

Pedestrians' vulnerability in floodwaters: sensitivity to gender and age

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Among the causes of fatalities during floods, the loss of stability is an aspect which has been usually investigated with conceptual models and laboratory experiments. The human body geometry has been often simplified to derive mechanical equilibrium conditions for toppling and sliding due to weight and hydrodynamic actions. Experimental activity produced water depth versus velocity diagrams showing the critical conditions for people partly immersed in floodwaters, whose scatter reflects the large variability of tested subjects (i.e. children, men and women with different physical characteristics). Nevertheless, the proposed hazard criteria based on the product number HV are not capable of distinguishing between different subjects. A dimensionless approach with a limited number of parameters and 3D numerical simulations highlight the significance of subject height and quantify the drag forces different subjects are able to withstand. From the mechanical point of view, this approach significantly reduces the experimental scatter. Differences in subjects' height are already an evidence of gender differences; however, many other parameters such as age and skeletal muscle mass may play a significant role in individual responses to floodwater actions, which can be responsible of the residual unexplained variance. In this work, a sensitivity analysis of critical instability conditions with respect to gender/age-related parameters is carried out and results and implications for flood risk management are discussed.