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A review of injury risk curve development to support human factors and ergonomic design under extreme loading conditions

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Conducting risk assessments in underbody blast (UBB) scenarios on landmine-protected vehicles is important for evaluating vehicle safety, crew injury risk, and the effectiveness of blast protection systems. Due to the hazardous, costly, and resource-constrained nature of UBB testing, injury risk assessment commonly relies on survival analysis methods to estimate injury probabilities from limited and censored experimental data. This paper presents a structured review of survival analysis methods used to develop lower-limb injury risk criteria under UBB loading conditions. Parametric, non-parametric, and semi-parametric survival models are reviewed and compared with respect to their assumptions, data requirements, and suitability for constrained experimental environments. Emphasis is placed on their application to injury risk curve development for lower extremity injuries. The review highlights methodological strengths, limitations, and practical implications of model selection for engineering decision-making, including risk threshold definition, test evaluation, and validation of protective systems. A limited illustrative dataset is used to demonstrate the application of selected methods. The findings support more consistent and transparent use of survival analysis techniques in injury risk assessment for extreme loading scenarios.