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Years of potential life lost in residents affected by floods in Hunan, China

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Summary The potential life loss caused by floods has not been studied before. We carried out a retrospective cohort study in flood areas in Hunan, China in 1999. The standard mortality rate (SMR) and years of potential life lost (YPLL) were used to quantify the burden of flood on health. The SMRs of injury/poisoning and malignant neoplasm were higher in the river flood (151.36×10^{-5}, 127.30×10^{-5}) and drainage problems (143.74×10^{-5}, 105.87×10^{-5}) groups than those in the no-flood group (113.40×10^{-5}, 74.81×10^{-5}). The standard rates of YPLL (SYPLL‰) in the river flood (89.56‰) and drainage problems (71.30‰) groups were significantly higher than those in the no-flood group (65.74‰, $P < 0.05$). The SYPLL was significantly higher in males than in females. The percentages of attributable risk (PARs) of SMRs and PARs of SYPLLs resulting from flood were 12.26 and 26.60% in the river flood group and 10.56 and 7.80% in the drainage problems group. We conclude that floods increase the affected residents' SYPLL, and that the river flood had stronger effects than the drainage problems floods.

1. Introduction

Every year floods cause enormous damage all over the world. They not only lead to property losses but also to human casualties and non-casualty health problems (Hajat et al., 2003; Ohl and Tapsell, 2000). The health effects of floods can be immediate (e.g. those resulting from drowning) or delayed (e.g. due to psychological effects or diseases) (Jonkman and Kelman, 2005). Previous studies on the health effects of floods focused on epidemics of infections (Kalashnikov et al., 2003; Li et al., 2002), morbidity (Li et al., 2004) and quality of life (Tan et al., 2004).

In 1998, severe floods occurred in China that affected over 180 million people. Those floods caused 4150 human casualties and destroyed 6.85 million houses; 18.39 million residents of the affected areas had to be relocated, and the direct economic loss was about $32 billion (Ministry of Water Resources, 1999). Hunan is a flood-prone province in China. Between June 10 and July 24 1998, severe floods hit Hunan because of heavy rainfall, mainly around the

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Dong-Ting Lake area. The main types of floods in this place are slow-onset floods, such as river or lake floods from embankment breaches and drainage problems.

Years of potential life lost (YPLL) is a comprehensive measure of mortality that takes age at death into account (CDC, 1992). It is a more sensitive index than the traditional mortality rate in highlighting 'premature mortality'. Many researchers used YPLL to assess the general health status of the population (CDC, 1992; Humblet et al., 2000). No previous study has examined the potential life loss caused by floods, however. In the present study, we used YPLL to examine the health effect of different types of flood.

2. Materials and methods

2.1. Definition and classification of flood

A flood is defined as 'a flood that significantly disrupts or interferes with human and societal activity' (Jonkman, 2005). Flood fatality is 'a fatality that would not have occurred without a specific flood event'. Synonyms and related terms include 'flood deaths', 'loss of life in floods', 'flood mortality'.

Floods can be divided into two types: river floods and drainage problems. A river flood is caused by flooding of the river from its regular boundaries, which can be caused by various sources, such as high precipitation levels, melting snow or blockage of the flow (Jonkman, 2005). In our study, river banks also collapsed because of the long time they were submerged by the deluge. The water overflowed farms and houses in a short time and the economic loss was enormous because of the devastating nature of the flood. A drainage problem is a flood that is caused by high precipitation levels that cannot be handled by regular drainage systems (Jonkman, 2005). The water accumulates in the farms and houses during a period of time in this kind of flood. Generally, destruction caused by drainage problems is less severe than that caused by river floods.

2.2. Background of the current study

A flood disaster occurred because of high precipitation levels in June 10—July 24 1998 in the Dong-Ting Lake area of Hunan province in southern China. The flood collapsed 939 000 houses and destroyed 1.46 million hectares of crops, and about 1 million residents needed to be evacuated (Zhu, 2005). The residents in the river flood areas were all evacuated and temporarily lived in relief tents during the period of disaster; all their properties were destroyed. In drainage problem areas, the villagers needed to be evacuated only if the flood soaked their houses, and they went back to their homes when the flood receded. The main economic losses in the drainage problem areas were due to crop damage. The villagers living in no-flood areas were not affected. The whole flood time was about one-and-a-half months. The flood damaged the water supply and contaminated the soil and houses. During the flood period, the villagers fought the flood day and night and had to go home to restore their houses after the floods. Although the floods affected large areas and more than 1 million residents, deaths caused directly by flood were few. In this study, we focused on the delayed effects of flood, and excluded deaths caused directly by flood (such as drowning).

2.3. Study areas and populations

We selected three kinds of villages (river flood group; drainage problems group; and no-flood group, i.e. control group) in the Dong-Ting Lake area as our study fields. Dong-Ting Lake is an inland lake, lying south of the middle reaches of the Yangzi River and to the west of JingGuang railway. The river flood, drainage problems and control spots are located to the south, northwest and north of Dong-Ting Lake, respectively, and the distances between the three fields and the Yangzi River are about 112, 40 and 50 km in turn. The direct distances between the river flood spot and the control spot, the drainage problems spot and the control spot, and the river flood spot and the drainage problems spot are about 72, 54 and 88 km, respectively. We randomly sampled 35 villages in 265 river flood villages, 68 villages in 556 drainage problems villages, and 174 no-flood villages. Information on the residents' health status and demographic characteristics in the selected villages was collected by trained personnel.

2.4. Survey methods

We trained the staff in local centres for disease control and prevention in sampled villages as interviewers. The retrospective study was carried out in 1999 (1 year after the 1998 flood disaster). The interviewers collected data by household interviews of adult family members with a pre-designed questionnaire that included the family member's age, sex, education, health status, income, death and cause of death. Moreover, investigators checked the death certificate and consulted the village doctors, who were familiar with the health status of all residents in his/her village. The causes of death were verified by death certificate. When the death certificate was not available, the verification was based on medical records provided by the village doctors. Interviews began in September 1999 and were completed within a month.

2.5. Quality control

All interviewers were trained for 2 days, and a pre-interview session was undertaken before the actual interview. A working manual was created to ensure all interviewers had the same understanding of the questionnaire. The collected data were checked by the coordinating centre of the study. If the data were found to be incomplete or incorrect, another interview with the adult family member was performed.

2.6. Data management and analysis

Causes of death were coded according to international classification of disease, 10th revision (ICD-10). We defined death in 1—64 years old as the 'premature mortality' age range, with a cut-off point at 65 years old in calculating the YPLL (CDC, 1992; Semerl and Sesok, 2002). The census data of Hunan Province in 2000 was used as the reference