



## INTRODUCTION

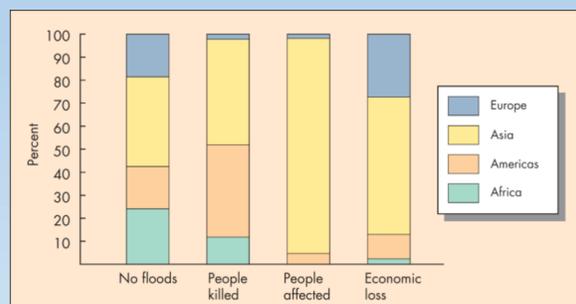
Hydrometeorological disasters comprise the most reported type of natural disaster, and floods account for the majority of disasters in this category in both developed and developing countries. Various definitions of floods have been provided from various sources. The common point of all these definitions is the temporary partial or complete water inundation of normally dry land resulting from various processes and causing damage and losses to human, natural and built environments. According to their generation mechanism and their basic characteristics, floods are classified into: (a) river or fluvial, (b) coastal, (c) urban, (e) groundwater, (f) rain-on-snow and (g) ice-jam floods. According to their duration, floods can be divided into: (a) slow-onset floods lasting for long period of one or more weeks or even months, (b) rapid-onset floods lasting for short period of only one or two days and (c) flash floods occurring within minutes or few hours. Regardless of classifications, flooding can lead to extensive morbidity and mortality and pose multiple risks to public health throughout the world.

## AIM

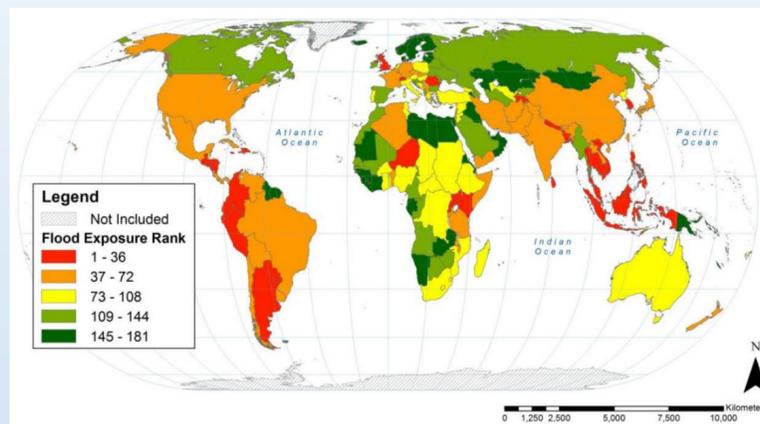
This study aims to review the physical health effects of floods occurred worldwide from 1942 to 2014 and in particular to describe the basic epidemiological profile of potential infectious diseases following floods induced by extreme precipitation events. Moreover, the most fatal infectious diseases along with the associated key risk factors and the most vulnerable population groups in terms of age and gender based on the available scientific data are also presented.

## METHODOLOGY

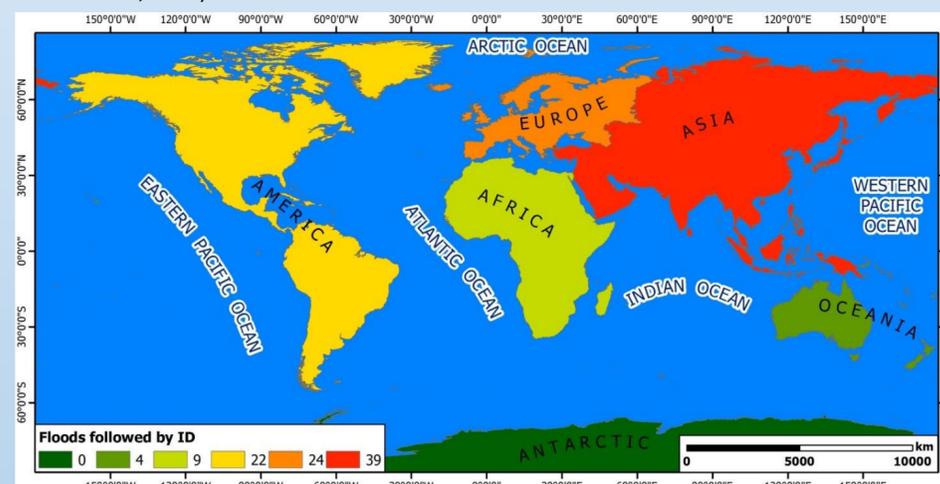
This study involved an extensive and systematic literature review of 124 research publications related to public health impact of 98 floods that occurred globally (Oceania: 4, Africa: 9, America: 22, Europe: 24, Asia: 39) from 1942 to 2014. The inclusion criteria were literature type comprising journal articles and official reports, natural disaster type including floods induced after extreme precipitation events (accumulation of rainwater in poorly-drained environments, riverine and flash floods), population type including humans, and outcome measure characterized by infectious disease (ID) incidence increase.



Global view of the flood hazard (Keller, 2012) based on data from 1997 to 2006 [Center for Research on Epidemiology of Disasters (CRED) University of Louvain, Brussels, Belgium]. Asia is greatly affected by flooding.



Rankings of country-level population flood exposure expressed as quintiles. 48 countries (of 228) had no floods in populated areas during the 1985-2003 period of analysis and are each tied for 181<sup>st</sup> rank (Christenson et al., 2014).



Spatial distribution of floods caused by extreme precipitation events and followed by infectious diseases.

Types of infectious diseases following 98 studied floods caused by extreme precipitation events		
Types of Infectious diseases	Number of events	Percentage
Rodent-borne	38	38.78 %
Water-borne	33	33.67%
Vector-borne	25	25.51%
Respiratory	19	19.39%
Fecal-oral	14	14.29%
Skin	9	9.18%
Blood-borne	4	4.08%
Eye	3	3.06%
Soil-related	3	3.06%
Ear	2	2.04%
Fungal	1	1.02%
Wound-borne	1	1.02%

## POTENTIAL INFECTIOUS DISEASES FOLLOWING EARTHQUAKES AND THEIR SECONDARY ENVIRONMENTAL EFFECTS

The potential post-flood ID are classified into 12 groups including rodent-borne (reported in 38 of the total 98 events, 38.78%), water-borne (33, 33.67%), vector-borne (25, 25.51%), respiratory (19, 19.39%), fecal-oral (14, 14.29%), skin (9, 9.18%), blood-borne (4, 4.08%), eye (3, 3.06%), soil-related (3, 3.06%), ear (2, 2.04%), fungal (1, 1.02%) and wound-borne (1, 1.02%) ID. The most fatal post-flood ID are leptospirosis and diarrhea followed by respiratory tract infections.

## VULNERABLE AGE AND GENDER POPULATION GROUPS

Based on available age and gender data, it is concluded that the most vulnerable population groups are predominantly young children (age ≤ 5 years) and male.

## RISK FACTORS FOR DISEASE EMERGENCE AND DISEASE INCIDENCE INCREASE

The detected risk factors include (1) poor economic status and living in flood prone areas, (2) destruction of infrastructures, disruption of public utilities and interruption of basic public health services, (3) direct physical exposure to sewage-polluted flood water, (4) lack of adequate potable water and water-supply from contaminated ponds and tube wells along with lack of distribution of water purification tablets, (5) aggravation of environmental conditions comprising rapid cooling of the environment and heightened humidity, (6) population displacement resulting in densely populated and overcrowded regions, (7) unfavorable living conditions in emergency shelters (8) improper and inadequate sanitation or no access to clean water and sanitation, (9) proliferation and abrupt increase of vector and rodent populations after flooding, (10) contamination of water, damp soil, mud or vegetation caused by rodent urine, dead animals and overflow of latrines.

## CONCLUSIONS

Various ID emerge after the flood onset, and outbreaks may result due to the combined effect of several aggravating socio-economic factors and unfavorable environmental conditions. Because of the increased potential for outbreaks after flooding disasters, enhanced public health services and surveillance systems are necessary for the early detection of emerging diseases and outbreaks, and the targeted intervention for disease control. The integration of different scientific domains and fields are necessary for the early detection of emerging diseases and outbreaks and the targeted intervention for disease control.