures, and scripts are openly provided and will be versioned with additions beyond the cut-off. Repository link: [10.17605/OSF.IO/U9YDM](https://doi.org/10.17605/OSF.IO/U9YDM)

Author contributions

65 Conceptualization: [A.H., R.A.H., A.M.]; Methodology: [R.A.H., A.H.]; Screening/Extraction: [O.K.M, A.H.]; Analysis: [A.H.,O.K.H, T.W.]; Writing original draft: [A.H.]; Writing review & editing: [all authors].

Competing interests

The authors declare no competing interests.

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References

Hetland, A., Hetland, R. A., Skille, T. T., & Mannberg, A. (2025). Review article: A scoping review of human factors in avalanche decision-making. *Natural Hazards and Earth System Sciences*, 25, 929–948. [https://doi.org/10.5194/nhess-25-929-](https://doi.org/10.5194/nhess-25-929-2025)

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